How does the health status of older migrants compare to the Canadian and Australian-born population?

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Abstract

Background: Despite Australia's and Canada's rich migration history and the well-known challenges posed by an ageing heterogenous migrant population, little attention has been paid to the health of older migrants in research, policy and practice.

Aims and methods: My thesis investigated the variations in the health status of older migrants and their host population and its subsequent determinants using three study designs: systematic literature review (Australia, Canada); serial cross-sectional analyses of a combined dataset (Dynamic Analyses to Optimise Ageing (DYNOPTA), Australia); longitudinal analysis of a DYNOPTA contributory study (Household Income and Labour Dynamics in Australia Study (HILDA)).

Findings: In general, the systematic review found older migrants reported an objective health advantage for some non-communicable diseases, but a disadvantage for infectious diseases and poor mental health relative to the older Australian and Canadian-born population. Health (dis)advantages varied by region/country of birth, age, sex and migrating circumstances.

With regards to self-reported health, neither the systematic review nor the repeated cross-sectional analysis found convincing differences using binary country of birth. However, using region of birth sub-groups the systematic review and longitudinal analysis demonstrated a self-rated health advantage in North-West Europeans and a self-rated health disadvantage in Southern and Eastern Europeans – both of relevant magnitude. Longitudinally, being older, divorced or never married, current or former smoker and first, native or preferred language other than English were associated with poor health. Higher education attainment, alcohol consumption and being female were associated with better self-rated health. Language, education and increasing age showed a "dose-dependent" association with self-reported health.

Conclusions: My findings provide evidence that older migrants with cumulative education and language disadvantages – both potentially remediable - experience poorer self-rated health. In addition to economic integration, policies should address these issues with

regard to their impact on health literacy and health inequalities, which persist and magnify as the migrant becomes older.

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Author's declaration

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Chapter 1 Introduction, aims and objectives

1.0 Introduction

While the issues of migration and health are well documented, little attention has been paid to the health of older migrants. For older heterogenous migrants aging in a foreign country (hereafter host country) may result in double jeopardy for their health. As such they provide a unique opportunity to examine the impact of ageing on the health of older individuals in countries with differing cultures, environment and varying levels of disease risk.

The overall purpose of this thesis is to examine the health status of older migrants over time compared to the older Australian and Canadian-born population, identify and discuss factors influencing these changes. The two countries alongside the United States and the United Kingdom are referred to as major migrant receiving countries (8-10). Australia's population is diverse (11) and has evolved from primarily Anglo-Celtic (descended from British or Irish people) to multi-culturalism (12-15), with migrants consisting of an estimated 29% of the total population in 2017 (16). Canada's population is also diverse (17-19), evolving from a primarily European heritage to multi-culturalism (4, 20, 21) with migrants accounting for 21.9% of the total population (22).

Australia and Canada primarily admit self-selected migrants through comprehensive point-based selection systems whereby age, education background, official language skills, health and work experience of potential migrants are weighted (9, 10, 23-25). Australia (26) and Canada (27) also have universal health care systems. However, they have interesting differences in terms of climate particularly regarding levels and amount of sunshine. There is limited comparative research on how migrant health differs in the two countries. Exploring the differences is important for the two ethnically[1] diverse countries with significant migrant populations, similar migrant selection systems and universal health care systems.

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[1] Ethnicity refers to a group of individuals sharing distinctive cultural attributes such as language, religion and dietary patterns

1.1 Background: migration

1.1.1 Concept of migration

Migration is a global phenomenon affecting many countries in the world. It is a significant factor in redefining a receiving country's health care (28, 29), socio-economic, demographic (29) and economic systems (30). The implications of migration on these systems are complex due to the changing nature of migration policies and patterns (31).

The definition of the term "migrant" is broad. The UN (32) defines a migrant as "someone who changes his or her country of usual residence, irrespective of the reason for migration or legal status." Statistics Canada (33) provides a more specific definition, whereby "migrants" are defined as "individuals who are or who have ever been landed[2] migrants or permanent residents and have been granted the right to live in Canada permanently." This definition extends to individuals who have obtained Canadian citizenship by naturalisation[3] (34).

Individuals migrate for different reasons such as education, better economic opportunities, to escape conflict and violence (5, 31) and family reunion (22, 35-37). A distinction is made between short-term (3-12 months) and long-term migration (greater than one year)(32). The UN definition for long-term migrants is broad and encompasses individuals migrating for a specified period such as international students and those aiming to settle in their host country permanently. This definition largely differs from those used in some migrant health studies. For example, recent migrants are defined as those living in Canada for less than 10 years, while long-term migrants are those who have lived in Canada for 10 years or more (20, 38, 39). The greater duration of residence provides researchers with enough data to study migrant interactions with their host countries socio-demographic and environmental systems which could affect their pre-migration health status over time (40, 41) and impact on the host country's health care systems. These data aid in formulating migration policies and effectively plan education, employment, health care and other services.

[2] Arrived in their host country
[3] Legal process through which a non-citizen of a country acquires citizenship or nationality

Other than duration of residence, further categorisations relating to race/ethnicity and country/region of birth are used to examine migrant health status. This includes "European[4]" verses "non-European" (42), "English speaking (ESB)[5]" verses "non-English speaking backgrounds (NESB)", "culturally and linguistically diverse (CALD)", "Anglo-Celtic", "ethnic elderly[6]" (43), "White" verses "visible minority[7]" (20, 38) and migrants from "developing" verses "developed" countries (9). Other studies simply use country/region of birth for example "North-East Asia" (45) to measure differential health between migrants and the host population.

Though, categorising individuals aids in health comparisons and in identifying health inequalities and subsequent determinants, it may be problematic. Some terms such as "Non-White" erroneously assume homogeneity as they include individuals with substantial geographical and socio-cultural variations. Besides, the "homogeneity" assumption hardly applies to individuals born in the same country in some instances (43). Some terms also bear negative undertones as they focus on skin colour and have conflicting definitions. For example though "NESB[8]" differentiated individuals using a single cultural factor; English, Vietnamese individuals were more likely to be categorised as "NESB" as opposed to Gaelic-speaking Irish

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[4] Generally, includes migrants from Europe, the United States of America, New Zealand and either Australia or Canada (if not included as the host country in the study)

[5] England and Wales, New Zealand, the United States, South Africa and either Australia or Canada (if not included as the host country in the study). This definition is specific to some studies as South Africa may not be included in some earlier studies. An example of this categorisation can be found in 41. Jatrana S, Pasupuleti SS, Richardson K. Nativity, duration of residence and chronic health conditions in Australia: do trends converge towards the native-born population? Social Science & Medicine. 2014;119:53-63.

[6] Individuals aged 65 years or more of non-English backgrounds usually born in non-English speaking countries 43. Orb A. Health care needs of elderly migrants from culturally and linguistically diverse (CALD) backgrounds: A review of the literature2002.

[7] Defined as "persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour". Mainly consists of the following groups: South Asian, Chinese, Black, Filipino, Latin American, Arab, South-East Asian, West Asian, Korean and Japanese (44.Statistics Canada. Dictionary, Census of Population, 2016 2016 [Available from: https://www12.statcan.gc.ca/census-recensement/2016/ref/dict/pop127-eng.cfm.)

[8] Ministerial Council of Immigration and Multicultural Affairs (MCMIA) in 1996 decided to drop that the term NESB from official communications due to negative connotations (46. Sawrikar P, Katz I. How useful is the term 'Culturally and Linguistically Diverse' (CALD) in Australian research, practice, and policy discourse?2009.)

individuals (46). Such broad categories may not account for the heterogeneity in diverse migrant ethnicities and may not accurately inform on the health differences.

1.1.2 Migrants in Australia and Canada

As prior stated migrants in Australia and Canada are diverse and represent an increasingly large proportion of the total population. Historically, before the abolishment of restrictive migrant policies such as "White Australia"[9] in the mid-1970s migration to Australia was almost entirely from Europe (13, 48, 49). Migration patterns have gradually changed over time with the proportion of European migrants declining from 87% of the total migrant population in 1947 to 50% in the 1990s, as the proportion of migrants from Asia, Oceania, Africa and the Americas increased (13). Similarly, long-term migrants in Canada are largely European while recent arrivals are likely to be Asian[10] (4, 20, 22).

The diverse migrant population reflects the changing migrant policies which have shifted from population to skills based. The latter employs a stringent selection criterion aimed at selecting highly skilled migrants and minimising any potential burden on the health care systems of the host country (9). Individuals migrating under skills based policies are commonly referred to as economic migrants, other categories of migrants include; family reunification[11] and humanitarian migrants[12] (51). Migration policies aid in checking against population ageing (25, 52) and spurring or sustaining economic growth (22, 53), more so in areas where specific skills are deficient (52). The changes in migrant composition with corresponding policies are indicated by Figure 1.1[13].

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[9] A policy aimed at restricting non-White/non-European migrants from settling in Australia, some key features included entrance examination in any European language (47.Britannica T. "White Australia policy." Encyclopedia Britannica; 2020 [Available from: https://www.britannica.com/event/White-Australia-Policy.)

[10] Around 61.8% (including individuals of Middle Eastern descent) 22. Statistics Canada. Immigration and ethnocultural diversity: Key results from the 2016 Census. 2017.

[11] Migrating (more so children, spouses and elderly dependents) with the sole purposes of re-uniting with family members living in a different country (50. Thp Thp Thp THP, Meyer A, The Hague Process on R, Migration, Processus de La Haye sur les réfugiés et les m, Proceso de La Haya sobre Refugiados y M, et al. People on the move: handbook of selected terms and concepts.

[12] Individuals escaping conflict and wars in their home country

[13] The term "European migrants" represent a shift from predominantly British to include migrants from other European populations

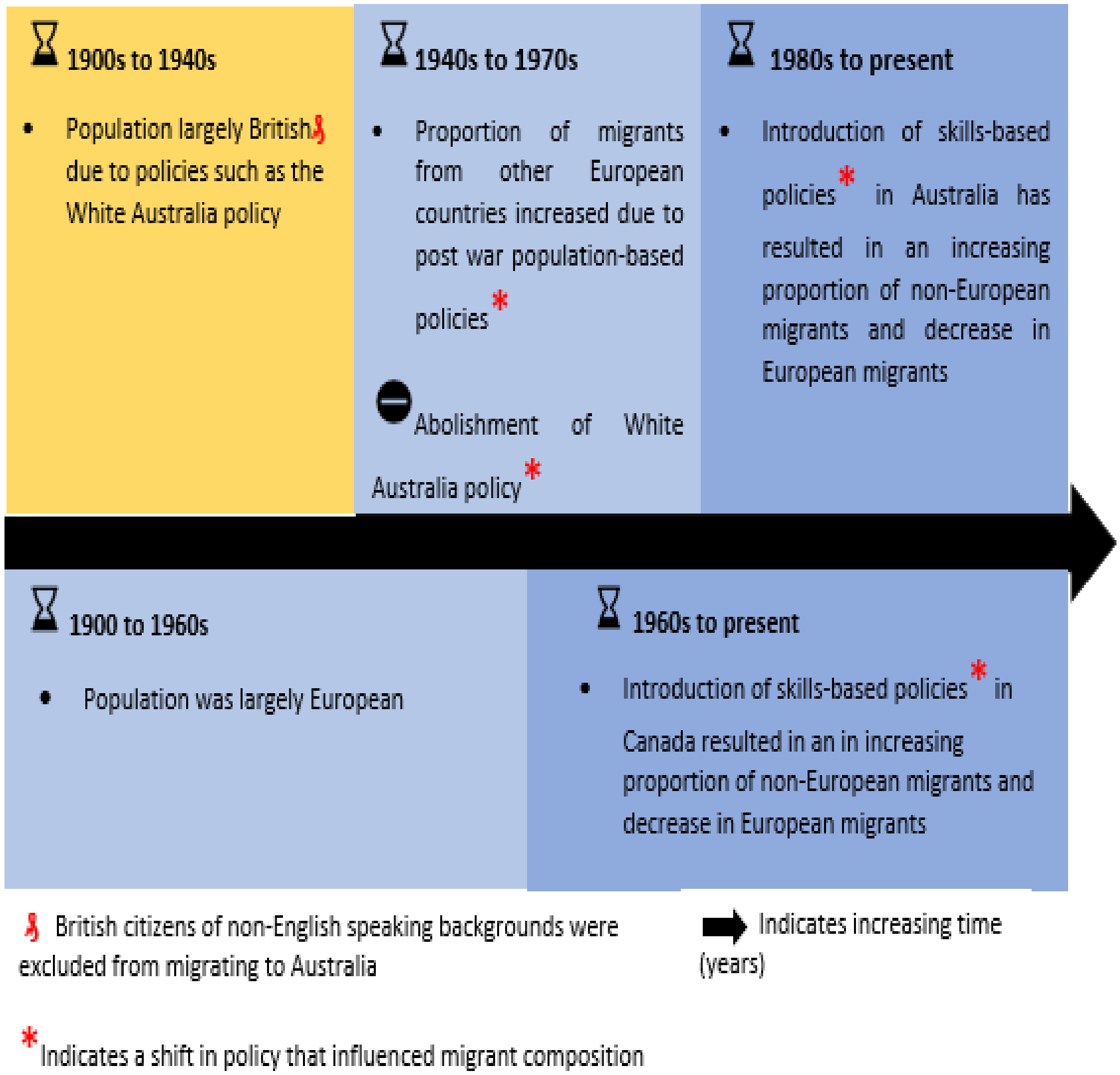

Figure 1.1: Evolving migrant composition with changing migration policies in Australia and Canada

1.1.3 Older migrants

Canada[14] (33) and Australia's (54) population is ageing and so is the migrant population. In 2016, older migrants in Australia (54) and Canada (33) comprised a third of all older individuals aged 65 years or more. The ethnic diversity and age distribution of older migrants is similarly shaped by successive migration policies.

Older migrants are categorised as those who migrated young and grew old in their host country (hereafter older established migrants) and those who migrated in later life (hereafter later life migrants) (10, 35-37, 55). Older migrants are likely to have migrated as young adults (35). Possibly, there exists a third category of older migrants as some individuals admitted as economic migrants in earlier periods may either be in old age or approaching older age. Admission of skilled migrants to Canada dates back to 1967 (1, 4, 56)[15] and in Australia towards the end of the 1980s (57, 58) with a greater emphasis for skilled migration[16] reinforced in the late 1990s (58).

Other than age at migration[17], older migrants have other noteworthy distinctions which are likely to influence healthy ageing (Table 1.1). Older established migrants mainly comprise of individuals of European descent including British, other North Europeans, Southern and Eastern Europeans (4, 43). They constitute a large proportion of the total older population in Australia (37, 59, 60) and are likely to be in the oldest age groups compared to other migrant groups. Later life and economic migrants are more likely to be Asian (37, 60) or from Oceania, Africa and the Americas (13).

Some older migrants, more so British migrants may share similar characteristics to their host population. Persistent low socio-economic status and poor language proficiency reported by

[14] Around 15.9% of individuals in Canada are aged 65 years or more
[15] Though data on migrant admission categories is only available for migrants admitted to Canada since 1980 in the 2016 Census (22. Statistics Canada. Immigration and ethnocultural diversity: Key results from the 2016 Census. 2017.)
[16] Compared to family reunification
[17] Refers to the age (years) at which a migrant arrived in their host country

some older established migrants may have resulted from a lack of policies addressing the disadvantages (59, 61-64). While in later life migrants it may be due to a lack of selection effects as their eligibility to migrate may not be subject to their health status (65) or skills. As later life migrants are likely to migrate for family reunification purposes (35-37) they may not be eligible for government assistance (60) and are more likely to depend on their family for financial support (60, 66).

Table 1.1 Summary of older migrants' characteristics in Australia and Canada

Attributes	**Characteristics**		
	Older established	**Later life**	**Economic migrants**
Policies	• Population based	• Family reunification	• Skills-based
Reason for migration	• Re-population of Australia/unskilled work	• Largely family reunification	• Largely economic reasons
Age	• Oldest age groups	• Younger age groups	• Younger age groups
Age at migration	• Migrated as young adults	• Migrated in later life	• Migrated as young adults
Race/Ethnicity	• Largely of European descent[18]	• Largely of Asian descent	• Characterised by a large proportion of migrants from Asia, Oceania, Africa and the Americas[19]
English proficiency	• Some report poor language proficiency i.e. Southern European migrants • Others may share similar characteristics to their host population i.e. British migrants	• May report poor language proficiency	• May report increased language proficiency

[18] Including British migrants

[19] 13. Raymer J, Wilson T. The Changing shape of Australia's overseas-born population. Population & Socieities. 2017(545).

Table 1.1 continued			
Attributes	**Characteristics**		
	Older established	**Later life**	**Economic migrants**
Socio-economic status	• Some may report lower socio-economic status • Others may share similar characteristics to their host population i.e. British migrants	• May report lower socio- economic status	• May report better socio-economic status
Education	• Some may report lower education attainment/low skills • Others may share similar characteristics to their host population i.e. British migrants	• May report lower education attainment/low skills	• Largely highly educated

Information for Table 1.1 derived from; (1, 10, 13, 35-37, 43, 55, 56, 58, 59, 61-67), in text (section 1.1.3), the citations correspond to migrant characteristics.

1.2 Migration and health

The process of migration is stressful and disruptive (68) and plays an important role in influencing health at the individual and population level (69). Individuals socio-economic and cultural factors may result in negative health consequences (70) or positive health changes in their host country (71). At the population level, migration may result in the (re)emergence of public health threats and risks (72).

Migrant health is also of interest epidemiologically as diverse disease patterns in different migrant groups can provide potential etiological insights that have broad applicability. The factors related to changes in migrant health are multi-faceted and complex, often interrelated theories, frameworks and hypotheses are used to account for their association. The subsequent sections discuss some of these frameworks, theories and hypotheses associated with migrant health.

1.2.1 Healthy migrant effect (HIE[20])

This is a widely accepted hypothesis explaining the changes in migrant health in countries such as the United States of America (USA), United Kingdom (UK), Australia and Canada (73). At the time of arrival migrants appear to have a health advantage which then decreases over time, as the health of migrants converges towards that of the host population (3, 10, 68, 70, 73-78).

In Canada, cross-sectional studies have found recent migrants generally have lower odds of chronic conditions[21] (4, 78, 79), disabilities (79), obesity (78, 80)[22], self-reported anxiety disorders (38) and mortality[23] (81) compared to the Canadian-born population. While in

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[20] Often referred to as the "healthy immigrant effect" in studies hence the abbreviation (HIE). However, my thesis uses "migrants" to describe individuals not born in Australia, for consistency the term "healthy migrant effect" is used

[21] Included chronic conditions; arthritis, cancer, diabetes, heart disease/stroke, respiratory diseases (bronchitis, asthma), diseases of the digestive system, allergy, hypertension, headaches, sinusitis, urinary incontinence and mood disorders/anxiety

[22] For reference no 80. Cairney J, Ostbye T. Time since immigration and excess body weight. Can J Public Health. 1999;90(2):120-4. healthy migrant effect for lower odds of obesity were particularly evident in women (all migrants included in study) and Asian men

[23] Overall and cause specific mortality (cardiovascular diseases, accidents, poisoning and violence, respiratory diseases, cancers and diabetes)

Australia recent migrants had lower odds of self-reported chronic conditions[24] (76) and cancer mortality (colon/rectum, breast)[25] (82) compared to the Australian-born population.

Relatively recent longitudinal studies have found a migrant health advantage for cancer[26] (83), chronic conditions[27] (41) and self-rated health (39) compared to the Australian and Canadian-born populations. Others have reported mixed or no evidence for the healthy migrant effect in diverse health measures. Newbold (4) found no significant differences in the risk of developing chronic conditions between migrants and the Canadian-born population. Jatrana, Richardson (84) found no differences in the physical, mental and self-rated health of migrants (overall nativity status) and the Australian-born. However, by migrant subgroups there were clear differences, migrants from English speaking countries had a health advantage with respect to all health measures compared to the Australian-born while those from non-English speaking countries reported a health disadvantage. There was no evidence that these differences changed by duration of residence, other than in the self-rated health of migrants from non-English speaking countries who reported worse self-rated health compared to the Australian-born population after 20 years.

While the healthy migrant effect is associated with self-reported measures and largely chronic non-communicable diseases, it may not extend to infectious, parasitic diseases and non-Hodgkin's lymphoma (81). Key concepts associated with the healthy migrant effect are discussed in the subsequent sections.

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[24] For 76. Biddle N, Kennedy S, McDonald James TED. Health Assimilation Patterns Amongst Australian Immigrants*. Economic Record. 2007;83(260):16-30.; Asthma, diabetes and heart disease for 41. Jatrana S, Pasupuleti SS, Richardson K. Nativity, duration of residence and chronic health conditions in Australia: do trends converge towards the native-born population? Social Science & Medicine. 2014;119:53-63.; cancer, cardiovascular disease (CVD), arthritis, diabetes and respiratory disease

[25] East and South-East Asian migrants

[26] Asian migrants

[27] Migrants who had lived in Australia for 20 years or more

1.2.1.1. Selection effects

The healthy migrant effect is said to result from positive selectivity as the health of migrants can be associated with their migration process. Countries such as Australia and Canada use a stringent criterion in the selection of skilled migrants based on their economic potential and health (49). The latter requires potential migrants to undergo medical examinations assessing for serious medical conditions (79, 85) which may possibly constrain the health systems of the host country (9). Migrants may also self-select (9, 10, 85) as healthy individuals are more likely to migrate as opposed to those in poor health (79).

As the healthy migrant effect is influenced by positive selection effects, some migrants are more likely to be healthy compared to others. Individuals who migrate for economic purposes are more likely to be healthy than those who migrate for humanitarian reasons and family reunification (74), as they face additional challenges pre-migration and post migration. Premigration, humanitarian migrants often experience conflict and war as well as poor living conditions and may face greater health challenges post migration as opposed to economic migrants. Likewise, as older migrants are more likely to have migrated under population-based policies as opposed to skills-based policies, the healthy migrant effect may not apply to them at any stage of their life course[28].

The healthy migrant effect may also be stronger for specific migrant populations such as recent non-European migrants, who were more likely to report a decline in their self-rated health over a period of eight years compared to long-term European migrants and the Canadian-born population (39). They were also less likely to report chronic conditions compared to long-term European migrants and the Canadian-born population (79). Recent non-European migrants in Australia and Canada may possess “positive selection effects” having migrated under skills-based policies, this may result in better health.

[28] A person’s life in entirety from birth to death and the circumstances they experience in their society as they age

Other possible selection effects may include the emigration of less healthy and less economically successful migrants to their country of birth (10, 40). A phenomenon commonly referred to as the “salmon bias”.

1.2.1.2 Acculturation, convergence and duration of residence

Acculturation is often used to explain processes and subsequent changes occurring when individuals from diverse cultural backgrounds come into continuous contact with one another (86). Acculturation theories and strategies have evolved over time, from unidimensional (straight line of assimilation) to multidimensional models (87). A notable acculturation theory; Berry’s model of acculturation strategies categorised individuals’ acculturation into two broad dimensions; receiving-culture acquisition and heritage-culture retention. From these two dimensions, four acculturation strategies emerged; assimilation (adapting the dominant or receiving culture while rejecting their original culture), separation (rejection of the dominant or receiving culture in favour of their culture of origin), integration (adapting the dominant or receiving culture norms while retaining their culture of origin) and marginalisation (rejecting both culture of origin and the dominant or receiving culture) (88). Later frameworks highlight individual and societal factors which Berry (89) assert should be considered in psychological health research. This included pre-acculturation factors related to migrants’ country of birth such as political, economic and demographic factors that are largely attributable for the individual level factors; age, gender, education, migrating circumstances, language, religion and personality. Secondly, host country factors (societal attitudes, ethnic attitude and social support) and individual factors (attitudes and behaviours, coping strategies, social support and societal values) arising during acculturation. According to the framework, acculturation is characterised by biological, economic, social and cultural changes. For example, socio-economic changes may lead to a “loss of status” characterised by a lack of recognition of migrants’ country of birth qualifications in their host country leading to underemployment and (or) unemployment, which may negatively affect health (89).

Though criticised for conceptual and methodological limitations (discussed in later sections), acculturation is a widely used concept in epidemiological research. A number of migrant health studies have illustrated the relationship between the healthy migrant effect and acculturation related factors. It is suggested, migrant health converges towards that of the host population rates as their duration of residence increases (76). The subsequent health changes are said to be a consequence of acculturation related factors (68, 70, 90, 91), including lifestyle patterns (dietary, physical exercise, smoking and alcohol consumption) (41, 68, 87), ethnicity, physical environment, migrating circumstances, age and other socio-demographic factors, migrant generation status and language related factors[29] (87) which may potentially impact the health of migrants.

Duration of residence is central to the healthy migrant effect as changes in health for specific migrant groups are observed as their length of stay increases in their host country. It is a proxy for acculturation (49, 70) as it highlights the challenging events experienced by migrants in a new culture and the adaptation process (92). It also measures the extent of exposure of migrants to the diverse habits of the host population (49) which may subsequently influence their health. The changes in migrant health are described as a "convergence" towards their host population health patterns with increasing duration of residence, though this may not apply to all migrant populations. Convergence, therefore is a process which indicates a shift in migrant health patterns towards that of the host population as a result of acculturation. Though acculturation for the healthy migrant effect is discussed in terms of a health decline, it may also positively impact migrant health.

The process of acculturation and the subsequent convergence in health may vary for specific migrant populations as it is influenced by diverse cultural and environmental differences between the host and country of birth (74). Migrants with greater cultural and environmental dissimilarities and from countries with varying disease prevalence risk compared to the host population may report the greatest health changes (87). Migrants from countries with a lower incidence of suicide than the Canadian-born population were said to experience an increase in their risk of suicide compared to their country of birth rates, while those from countries with higher rates tend to experience a decrease in their suicide risk (93). Though the study had a large sample size (n=12,687) their findings do not infer cause and effect as data were of a cross-

[29] Country of birth language and proficiency is host country's language

sectional nature and were derived from a registry database (Statistics Canada) for the years 1969-1973. Other than age, sex and country of birth other factors that could account for differential suicide rates were not assessed due to registry data limitations. Data for countries of birth suicide rates were extracted from a different database (World Health Organisation) (93), differential data collection methods and lack of information on underreporting in different countries would possibly bias their findings. Variations in dietary patterns between host and country of birth may account for the lower or higher risk of chronic conditions in some migrant populations at the time of migration compared to their host population, and the subsequent convergence. For instance, some Asian[30] countries report lower incidence rates for colorectal and breast cancers (94, 95). However, the lower risk of morbidity and mortality for colorectal, breast and prostate cancer in migrants from East[31] and South-east Asia[32] was found to be converging towards the Australian-born rates with increased duration of residence (82, 96).

Migration may also be beneficial to migrants' health as their risk of diseases predominant in their country of birth may substantially reduce with increased duration of residence. This may extend to conditions strongly linked to a viral or bacterial aetiology such as nasopharyngeal and liver cancers (96). Migrants from East and South-east Asia experienced a substantial reduction in the excess risk of death from nasopharyngeal and liver cancers three decades after migration, though they maintained a higher risk compared to the Australian-born population (82). Figure 1.2 summarises the effects of acculturation related factors on migrant health with increasing duration of residence. This includes convergence and possibly no health changes due to lack of acculturation or similarities in the health of migrants and the host population prior to migration.

[30] South Asia (India, Pakistan, Bangladesh and Nepal and others) & East Asia (China)
[31] China, Hong Kong, Japan, Korea and Taiwan
[32] Myanmar (Burma), Cambodia, Indonesia, Laos, Malaysia and the Philippines

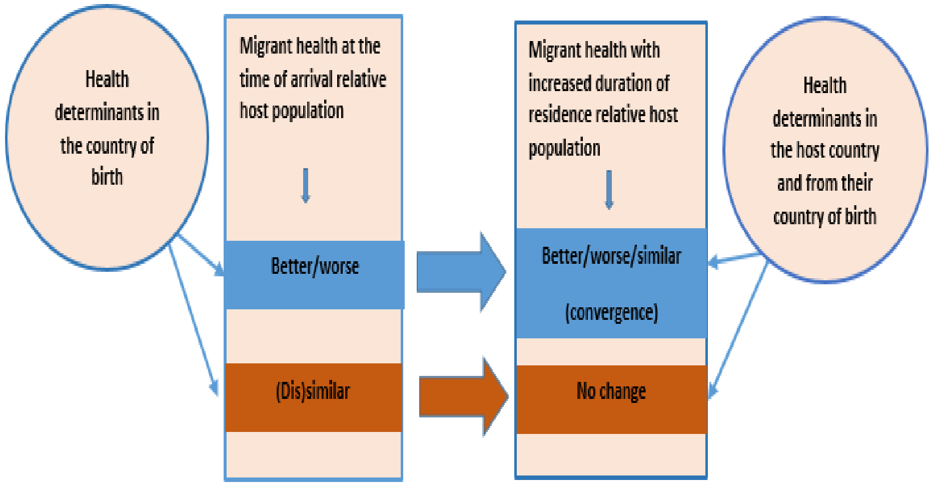

Figure 1.2:Effects of duration of residence on migrant health

1.2.2 Determinants of health framework

This includes the "social determinants of health perspective," which highlights cultural, social and economic factors at the population and individual level as opposed to medical care inputs and health behaviours (smoking, diet, exercise, etc.) as important health determinants (1, 3, 97, 98). A further, comprehensive framework by the World Health Organisation (WHO); the conceptual social determinants of health framework (CSDH) elaborates on the pathways through which socio-demographic and economic determinants of health influence health and wellbeing of individuals (99). In this framework, social determinants of health are categorised into two broad categories. Firstly, the structural determinants of the social determinants of health including social, political and economic policies and factors such as education, socio-economic status, gender and ethnicity. Secondly, the intermediary determinants of the social determinants of health such as material circumstances, behaviour and biological factors, psychosocial factors and health systems (99). Figure 1.3 highlights individual and population health determinants, some are discussed in detail in the subsequent sections. Some migrant health specific determinants such as duration of residence and period of migration are discussed in prior sections.

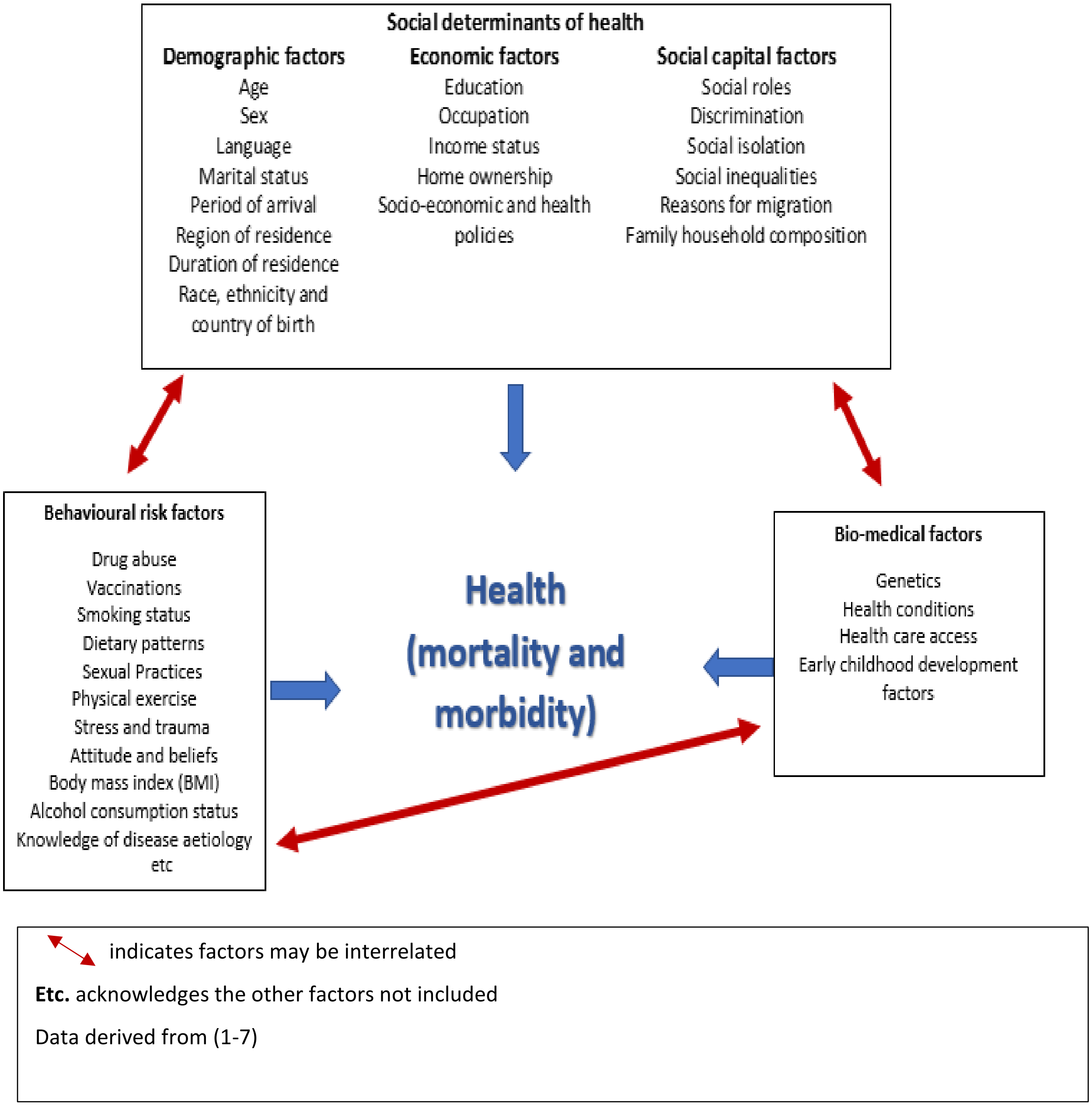

Figure 1.3: Determinants of health

1.2.2.1 Socio-determinants of health; demographic factors

The probability of reporting poor health increases with age (1, 3, 74). The gradient to poor health is said to be steeper for older migrants (3). Older Canadian migrants were more likely to report having more chronic conditions compared to their Canadian-born counterparts (3). Aging also increases an individual's risk of specific health conditions such as cardiovascular disease, chronic conditions such as arthritis and diabetes (67) and mental health problems (36, 67).

Women are more likely to report their health as fair or poor compared to men (74). Different factors influence men and women's perception of their health. For migrant men being married and a principal visa applicant and for migrant women increased proficiency in their host country's language were associated with better self-rated health, unemployment was significantly associated with poor health in male migrants, but only moderately for females (100). Though women migrate for diverse reasons[33], some of the roles played by women in the migration process may affect their health negatively. Premigration, women who migrate for family reunification purposes are unlikely to be the principal decision makers, while post-migration their role is more likely to be restricted to care giving at home (101). This may result in poor assimilation and inadequate language proficiency skills, which may adversely affect their health and health seeking behaviours over time (102).

An individual's marital status has implications on their health (103). Those who are married report better health than divorced, widowed and single individuals (3, 55, 104). Marital status is a form of social support, as individuals who are married provide each other with various forms of support such as personal care in times of sickness (51) which may positively influence the ability of individuals to cope effectively with disease (105). Migrants who are married have

[33] Prior to the introduction of skills-based policies in Australia, earlier policies emphasized on selecting the "breadwinner," or head of the family unit, mostly men who could supply the labour market's need for manual labour, as a result, women migrated as dependents. However, the proportion of women who migrate as principal applicants is increasing, in 1989/90 around 40% (compared to 60% men), while in 2002 48% (compared to 52% men) (101. Inglis C. Mothers, Wives, and Workers: Australia's Migrant Women 2003 [Available from: https://www.migrationpolicy.org/article/mothers-wives-and-workers-australias-migrant-women

been found to have a reduced risk of hospitalisation compared to their counterparts who were not (1).

Migrants' official language proficiency can be assessed at two levels: proficiency in public places (workplace, school) and at home. Official language competency is an important acculturative measure (106), commonly assessed as an indicator of migrant health changes with increased proficiency associated with positive health changes while inadequate language skills are associated with poor health (77, 107). Other than health, inadequate language skills affect all aspects of life (108) as it may lead to social isolation (36), difficulties in the labour market (51), in navigating health care systems (54) and education and social security systems.

Some individuals are proficient in more than one language, with the host country's official language used as a medium of communication in work and public places, while a different language is used at home (65). Though, language spoken at home is an indicator of how different migrant groups retain their culture, it may also be a proxy for official language proficiency. Studies also demonstrate its association with health. Elderly Iranian migrants who did not speak English at home were at a higher risk of psychological distress and greater physical functioning limitations compared to those who spoke English at home (91). Language spoken at home may also expose inequities in accessing health care. ABS (109) found individuals who spoke a language other than English at home were less likely to access subsidised mental health related services compared to people who spoke English at home.

Individuals from regions/countries of birth with varying environmental, cultural, political and genetic factors may present differential morbidity and mortality rates to their host population. Migrants from South of Europe whose dietary patterns (low in saturated fats and high in fibre) differ from the Australian-born population were less likely to die from colon cancer, while British-Irish migrants who may share similar dietary patterns to the Australian-born population had similar mortality rates (110). Self-rated health differences also exist by region/country of birth. Canadian migrants from Asia, Africa or South America were more likely to report poor health than their counterparts from Europe, Australia, the US and Mexico (3). Ethnicity is also a health determinant as it indicates variations in socio-economic factors, linguistic capabilities, socio-cultural factors and access to health care which may result in health inequalities. A review by Adhikari and Sanou (25) found ethnicity alongside gender, age at migration and education attainment were risk factors for diabetes in Non-White Canadian migrants from South Asia, Caribbean, Sub-Saharan Africa and Latin America. These populations bore a disproportionate burden of diabetes with an increased risk of an earlier onset and worse outcomes compared to White migrants and the Canadian-born population. In Australia, older culturally and linguistically diverse migrants (CALD) are at an increased risk of poor health (43). This may result from poor language proficiency, social isolation, difficulties in accessing services, inadequate and inappropriate services for culturally and linguistically diverse migrants.

1.2.2.2 Socio-determinants of health; socio-economic factors

Education is a well-established determinant of health (9). Individuals with no formal education or less than high school education are more likely to report poor health compared to individuals with tertiary education (1). Higher levels of education are associated with an increased access to health information, which would enable an individual to make better health decisions. For migrants higher education attainment is associated with increased ability to adapt to a new culture (51).

Higher economic status is positively correlated with health. The gradient for better health increases with increasing income (3). Individuals who are employed are more likely to be healthy compared to those who are unemployed or on government welfare (3). As higher education attainment correlates with higher economic status, individuals may have more resources to invest in their health (51).

The effects of socio-economic status on health also extends to older individuals. Older migrants (aged 65 years or more) from culturally diverse backgrounds are more likely to have a worse socio-economic status compared to the older Anglo-Australian-born population (54), which may negatively affect their health.

The relationship between migrant health, education and economic status is complex. Though countries such as Australia and Canada prefer skilled migrants. As prior mentioned migrants may experience *a* "loss of status" (89) as their qualifications from their country of birth may not be recognised in their host country resulting in unemployment or underemployment (1). Some studies have found, recent migrants in Canada[34] (111) and Australia (112) face unemployment or under-employment regardless of their high education attainment. This may lead to reduced or lower income which may negatively affect their health (1). Reid (112) using data from three Longitudinal Survey of Immigrants to Australia (LSIA), with multiple data collection waves conducted between 1994 and 2006 found there was a large under-utilisation of migrants' employment skills three and a half years post migration which was associated with poor mental health. Education may therefore be a measure of acculturative difficulties faced by migrants which may result in socio-economic and health inequalities, however, such an assertion warrants further research.

1.2.2.3 Socio-determinants of health; policies

Socio-economic and health policies are also associated with health status. Policies addressing social inequalities can aid in the reduction of health disparities (98, 113). As prior stated migrant policies in Australia and Canada have evolved over time to current skills-based policies, which are said to result in migrants who are healthy at the time of arrival compared to the host population. Some policies are negatively associated with health as access to health care in some migrant subgroups is linked to their legal status such as in undocumented migrants who may have the least access to health care services compared to legal migrants (114).

1.2.2.4 Socio-determinants of health; social factors

Diverse social factors may have adverse effects on health. Social inequalities measures such as poverty may limit access to health care (115). Discrimination of migrants in their host countries is associated with worse health, more so for visible minorities (116) while individuals who

[34] Turkish migrants

migrate for humanitarian reasons are more likely to report poor health compared to economic migrants (74).

1.2.2.5 Socio-determinants of health; health systems

Solar and Irwin (99) postulated health systems are a social determinant of health as they indicate access to health care and play an important role in mediating differential consequences of illness in people's lives.

1.2.2.6 Behavioural risk factors

This refers to individual and population characteristics and behaviours that may impact health (6). As mentioned in earlier sections, some diseases such as cancer (stomach, pancreas, colon and rectum) (117, 118) and heart disease (118) are linked to dietary patterns. For migrants, adapting to their host population dietary patterns may result in an increase or reduction in the risk of diseases linked to such dietary patterns. In elderly Greek migrants living in Australia, a shift from a traditional Greek diet of cereals, wine and olive oil to that consisting of a higher intake of meat, margarine and beer was associated with an increased risk in heart disease and cancer (118). The shift in dietary patterns was also associated with an increased body mass index (BMI) in elderly Greek migrants (118) which increased their risk to diseases such as diabetes (119).

Other than dietary patterns, migrants are also likely to adapt to other lifestyle behaviours detrimental to their health such as smoking (120) and alcohol consumption (121), though prevalence may vary among different migrant populations. The National Drug Strategy Household Survey 2016 (NDSHS) reported migrants from New Zealand, North Africa and the Middle East had a higher prevalence of tobacco smoking compared to the Australian-born population while for migrants from the UK, Europe, South-East Asia, Americas and Sub-Saharan Africa the prevalence was lower (122). However, these migrant smoking trends may not correspond with their country of birth rates as some specific South-East Asian countries have some of the highest smoking rates in the world. For example, in 2020 the smoking rate in Indonesia was 39.9% compared to 14.9% in Australia (123). The NDSHS 2016 findings may be an indicator of the healthy migrant effect, whereby individuals with positive selection effects including positive health behaviours are more likely to migrate compared to those with risky health behaviours. However, the NDSHS 2016 findings were biased by a moderately low response rate (51.1%) (124) and lack of information on other migrant characteristics such as migrating circumstances (economic, humanitarian or family reunification) which would aid in understanding the positive health behaviours observed in their participants. Still, there is evidence for convergence as migrants with initially lower rates of smoking may report higher rates with increased duration of residence as their smoking behaviour converges towards that of the host population. The initial lower smoking prevalence of migrants from non-English speaking countries[35] converged towards the higher rates of the Australian-born population after 20 years of residence (120). Though the study was longitudinal, variations in the ethnic composition of non-English speaking migrants which included individuals from countries such as Italy, Germany, Vietnam, the Philippines, the Netherlands, China and India could bias their findings.

1.2.2.7 Biomedical factors

Chronic conditions are a direct measure of health (76). They are also a measure of how individuals perceive their health as those with chronic conditions are more likely to report poor health than those without. For example, migrants with poor mental health (26, 36) and chronic conditions (125) were more likely to report poor self-rated health compared to migrants without. Chronic conditions are also a measure of acculturation as migrants with a lower incidence of chronic conditions have been found to experience an increase in incidence as they adapt to their host country's environmental and socio-cultural factors over time. Recent non-English speaking Australian migrants reported a low incidence of asthma which over time converged towards that of the Australian-born population (76). Similarly, with increasing duration of residence the incidence of ovarian cancer mortality for migrants from low risk countries increased and approximated towards that of the Australian and Canadian-born populations (126).

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[35] Migrants from other countries except those born in the United Kingdom, United States of America, New Zealand, Canada, Ireland and South Africa

Other life course perspective factors including maternal malnutrition and other childhood development factors, poor educational facilities in childhood and occupations with physical hazards may also influence migrant health over time (113). Setia and colleagues linked data from the Longitudinal Survey of Immigrants to Canada (LSIC) to comparable international sources including the United Nations Development Program, United Nations Population Division and the World Bank to create the variables; Human Development Index (HDI), Gross National Income per Capita (GNI per capita), Political Stability Measure (PSM) and Infant Mortality Rate (IMR) which were assessed as determinants of migrant health. Though political stability was not associated with migrant health in Canada, coming from countries with a low human development index, low gross national income or high infant mortality rate was associated with poor health for women while only HDI and IMR were significant health determinants in men (100). The study concluded some migrants' health disadvantages may stem from their country of birth and women at the time of arrival are particularly vulnerable to these influences.

1.2.3 Limitations to the existing hypotheses and determinants of health framework

Though the healthy migrant effect and the determinants of health framework provide important pathways through which the health of migrants compared to the host populations can be studied they have several conceptual and methodological constraints.

1.2.3.1 Acculturation theory assumptions

Acculturation may provide a simplistic view on the complexity of migrant health changes over time. It assumes negative behavioural changes in migrants are mainly associated with their host country while ignoring any positive health behaviours linked to the host country (84). For example, migrants may benefit from existing public health awareness programs such as smoking cessation and increased physical activity campaigns (79). The migrants "superior health behaviours" assumption at the time of migration may also overlook their country of birth "negative health behaviours" or risk factors with severe consequences. Migrants from countries with a high incidence of hepatitis C bear a disproportionate risk of chronic hepatitis

C and the subsequent liver disease related morbidity and mortality in low incidence countries (127) as they are less likely to present behavioural risk factors such as problematic alcohol or drug use (128). Undetected hepatitis C infections often remains asymptomatic until they progress to chronic liver disease and liver cancer (129).

Acculturation also assumes linearity of health changes that is the greater the duration of residence the greater the convergence in health. It may not consider long-term migrants (who are likely to be older and from diverse European countries) and recent migrants (comparably younger and non-European) may not share similar characteristics (1, 41, 130), and the subsequent variations in health in recent and long-term migrants may not be an indicator of the healthy migrant effect. Health comparisons in such dissimilar populations are often confounded by cohort effects more so in cross-sectional studies (20, 38, 85). For example, Ro, Geronimus (131) found most recent migrants to the United States had a significantly lower likelihood of reporting fair/poor self-rated health compared to long-term migrants. They postulated these differences arose from improved standard of living in the migrants' country of birth, United states policies assessing socio-economic characteristics of potential migrants and variations in the ethnic composition of recent and long-term migrant cohorts.

A further criticism of the acculturation theories is that they adopt a "one size fits all" approach. For instance, Berry (88) acculturation model assumes the same acculturation processes characterise all migrants equally regardless of socio-demographic differences. Some of the healthy migrant effect studies broadly categorise migrant populations as "European" or "Non-European" (42), "English speaking" or "non-English speaking" (41) and "White" or "visible minority" (20, 38). Such broad categories limit applicability to overall migrant populations as they do not fully capture the ethnic diversity of migrants as well as differences in socio-demographic factors in their host countries.

1.2.3.2 Limitations for self-rated health

Many studies show self-rated health to be an overall good indicator for health status and subsequent mortality and morbidity (1, 132-134). However, it may be influenced by variations in health perceptions between migrants and the host population which are likely to change over time (84). Migrants are more likely to compare their health to the host population as opposed to their country of birth population as the reality of migrant life sets in over time (4).

In longitudinal studies, self-rated health may be confounded by measurement errors such as ceiling effects whereby individuals reporting the highest level of self-rated health cannot report any subsequent improvement in their health (135).

1.2.3.3 Reporting bias

The lower odds of chronic conditions in migrants compared to the host population might be more "apparent" than "real". Language and healthcare barriers may influence individuals knowledge of disease aetiology leading to underreporting of chronic conditions by recent migrants (85). Increased duration of residence in the host country may lead to increased reporting of chronic conditions as it is associated with greater awareness of health services, increased knowledge of disease aetiology and increased willingness to report chronic conditions (4, 84, 85). However, some researchers argue against a reporting bias. Jatrana, Pasupuleti (41) found including English language as a time variant[36] factor in their analysis did not alter their results (the likelihood of migrants reporting chronic conditions increased over time and the prevalence of chronic conditions for migrants from English and non-English speaking countries converged to that of the Australian-born population), they concluded a reporting bias was unlikely in their study.

1.2.2.4 Applicability to older migrants

As the healthy migrant effect results from positive selection effects at either the individual or population level, it may not account for changes in the health status of older migrants who purposely migrate for family reunification (35) or older established migrants who comprise a large proportion of the total older migrant population in Australia and Canada. However, there is a paucity of data investigating the presence of any health advantage in older migrants. Much

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[36] Changes over time i.e. English proficiency is expected to improve with increased duration of residence for individuals with poor language skills

of what is known about the healthy migrant effect is derived from adult migrants' studies; usually working age adults, excluding migrant children and older individuals aged 65 years or more (10).

1.2.3.5 Cross-sectional studies

Some findings on the healthy migrant effect are derived from cross-sectional studies which provide useful information on health inequality (41) and disease prevalence. However, they provide limited insight into changes in health status over time as migrants adjust to the host country (1, 4, 130). Cross-sectional studies[37] also do not capture the changing trends in specific disease incidence in migrants' country of birth and their influence on migrant health in their host countries over time. For instance, though Asia has one of lowest overall cancer incidence rates in the world it has the second highest mortality incidence ratio (136).

1.2.3.6 Narrow focus of health determinants frameworks

Though, determinants of health are an increasingly important foci in public health research and practice, in studies they retain a relatively narrow focus on individual characteristics and behaviours as opposed to broad societal factors. Castaneda, Holmes (137) argued migrant health studies in the US lacked a broad social determinants perspective on structural factors such as socio-economic policies which directly impact health. They highlighted the danger in using the "individual" as the primary unit of analysis and intervention in migrant health studies. This may lead to the individualisation of responsibility and risk by assuming individual choices are largely unconstrained by socio-economic structures and policies rather than investigating the prior and subsequent social systems which may account for individual characteristics linked to poor health. They recommended expanding research to structural socio-economic factors that may result in the inclusion or exclusion of individuals and communities from adequate health care and health promoting resources.

[37] This limitation also extends to longitudinal studies

Though migrant health studies acknowledge the role some policies play in changes in migrant composition, any direct links to health are not investigated in subsequent data analyses. It is also unclear the role existing socio-economic policies play in the health status of migrants. Inadequate policies addressing individual health determinants may not fully address differential health status if the root cause of poor health in specific migrant populations is rooted in the host country's structural systems.

1.3 Overall aim of the thesis

The overall aim of the thesis is to gain a better understanding of the health status of older migrants compared to the older Australian and Canadian-born population over time to inform policy makers, service providers and researchers.

1.3.1 Research questions, objectives and hypotheses

I shall investigate the following research questions: -

1. What is the health status of older migrants compared to the host population?
2. What is the relationship between potentially influential factors and the health of older individuals?
3. How does the health status of older migrants vary over time compared to the host population?
4. What factors are associated with the health of older individuals' over time?

My 1st and 3rd research questions relate to the health status of older migrants compared to their host population, however, the 2nd and 4th research questions relate to factors associated to <u>all older individuals'</u> health status. This provided a broad overview of determinants of health in the population many of which may be relevant to older migrants.

To answer my research questions, the main objectives are: -

1. To summarise the existing knowledge on older migrants' health.
2. To identify gaps in migrant health studies.

3. To identify variations in the health status of older migrants and the host population.
4. To identify factors related to the health status of older individuals.
5. To identify variations in health status in older migrants compared to the host population over time.
6. To identify factors related to older individuals' health over time.
7. Highlight implications for research, practice, and policy.

Basing on the evidence summarised in prior sections, the research questions will test the following hypotheses:

Hypothesis one: The health status of older migrants differs compared to the host population.

Hypothesis two: Diverse determinants of health are related to the health of older individuals.

Hypothesis three: The health status of older migrants differs compared to the host population over time.

Hypothesis four: Diverse determinants of health are related to the health of older individuals over time.

The quantitative analysis will derive data from the Dynamic Analyses to Optimise Ageing (DYNOPTA) study, a pooled dataset consisting of nine longitudinal studies of ageing in Australia, whose data were collected between 1990-2006 (138). The analyses of the diverse socio-demographic, risk and health factors may enable a more comprehensive understanding of older migrants' health status compared to the host population (138).

1.3.2 An introduction to research methods

My thesis used a range of methods to address my research questions; a systematic review, repeated cross-sectional and a quantitative longitudinal analysis. The systematic review summarised older migrants' health status compared to their host population from existing studies and identified factors associated with the health of older individuals. This identified the gaps in knowledge and strengths of prior migrant health studies, particularly, the lack of cohort studies with self-reported health as the dependent outcome variable. This review informed the nature of my subsequent analyses in a cohort dataset. The repeated cross-sectional analysis investigated the health status of older migrants and their host population and factors associated with health at repeated time points using the whole DYNOPTA dataset to utilise its large sample size and to observe the changes in a different sample of individuals over time. It also identified the strengths and weaknesses of the DYNOPTA dataset, particularly with regard to key missing data about country and region of birth. This informed the longitudinal analysis. Lastly, the longitudinal analysis investigated health status and identified factors associated with older individuals' health status in the same group of individuals over time in a single contributory study. This responded to the weaknesses identified in the cross-sectional analysis in order to make the results more robust, allowing me to distinguish more easily between age, cohort and period effects[38] on health status. The use of a smaller dataset also gave me the opportunity to develop the skills in longitudinal analysis to address my research questions. The findings from each study design were then summarised in a final discussion, by comparing the findings in relation to each research question from the different study designs. Table 1.2 indicates the research questions and objectives as per the study design that will be used in investigating them. Chapter (2) Methodology provides a further detailed rationale for the study designs.

[38] Age effects are differences that occur as individuals age, cohort effects are variations as result of being born in the same period or basic shared experiences at a particular period of time. Lastly, period effects are differences at the time of observation 139. Rafferty A, Walthéry P, King-Hele S, editors. Analysing change over time:: repeated cross sectional and longitudinal survey data2015.

Table 1.2 Study outline

Research questions	Objectives	Study design
1. What is the health status of older migrants compared to the Australian and Canadian-born population? 2. What is the relationship between potentially influential factors and the health of older individuals in Australia and Canada? 3. How does the health status of older migrants vary over time compared to the Australia and Canadian-born population? 4. What factors are associated with the health of older individuals over time in Australia and Canada?	1. To summarise existing knowledge in older migrants' health in Australia and Canada. 2. To identify gaps in migrant health studies in Australia and Canada. 3. To identify variations in the health status of older migrants and the Australian and Canadian-born population. 4. To identify factors related to the health status of older individuals. 5. To identify variations in health status in older migrants compared to the Australian and Canadian-born population over time. 6. To identify factors related to older individuals' health over time in Australia and Canada. 7. Highlight implications for research, practice, and policy.	**Systematic review**
1. What is the health status of older migrants compared to the Australian-born population? 2. What is the relationship between potentially influential factors and the health of older individuals in Australia?	1. To provide a baseline description of participants. 2. To identify variations in the health status of older migrants and the Australian-born population. 3. To identify factors related to the health status of older individuals in Australia. 4. Highlight implications for research, practice, and policy.	**Repeated cross-sectional data analysis**

Table 1.2 continued		
Research questions	**Objectives**	**Study design**
1. What is the health status of older migrants compared to the Australian-born population over time? 2. What factors are associated with the health of older individuals over time in Australia?	1. To identify variations in the health status of older migrants compared to the Australian-born population over time. 2. To identify factors related to the health of older individuals over time in Australia. 3. Highlight implications for research, practice, and policy.	**Longitudinal data analysis**
1. What are the implications of the research findings?	To summarise: - 1. My findings with regard to the thesis research questions, aims and objectives 2. The strengths and weaknesses of my work 3. The implications of the research findings for research, practice and policy.	**Discussion**

1.4 Significance of the study

There are several justifications for studying the health of older migrants as a distinct group. As earlier mentioned, some older culturally and diverse migrant populations are susceptible to poor health, likely due to language related barriers such as social isolation and difficulties in accessing health care (43). Though the challenges posed by an ageing population to the health care systems are well documented, little attention has been paid to the health status of older migrants and factors affecting their health.

As the proportion of older heterogenous migrants in countries such as Australia and Canada rise the demand for appropriate migrant health services is expected to increase. Older migrants' morbidity and mortality patterns have severe implications for health care systems in their host countries. It is vital to ascertain how their health status differs from the host population over time by obtaining insights on how exposure to the host country's socio-economic and physical environment is associated with health. Understanding their determinants of health can inform migration and health policies, older migrants' health promoting interventions and guide future research in older migrants' health.

1.5 Study Limitations

I expect several limitations associated with the study design as the research relies solely on secondary analysis. For the systematic review, there might be limitations on the quantity and quality of data, as well as access to some studies on older migrants' health, which might bias the quality of the findings and limit the generalisability.

For the secondary data analysis, as the overall aim of the DYNOPTA study was not aimed at addressing older migrants' health but older individual's health in Australia there might be a paucity of data to investigate the research questions or test my hypotheses. Also, some factors important to migrant health such as duration of residence or ethnicity may not be available. As a result, this research may not fully inform on older migrants' health but may provide useful insights for future research and migrant health policies. Detailed study limitations are provided in Chapter (2) Methodology and summarised again in Chapter (6) Summary of findings.

1.6 Conclusions

This chapter introduces migration and migrant health related issues and their implications at the individual and population level. It also specifies the overall aim, research questions, objectives and hypotheses of the thesis.

The next chapter presents a detailed and systematic discussion of the methodology for their investigation.

Chapter 2 Methodology

2.0 Introduction

The previous chapter gave an overview of topics of migration, ageing and health. The chapter demonstrated the importance of understanding the health status in older migrants, whose proportion and ethnic diversity is increasing in countries such as Australia and Canada. The chapter concluded by outlining the thesis research questions, hypotheses, aims and objectives, it also provided a brief description of the methods.

This chapter discusses the rationale and structure of the methods used to address the thesis' objectives. As stated in Chapter (1) Introduction, three study designs will be used: a systematic review, repeated cross-sectional and longitudinal data analysis (Figure 2.1). Findings from all studies will then be summarised in a final discussion. Using different study designs to investigate the research questions results will increase the robustness of my findings as the strength of each approach can make up for the weaknesses of the other with regard to specific questions. The findings will be reported in their own chapters, with each step investigating several interrelated research questions and objectives.

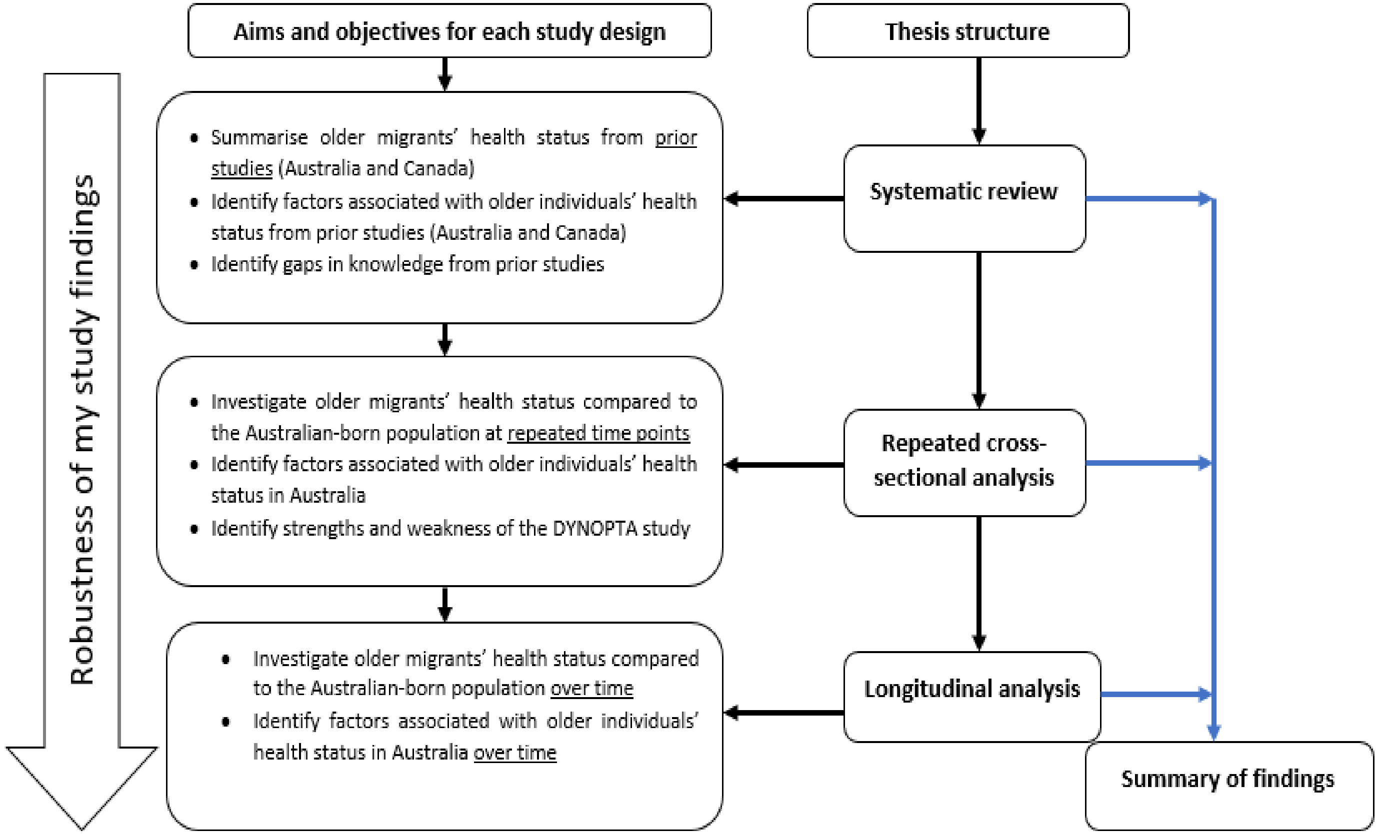

Figure 2.1: Thesis structure

2.1 Systematic review

A systematic review is defined as a summary of all primary studies focused on a specific subject using clear and reproducible methods for a specified period relevant to the study in response to a stated research question using a search strategy written prior to the start of the review (140-142).

Systematic reviews summarise the findings of several studies, making the conclusion more reliable and valid where these can be synthesised (141). As they are carried out using a systematic methodology they provide a reliable source of new evidence applicable for policy making, academia and research (142). They are also time and cost-effective compared to primary research (141). Unlike narrative and literature reviews, they aid in the reduction of researcher and publication bias through the use of prior written search strategies (143), which may be registered in open access online databases such as the International Prospective Register of Systematic Reviews; PROSPERO. Registering search strategies prior helps in the reduction of unnecessary duplication of systematic reviews' outcomes. It promotes transparency by maintaining a permanent public record of the key aspects of the planned review and increases the reproducibility of review methods, they also guard against any conscious and subconscious manipulation of the inclusion criteria and selective reporting of findings (144). Prior written search strategies also aid in the reduction of selection bias by identifying, evaluating and synthesising all relevant studies on a specific subject (140-142). This is accomplished by using an appropriate search strategy to identify potential studies from as many relevant databases as possible and using two or more reviewers to screen, appraise for quality and extract data from all or a proportion of the studies.

For this research, a *priori* aim for the systematic review is to provide a summary of the knowledge from all available studies on older migrants' health status over time in Australia and Canada between 1960-2020 and identify gaps. The review findings will also inform the choice of candidate variables[39] possible from the DYNOPTA study and highlight the implications for research, practice and policy.

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[39] Measurable individual/population characteristics/factors

2.1.1 Importance of a systematic review on older migrants' health in Australia and Canada.

2.1.1.1 Past reviews on older migrants' health had a narrow focus

Some published Australian and Canadian reviews were migrant sub-groups or sex specific such as migrants from culturally and linguistically diverse backgrounds (43), older Arabs (24) and older women (145). As a result, they do not provide a full picture on the health status of diverse ageing migrant populations in either country.

Further, most of the studies were either scoping or literature reviews which though important in mapping the extent, range or nature of literature for a particular subject they do not attempt to include all possible studies and may be subject to selection bias. Scoping reviews also do not assess the quality of the included studies (145) and consequently may not provide a comprehensive critical analysis.

The findings of these reviews indicate older migrants from culturally diverse backgrounds face extensive health barriers in accessing appropriate health care (43, 108) and are susceptible to poor physical (145) and mental health (146).

Therefore, a more complete synthesis of all, or as much as can be found using systematic methods, existing evidence on older migrants' health would help to provide a more accurate summary of current knowledge and identify gaps in the evidence base.

2.1.1.2 Past reviews rarely focus wholly on older migrants

Although often limited by specific migrant group and disease, most reviews on migrant health are not restricted by age. Some review findings indicate migrants may have a health advantage compared to the Australian-born as they generally reported lower rates of mortality, hospitalisation, disabilities and risk factors such as obesity and high blood pressure (75). However, it is unclear if such health advantages extend to older migrants.

Some reviews indicate a paucity of data. For example, there were insufficient evidence to draw conclusions on the risk of cardiovascular diseases in migrants from culturally and linguistically diverse backgrounds compared to the Australian- born population due to the poor-quality design of the included studies (147). Ginieniewicz and McKenzie (148) found little information on the mental health of Latin American migrants in Canada and the factors that possibly influence it, as most studies included in their review were older (at least a decade old) and mainly focused on the mental health of refugees.

The paucity of data in older migrants' health indicates a gap that needs to be addressed.

2.1.1.3 There is limited evidence on the healthy migrant effect in older migrants

Reviews examining the healthy migrant effect, again, tend to be focused on a specific disease and migrant group but are not restricted by age. Overall, their findings indicate that recent migrants largely are less likely to report poor self-rated health, poor mental health (self-reported anxiety and depression), chronic conditions and mortality which increased over time relative to the host population (10, 149).

As discussed in Chapter (1) Introduction the health advantage may be less apparent in older migrants compared to their younger counterparts. Older migrants likely migrated under population based or family reunification policies as opposed to skills-based policies, for the latter a stringent selection criterion is said to result in healthy migrants compared to their host population. However, a paucity of evidence limits our understanding on the presence of any health advantage in older migrants by specific health measures, country/region of birth, age at migration and migrating circumstances.

There is a projected increase in the proportion of older migrants in the total population in both Australia (54) and Canada (146). Although these studies give valuable insights into migrant health in specific conditions, a better understanding across all groups and conditions in the older population – major users of health services - is important to inform policy and research.

2.1.1.4 Past reviews do not compare the health of migrants to the host population

One major limitation in many reviews is their inclusion of studies that do not compare their findings on migrant health to the host population. Comparison groups are important in understanding if the health of older migrants is significantly different from the older host population. They also help us identify factors influencing migrant health by focusing on those that could potentially account for any differences, increasing the validity of the results. This aids in tailored policies and programs for heterogeneous older migrants' groups in response to their specific health needs.

2.1.1.5 Date limitations of past reviews

There is a need to update reviews on migrant health as the diversity of migrants in Canada and Australia has been evolving over time. In Australia particularly, there is scarce literature on migrants' health from the new emerging non-European countries of birth.

2.1.2 Key components of thesis systematic review

Considering all the limitations of prior published reviews. I will carry out the first systematic review summarising current knowledge on all older migrants' health compared to the host population in Australia and Canada, using a wide range of health measures and over a wider time period.

I aim to provide new information on older migrants' health from the two countries by critically evaluating existing evidence on change in health status, as well as assessing if evidence exists of a health advantage as relating to older migrants. The key components of the review are discussed in detail in subsequent sections.

2.1.2.1 Compares the health of older migrants in two Commonwealth countries

This review compares the health of migrants in Australia and Canada. Older migrants in this thesis are defined as individuals who were born outside Australia and Canada (to non-Australian and Canadian parents) and have permanently relocated to Australia and Canada. As outlined in Chapter (1) Introduction, though Australia and Canada share several similarities and differences (Figure 2.2)[40] there is limited comparative research on older migrants' health. They are both Commonwealth countries and share similar migration histories in terms of British/white Europeans settling in a country with an indigenous population which was not integrated into the "birth" of the settlement/new country. The

[40] Adapted from Pixabay (no attribution required)

ethnic composition of the Australian and Canadian migrant population is evolving from predominantly European to multiculturalism as their migration policies change from "population" to "skills-based." They also have universal healthcare systems; all permanent residents are entitled to free healthcare. However, there are variations in terms of geographical location and climate. Comparing the health status of older migrants in the two countries would therefore highlight existing similarities and differences, informing researchers, policy makers and other relevant stakeholders on older migrants' health.

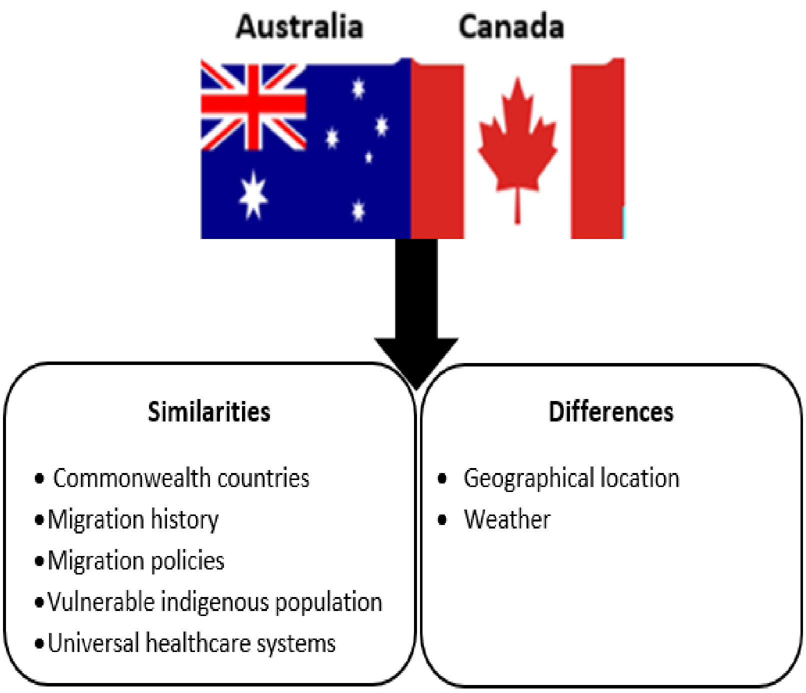

Figure 2.2: Canada and Australia's characteristics

2.1.2.2 Wide range of studies and health measures

The review will include all possible studies published in any language between 1960 and 2020, on older migrants' health in Canada and Australia meeting the eligibility criteria. The wider date limits will highlight health differences in diverse older migrant populations reflecting the changing migrant policies over time. To ensure all possible studies are included and reduce selection bias, the search will be conducted on various electronic multi-disciplinary databases (Table 2.1). Additional backward and manual searches for potential studies by reviewing the bibliography of various reviews and literature will be conducted to maximise the chance of finding relevant studies.

A comparison of migrant health status using diverse health measures will include both cross-sectional and longitudinal studies to account for differences in older migrants and the host populations at a particular period and over time. However, specific health conditions such as multiple sclerosis, which is more prevalent amongst certain ethnicities especially among young adults and persons of European ancestry (150) will be excluded.

Table 2.1: Scope of Electronic databases

Electronic database	**Scope**
Medical Literature Analysis and Retrieval System Online (MEDLINE)	• Life sciences and biomedical
Excerpta Medica database (EMBASE)	• Biomedical and pharmacological
The Cumulative Index to Nursing and Allied Health Literature (CINAHL Complete via EBSCO[41])	• Nursing
PsycINFO via EBSCO	• Behavioural science and mental health
SCOPUS	• Life sciences, social sciences, physical sciences and health sciences
Web of Science (WOS)	• Sciences, social sciences, arts and humanities

2.1.2.3 Includes studies that compare the health of migrants to host population only

Comparisons will be made to the Canadian/Australian-born population to establish if migrants experience differential health status. The comparator in this review will be restricted to non-indigenous older Australians and Canadians who are more likely to interact with migrants. Indigenous Australians (the Aboriginal and Torres Strait Islander people (151)) represent only 3% of the total Australian population, half of whom are aged below 20 years (152). Indigenous Australians account for an estimated 0.7% of the total older population (14) relative to an estimated 37% of older migrants in the total older population in Australia (153). Extensive research documents the health inequalities faced by indigenous Australians in every stage of their lifecycle in comparison to non-indigenous Australians (154-158). Similarly, though the Canadian indigenous population (First Nations, Metis and Inuit peoples (159)) consists of 4.9% of the total Canadian population (33), they also face greater health inequalities relative to non-indigenous Canadians (160).

[41] Acronym for Elton B. Stephens Co

Consequently, they do not match the criteria for a population comparator since their needs are significantly different from the non-indigenous Canadians or Australians. The variations in health between indigenous and non-indigenous Australians and Canadians could potentially bias the results, affecting the validity of the review.

2.2.2.4 Wider age range

Generally, older persons are defined as individuals aged 65 years or more (161). However, this review shall include studies investigating the health of persons aged 45 years or more, for several reasons.

To account for the possibility of a paucity of data on older migrants' health by including as many studies possible to provide a broader picture of older migrants' health. The wider age group will also aid in the inclusion of non-European migrants who are likely to be younger and recent, as opposed to only older established migrants who are likely to be older and European (37, 60), allowing for insights into the health of a broader and diverse migrant population.

The incidence of disease increases with age (27, 162) and chronic conditions usually emerge in middle age, often after a long exposure to an unhealthy lifestyle (162). The younger age group would aid in capturing such health changes in migrants and possibly factors influencing it. Using a relatively young age is consistent to other migrant health literature. Some studies on older migrants health restricted their sample size to those aged 55 years or more so as to account for current Canadian migrants, who are more likely to come from low income countries, whereby the life expectancy is lower (145) or to enable a broader definition of the older population by including those transitioning into retirement (67). Others included more younger individuals, for example those aged 45 years or more were included in a study comparing racial and migrant health status and health care access in later life in Canada and the United States as disease and disability become more common with age, more so middle age (27).

2.1.3 Nature and structure of analysis - rationales

2.1.3.1 Prior written search strategy

As earlier stated, using a prior written search strategy is a key feature of systematic reviews as it assists in the reduction of selection and researcher bias. A search strategy is also an important tool for researchers seeking to duplicate or countercheck findings (143). To increase transparency, effectiveness and to avoid diverging from the systematic review aims and objectives, a prior written and registered search strategy describing the aims, objectives, review questions, search strategy, inclusion and exclusion criteria, quality appraisal and approach to synthesis will be used (Appendix A)[42].

2.1.3.2 Studies' inclusions and exclusions

As the thesis is interested in determining the magnitude of effect in the health differences between migrants and the host populations. Peer-reviewed longitudinal (retrospective or prospective, case control or cohort studies) and cross-sectional quantitative observational studies, whose outcome was the health status of any/all migrant populations relative to the host population will be included.

Randomised[43] and non-randomised[44] control trials will be excluded though they measure magnitude of effect, this is generally restricted to effectiveness of potential treatments for specific populations (164). Qualitative studies will also be excluded, though they aid in understanding complex situations in a given context (165, 166) their findings are not quantifiable (166).

Grey literature like dissertations and theses are also recognised as sources of study data (167, 168) however they are not routinely published in peer-reviewed journals or indexed in conventional bibliographic databases. Though they may provide useful insights on older migrants' health, their methodological approach may not be subject to a peer reviewed

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[42] This protocol states the time frame for studies included as 1960-2018, however the review took longer the included studies time frame expanded to 2020

[43] Subjects are randomly assigned to either of two groups the experimental group receiving the intervention that is being tested or a comparison group or control receiving an alternative (conventional) treatment 163. Kendall JM. Designing a research project: randomised controlled trials and their principles. Emergency Medicine Journal. 2003;20(2):164.

[44] Subjects in the treatment or intervention trials are not allocated at random

process. Further it may not be possible to assess the quality of findings in some grey literature such as editorials, conference abstracts, unpublished studies and government reports. All grey literature will be excluded from the review.

Prior reviews will also be excluded as they potentially include some similar studies to the current systematic review.

2.1.3.4 Screening and quality appraisal

Screening for eligible studies in reviews is often done independently by multiple reviewers to reduce the risk of bias in study selection, it is also particularly effective where the search strategy results in thousands of potential studies as it reduces the risk of eligible studies being left out. After identification of eligible studies, data extraction is also conducted independently by two or more investigators to minimise the risk of errors (169).

I[45] will develop the protocol and standardised data extraction form in consultation with the thesis supervisors and other experts. Screening and selection of potential studies, data extraction and quality appraisal will involve two independent reviewers to minimise selection and researcher bias. Due to limitations (time and other resources) the second reviewer will only screen, assess for quality and extract data from 25% of all potential and eligible studies respectively. Possibly, this approach may result in substantially more potential studies missed however, other measures such as backward and manual searching from other reviews and studies may identify any studies excluded by random error.

Rayyan, a free web tool will be used to screen for eligibility as it is easily accessible, simple to use and provides suggestions for study inclusion by identifying key words for inclusion and exclusion. Also, it is easy to collaborate with the second reviewer while screening independently, as it provides a summary of the time spent on the review, studies included, excluded and disagreed on.

The quality of longitudinal studies will be assessed using the Critical Appraisal Skills Programme tool (CASP) using questions aimed at evaluating; participants recruitment and

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[45] Refers to principal researcher/PhD student

definition, clarity of the study aims and objectives, study population representativeness, appropriateness of the study design and statistical analysis and precision, reliability and applicability of the study findings. As CASP was not designed to appraise cross-sectional studies, the Appraisal tool for Cross-Sectional Studies (AXIS tool)[46] will be used to evaluate quality by assessing the study design and findings (170).

As these tools do not quantify the quality of studies, a summary score; low, medium or high quality will be incorporated as a simple measure of ranking study quality by assessing quality of data extracted and any study design or population issues that would limit the validity, reliability and generalisability of study findings. The Cochrane Collaboration on Systematic Reviews advises against assessing risk of bias using scoring systems and rigid checklists (171). Further, quality appraisals should be tailored to the review topic (171) and implications for specific study's methodology and findings should be assessed individually (172). As such the ranking is not aimed at "cherry picking" studies based on the strength of evidence but largely to inform my synthesis of findings process by identifying gaps and strengths in study's methodology and findings, which could accurately inform future research, policy and practice. For instance, the Kliewer and Ward (93) suicide study cited in Chapter (1) Introduction had several limitations. The study data were old, cross-sectional and derived from a registry database. Data for countries of birth suicide rates were extracted from a different database (World Health Organisation). Ranking this study as of low to medium quality informs on crucial gaps in knowledge that should inform future research on older migrants' health. However, it is possible to interpret such studies in their context citing their limitations, the study provides a broad picture on variations in suicide risk in migrant populations.

2.1.3.5 Analysis

A narrative synthesis will be used to analyse the review findings. Though all reviews require to an extent narrative synthesis to interpret their findings (173), it is commonly used where other statistical methods such as meta-analysis may not be appropriate (174) as a result of factors such as substantial heterogeneity (173, 175). It is used to summarise the findings of

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[46] The prior published systematic review protocol (Appendix A) lists CASP as the only tool for appraising study quality. However, as this tool was only designed for longitudinal studies, the AXIS tool was used to assess the quality of cross-sectional studies.

a systematic review (175), investigate findings in relation to a specific question and assess the robustness of the evidence through a textual approach (173).

Heterogeneity in reviews may be as a result of methodological factors (173, 175, 176). In my review it may result from variations in the migrants' ethnic composition, age and reason for migration, health measures and study designs. Migrants originate from different countries with cultural, demographic and environmental variations, also as a result of changing migrant policies the composition of migrant populations has evolved over time in countries such as Australia and Canada. Including such findings in a single meta-analysis might result in misinterpretation of results and misapplication of findings to research and policies which may lead to inappropriate interventions for specific migrant populations.

Narrative syntheses are subjective (173) which may result in researcher bias (176). Therefore any approach used by reviewers should be rigorous and transparent to reduce the risk for bias (173). To increase transparency of the analysis and applicability of findings, the general framework from a project for the Economic and Social Research Council (ESRC) Methods Programme developed to provide guidance on conducting narrative synthesis in systematic reviews (173) was used. The framework provides four main processes for a narrative synthesis which are applicable wholly or partly to reviews. This includes; developing a theory of how the intervention works, why and for whom, developing a preliminary synthesis of findings of included studies, exploring relationships in the data and assessing the robustness of the synthesis (173, 175).

The review narrative synthesis will not develop any theories but rather will rely on existing theories, hypothesis and frameworks to assess their applicability to the interpretation of our findings on older migrants' health. As discussed in Chapter (1) Introduction, this included theories such as acculturation, hypothesis such as the healthy migrant effect and determinants of health framework. Further, where possible the Bradford Hill Criteria, a group of nine aspects through which causality can be inferred in cross-sectional studies(177) will be applied. A detailed description of the Bradford hill criteria is provided in later sections.

A preliminary synthesis is usually developed by organising and describing the results of the included studies (173, 175) and exploring the relationships (175). The ESRC guidance suggests several tools and techniques applicable for this stage such as textual descriptions of studies, groupings and clusters, tabulation and vote counting (173). Vote counting is a simple technique highlighting preliminary trends by tallying the direction of outcome (positive or negative health changes) and/or using statistical significance in narrative syntheses (178). There are several limitations to be considered when using vote counting (173, 175, 179). It is often faulted for its simplicity and lack of transparency (178) as it does not consider the sample size and study design (173, 175, 179), or inform on effect size (179). Some researchers recommend it should not be used for any form of synthesis as it may result in misleading conclusions (175, 179). For this review, vote counting will be used as a simple preliminary measure to provide a visual overview of older migrants' health and to indicate commonly assessed health measures but not as a measure of the strength of evidence or to infer any relationships.

After initial preliminary synthesis, the relationships in the data will be explored. This stage involves identifying emerging patterns from the findings and factors which may explain them (173, 175). This will be done through techniques such as qualitative case descriptions, which is any process describing data to account for the differences in statistical findings (173). The second approach is the investigator/methodological/conceptual triangulation. This involves the use of different perspectives to study a particular phenomenon by analysing data of the included studies in their study context (173).

The last approach involves assessing the robustness of the synthesis product for drawing and generalising conclusions (173, 175). The robustness of the findings depends on the quality of included studies and the reliability of synthesis findings (173, 175).

2.2 Quantitative analysis - rationale

After analysing and summarising data from existing studies on migrant health, the next stage involves secondary quantitative data analysis. Data analysis is the systematic application of statistical techniques to evaluate data in response to a research question (180). Secondary data analysis involves using previously collected data usually by a different source for another primary purpose (181). Data analysis is a core component of medical sociological research as it aids in the identification of factors associated with health changes and in reaching valid conclusions to inform policies and programs for specific populations (182).

The quantitative analysis will compare the health of older migrants aged 45 years or more to a comparison group (the Australian-born population). As stated in earlier sections comparisons groups are important in assessing whether the health of older migrants is significantly different from the older host population.

2.2.1 Source of study data; background to DYNOPTA

The analysis will draw data from the DYNOPTA study whose contributary studies included; the Australian Longitudinal Study of Ageing (ALSA), the Australian Longitudinal Study of Women's Health (ALSWH mid and old cohort), the Australian Diabetes, Obesity and Lifestyle study (AusDiab), the Blue Mountains Eye Study (BMES), the Canberra Longitudinal Study (CLS), the Household Income and Labour Dynamics in Australia Study (HILDA), the Melbourne Longitudinal Study of Healthy Ageing (MELSHA), the PATH Through Life Study (PATH) and the Sydney Older Person's Study (SOPS) (138, 183).

The authors of DYNOPTA assert; the dataset is not a summation of individual studies but an entirely new and unique dataset comprising of new variables and constructs derived from complex harmonisation procedures (138). Harmonisation is the creation of a single variable measuring the same concept from questions which are asked differently across diverse datasets (183). Some variables, such as alcohol consumption[47] were harmonised to enable comparison with Australian benchmarks.

The DYNOPTA study focuses on four outcomes which contribute significantly to the burden of disease and disability; dementia and cognition, mental health, sensory impairment and mobility/activity limitations (138). At the baseline the DYNOPTA participants (*n*[48] = 50 652)

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[47] Were harmonised to provide classifications in accordance with those endorsed by the National Health and Medical Research Council (NHMRC)
[48] Sample size

were aged 45 to 103 years (*M*[49] = 61.73; SD[50] = 12.43) and were largely female (77.2 %), reflecting the inclusion of the all-female Australian Longitudinal Study of Women's Health and women's greater longevity (138, 183). Detailed information about the DYNOPTA study and its harmonisation process is provided elsewhere (138).

2.2.2 Characteristics of DYNOPTA studies

Tables 2.2 and 2.3 detail the characteristics of the DYNOPTA contributory studies. The studies used different participant recruitment and data collection methods. For example, ALSA randomly selected participants from the South Australia Electrol roll while ALSWH mid and old cohort randomly sampled female participants in the Medicare database. Three DYNOPTA contributory studies; ALSWH, AusDiab and HILDA were nationally representative. Other than ALSA and CLS, data were largely collected from non-institutionalised individuals. Individual studies had varying data collection periods; across and between waves. Data for HILDA were collected in four successive waves, while for AusDiab there was a three-year gap between data collection for its two waves. Data collection for the first four ALSA waves were successive however there was a one-year gap between data collection for subsequent waves. Other than ALSWH mid and old cohort, AusDiab, HILDA and PATH, data for the other studies were collected in the early and mid-1990s. Other than ALSWH mid cohort, AusDiab and HILDA which collected data for participants aged 45 years or more at the baseline, all the other studies collected data for participants aged 60 years or more. The period of data collection and age of participants at the baseline as expected suggests DYNOPTA participants are likely to be older established migrants. As highlighted in Chapter (1) Introduction, older migrants in Australia are likely to be European and migrated as young adults.

Though ALSWH mid and old cohort contributed a greater proportion of data to DYNOPTA compared to other studies, the data were for women only and the study also contributed the greatest proportion of participants with unknown nativity.

[49] Mean
[50] Standard deviation; informs on how measurements are spread from the actual mean

The DYNOPTA study provides a diverse range of socio-demographic, risk and health factors which may enable a more comprehensive investigation of changes in health for migrants relative to the host population (Table 2.3). A detailed discussion for some of these factors is provided in Chapter (1) Introduction and in the subsequent sections.

Table 2.2: Summary of DYNOPTA individual studies

Study	Location	Waves	Duration	Age range of participants at wave 1 (years)	Sample size at wave 1	Study setting	Participants' selection	Data collection methods[51]
ALSA	Adelaide	7	1992/93, 1993/94, 1994/95, 1995/96, 1998, 2000/01 & 2003/04	65-103	2087	Community dwelling and institutional residents	Randomly selected from the South Australian Electoral Roll	Structured interviews, clinical assessments, self-administered questionnaires, bio-chemical analysis and qualitative interviews
ALSWH-mid and ALSWH-old	National	4	1996, 1998, 2001 & 2004	45-51	13706**∞ƒ§**	Not specified	Random sampling of all women in the Medicare database	Mailed surveys
	National	4	1996, 1999, 2002 & 2005	68-76	12431**∞ƒ§**	Not specified	Random sampling of all women in the Medicare database	Mailed surveys

[51] May vary by wave

Table 2.2 continued

Study	Location	Waves	Duration	Age range of participants at wave 1 (years)	Sample size at wave 1	Study setting	Participants' selection	Data collection methods[52]
AUSDIAB	National	2	1999/00 & 2004/05	45-95	7296	Private dwellings	Stratified cluster sampling	Household interviews and biomedical examinations
BMES	Blue Mountains	3	1992/93, 1997/00 &2001/04	45-100	3654	Private dwellings	Door to door census	Household interviews and biomedical examinations
CLS	Canberra, Queanbeyan	4	1990/91, 1994/95, 1998 & 2002	70-103	1134∞	Community dwelling and institutional residents	Not specified	Household interviews

[52] May vary by wave

Table 2.2 continued								
Study	**Location**	**Waves**	**Duration**	**Age range of participants at wave 1 (years)**	**Sample size at wave 1**	**Study setting**	**Participants' selection**	**Data collection methods[53]**
HILDA	National	4	2001/02, 2002/03, 2003/04, 2004/05	45-90+	6164	Private dwellings	Multi-stage approach	Household interviews
MELSHA	Melbourne	11	1994, 1995, 1996, 1997, 1998, 1999, 2000, 2002/03, 2003, 2004/05 & 2005/06	65-94	1000∞¥	Private dwellings	Clustered sampling from the electoral roll	Household interviews
PATH	Canberra, Queanbeyan	2	2001/02 & 2005/06	60-66	2550∞	Private dwellings	Random selection from the electoral rolls	Self-completion of questionnaires

[53] May vary by wave

Table 2.2 continued

Study	Location	Waves	Duration	Age range of participants at wave 1 (years)	Sample size at wave 1	Study setting	Participants' selection	Data collection methods
SOPS	Sydney	5	1991/93, 1994/96, 1996/97, 1997/99 & 2001/03	75-97	630∞	Private dwellings	Random selection	Household interviews and medical examinations

∞ Studies included participants whose nativity was unknown (ALSWH mid=174, ALSWH old=809, CLS=96, MELSHA=1, PATH=340 AND SOPS=1)

Ƒ All female studies

§ There was an overrepresentation of women with university education and an underrepresentation of migrants from non-English speaking countries

¥ The sample was urban and predominantly from English-speaking backgrounds

Data derived from (41, 138, 184-191) and a prior descriptive analysis available on request.

Table 2.3: Summary of DYNOPTA variables

Category	Types of variables
Administration and demographics	Administration, participants, partners status, education, labour force, occupation, retirement, country of birth, language, geographic location, years lived in Australia, residency and income
Risk factors	Smoking, alcohol, physical activity, anthropometric data, blood pressure, social contact, life events, falls, medical conditions and grip strength
Mobility	Driving status and activities of daily living/instrumental activities of daily living
Psychological Constructs	Self-rated health and satisfaction
Mental Health	Centre for Epidemiological Studies-Depression (CES-D), Psychogeriatric Assessment Scale-Depression (PAS), Goldberg Anxiety and Depression Scale (GADS) and Medical Outcomes Study – Short Form 36 (SF-36) and Short Form 12 (SF-12)
Cognition and Dementia	Mini-Mental State Exam (MMSE)
Sensory functioning	Visual acuity, audiometry, tinnitus, visual aids, self- rated hearing, hearing aids, self- rated vision and hearing handicap inventory for the elderly
Service use	Hospital use and health service use
Carers	Carers

Data derived from (138)

2.2.3 Strategy for deriving data from the DYNOPTA study

DYNOPTA's large sample size potentially increases the statistical power and enables more precise findings, the longitudinal measurements provide an opportunity to examine older migrants' health status over time. Further, its broad geographical coverage aids in-depth analysis of topics (138, 190). In addition to the findings of a descriptive analysis[54] assessing the suitability of the DYNOPTA study in investigating the health of older migrants, several other factors will be considered: -

2.2.3.1 In-DYNOPTA factors

DYNOPTA contributory studies used a variety of survey designs, varied in their geographic and demographic coverage and data collection varied across and between waves (138). As some DYNOPTA contributory studies were not nationally representative the findings may not be generalisable to the Australian population and data for most of the medical conditions were self-reported (138). As with many longitudinal studies of ageing there is considerable attrition over time as a result of mortality, withdrawal from study and non-response. These complexities should be considered when deriving and analysing DYNOPTA as data for variables would considerably vary across the total sample.

2.2.3.2 Other DYNOPTA data derived studies strategies

Prior studies drawing data from the DYNOPTA study largely derived data from studies that contributed to their study outcome (183, 192, 193). For example Anstey, Burns (186) examined the prevalence rates of probable dementia and possible cognitive impairment from the two largest sources of population-based data available in Australia including the DYNOPTA study. Consequently, they derived data from DYNOPTA contributory studies focusing on cognitive decline or dementia; SOPS, CLS, PATH and ALSA. Similarly, Ross, Anstey (193) derived data from SOPS, BMES, MELSHA and ALSA to investigate driving status across three Australian states; identify demographic, health and functional predictors of driving status and investigate the extent to which remaining a driver in spite of cognitive and visual impairments varies as a function of sex.

[54] Full results available on request

2.2.3.3 Other migrant health studies

Lastly, deriving data should be informed by other past migrant health studies. This would largely inform the expected migrant composition and the type of data available for analysis. Chapter (1) Introduction highlighted migrant health studies largely focus on the individual as the sole unit of analysis (137, 194) and may lack broader societal factors. Similarly, as prior indicated by Table 2.3, the DYNOPTA study provides a broad range of individual health determinants.

Table 2.4 provides a summary on thesis strategies for deriving and use of DYNOPTA data. The cross-sectional design will try and maximise on a large sample size to broadly assess older migrants' health, however due to perceived data variability this may not be possible for the longitudinal study design. Further, the large sample size is dependent on the amount of data available from the contributory studies to the thesis primary dependent variable.

Table 2.4: Summary on thesis strategies for deriving DYNOPTA data

Strategy	Study design		Factors considered
	Cross-sectional	Longitudinal	
Maximise on a large sample size	√	X	1. In-DYNOPTA factors
Broad focus	√	X	2. In-DYNOPTA factors
Specific focus	X	√	1. In-DYNOPTA factors 2. Other DYNOPTA data derived studies strategies
Harmonisation	√	√	1. In-DYNOPTA factors 2. Other migrant health studies
Account for past migrant health studies	√	√	1. Other migrant health studies
Account for migrant composition	√	√	1. Other migrant health studies
Include contributory studies to dependent variable only	√	√	1. In-DYNOPTA factors 2. Other DYNOPTA data derived studies strategies

√ yes

X no

2.2.3.4 Dealing with missing data

Missing data is likely to be an issue for the DYNOPTA study, a longitudinal study of ageing. This refers to information or data for particular items or questions which are not available for analysis (195) as a result of natural attrition (death), loss to follow up over time or incompletely filled questionnaires. Missing data can reduce the statistical power of a study, resulting in biased and invalid findings (196-199).

DYNOPTA data dictionary cites the reasons for missingness as; non-response, information not obtained by study, study not included in harmonised variable, data not imputed, not asked in wave and response not compatible (200). Table 2.5 highlights the patterns of missingness from a randomly selected DYNOPTA sample, n=100. The reasons for missingness varied between and within individuals for the variables. For example, in some participants, missingness for the education variable was a result of non-response while for alcohol consumption and smoking status data were not collected for that particular wave. I accounted for missing data in the thesis analyses by mainly including DYNOPTA contributory studies to the thesis dependent variable and use of appropriate statistical methods (see later sections). Patterns of missing data; missing completely at random (MCAR), missing at random (MAR) and not missing at random (NMAR) and other methods of dealing with missing data are not discussed as they are beyond the scope of this thesis.

Table 2.5: Patterns of missingness from a random sample DYNOPTA population, n=100

DYNOPTA unique case number[55]	Patterns of missingness				
	High education attainment	Alcohol consumption risk factors		Smoking status	
	No response	No response	Not asked in wave	No response	Not asked in wave
2000022	0	0	0	0	0
2000035	0	0	0	0	0
2000091	X	0	X	0	X
2000094	0	0	0	0	0
2000145	0	0	0	0	0
2000172	X	0	X	0	X
2000187	0	0	X	0	X
3000193	0	0	0	0	0
3000236	0	0	0	0	0
3000250	0	0	0	0	0
3000253	0	0	X	0	X
3000297	X	0	0	0	0
3000372	X	0	0	X	0
3000374	0	0	X	0	X
3000450	X	0	X	0	X
3000451	0	0	X	0	X
3000464	0	0	0	0	0
3000495	0	0	X	0	X
3000526	0	0	0	0	0
5000553	0	0	0	0	0
5000584	0	0	0	0	0
5000596	0	0	X	0	X
5000618	X	0	X	0	X

[55] Personal identification number changed to further protect the identity of individual participants

Table 2.5 continued					
DYNOPTA unique case number[56]	Patterns of missingness				
	High education attainment	Alcohol consumption risk factors		Smoking status	
	No response	No response	Not asked in wave	No response	Not asked in wave
5000625	0	0	0	0	0
5000702	0	0	X	0	X
5000841	0	0	X	0	X
5000844	0	0	0	0	0
5000853	0	0	X	0	X
5000879	0	0	X	0	X
6000916	X	0	0	0	0
6000946	0	0	0	0	0
6001008	0	0	X	0	X
6001047	0	0	0	0	0
6001097	0	0	X	0	X
6001099	0	0	0	0	0
6001122	X	0	X	0	X
6001152	0	0	0	0	0
6001160	0	0	X	0	X
4001164	0	0	0	0	0
4001213	0	0	X	0	X
4001243	0	0	0	0	0
4001266	0	0	X	0	X
4001287	0	0	X	0	X
4001304	0	0	0	0	0
4001342	0	0	0	0	0
4001419	0	0	X	0	X

[56] Personal identification number changed to further protect the identity of individual participants

Table 2.5 continued					
DYNOPTA unique case number[57]	Patterns of missingness				
	High education attainment	Alcohol consumption risk factors		Smoking status	
	No response	No response	Not asked in wave	No response	Not asked in wave
4001509	0	0	X	0	X
4001542	X	0	X	0	X
4001562	X	0	X	0	X
4001565	0	0	0	0	0
4001682	0	0	X	0	X
8001715	X	0	0	0	0
8001766	0	0	0	0	0
8001797	X	X	0	X	0
8001815	0	0	0	0	0
8001828	0	0	0	0	0
8001861	0	0	0	0	0
8001884	0	0	X	0	X
8001886	0	0	0	0	0
8001898	0	0	X	0	X
8001899	0	0	0	0	0
8001937	0	0	0	0	0
8001938	0	X	0	X	0
8001961	0	0	0	0	0
8001999	X	0	0	0	0
9100088	0	0	0	0	0
9100099	0	0	X	0	0
9100125	0	0	0	0	0
9100134	0	0	0	0	0

[57] Personal identification number changed to further protect the identity of individual participants

Table 2.5 continued					
DYNOPTA unique case number[58]	Patterns of missingness				
	High education attainment	Alcohol consumption risk factors		Smoking status	
	No response	No response	Not asked in wave	No response	Not asked in wave
9100203	0	0	0	0	0
9100211	0	0	X	0	0
9100221	0	0	0	0	0
9100255	0	0	0	0	0
9100275	0	0	0	0	0
9100305	0	0	0	0	0
9100325	0	0	X	0	0
9100343	0	0	0	0	0
9100359	0	0	X	0	0
9100417	0	0	0	0	0
9100424	0	0	X	0	0
9100431	0	0	0	0	0
9100478	0	0	0	0	0
9100512	0	0	0	0	0
9100529	0	0	0	0	0
9100570	0	X	0	X	0
9900616	0	0	X	0	0
9900627	0	0	0	0	0
9900646	0	X	0	X	0
9900699	0	0	0	0	0
9900729	0	0	X	0	0
9900821	0	0	0	0	0
9900827	0	0	0	0	0

[58] Personal identification number changed to further protect the identity of individual participants

Table 2.5 continued					
DYNOPTA unique case number[59]	Patterns of missingness				
	High education attainment	Alcohol consumption risk factors		Smoking status	
	No response	No response	Not asked in wave	No response	Not asked in wave
9900837	0	0	X	0	0
9900860	0	0	X	X	0
9900862	0	0	0	0	0
9900895	0	0	0	0	0
9900916	0	0	X	0	0
9900951	0	0	0	0	0

2.2.4 Choice of primary dependent variable

2.2.4.1 Health measures in the DYNOPTA study

In the DYNOPTA study health status was assessed in two ways; firstly, participants provided self-reported health status and secondly the presence of self-reported current and past common medical conditions was noted. The two represent different health constructs, with self-rated health, a commonly assessed outcome measure in epidemiological studies (132, 201), consisting of an individual's overall appraisal of their health status (202, 203) including its biological, psychological and social dimensions (204). Chronic conditions represent diagnosed medical conditions which to an extent affects an individual's health status. For self-rated health, individuals ranked their health as either excellent/very good, good, fair or poor. Medical conditions may be measured at specific periods during the study, drawn from electronic databases or are dependent on the participants' ability to recall past or current diagnosed medical conditions. In DYNOPTA, individuals indicated yes or no to the question; ever had or currently has a specific medical condition (refer to conditions in footnotes under Table 2.6). Disparities may exist between self-reported medical conditions and drawing data

[59] Personal identification number changed to further protect the identity of individual participants

from electronic medical records, the latter may more accurately represent disease prevalence compared to the former (205) which maybe confounded by recall bias.

2.2.4.2 Rationale for primary dependent variable

In this thesis, I will use self-rated health status as the primary dependent variable. In migrant studies, self-rated health has been used by researchers to examine changes in the health of migrants in both cross-sectional and longitudinal studies and is a good health status proxy for minority populations (1). Many studies show self-rated health to be an overall good indicator for health status and subsequent morbidity and mortality (1, 132-134, 206). Some cross-sectional studies indicate, the probability of reporting better health relative to the host population declines over time, while the prevalence of specific chronic conditions in migrants converged towards that of the Canadian-born population (3, 207, 208). Longitudinal studies provide additional evidence on migrants' self-reported health status. Increased duration of residence is associated with a decline in the health of migrants' (132, 134).

However, some researchers have raised concerns in regards to the reliability and validity of self-rated health. One major argument against self-rated health is that it is an indicator of complex human judgements on severity of illness that are very subjective and often confounded by varied factors (132). Individuals in any defined settings often judge their health in reference to other complex groups and diverse factors such as gender and lifestyle behaviours (133, 209). In retrospect, migrants might assess their health in relation to other migrant groups, their migration process, their country-men back at home, the host population and any recent change in lifestyle behaviour (4, 84). Factors such as family history on longevity might influence how individuals rate their health generally. The age at which a man's father dies might influence how the man rates his health as he approaches that age, particularly if they shared certain lifestyle behaviours such as smoking or physical traits such as being overweight (133). Other limitations for self-rated health more so in relation to the healthy migrant effect are outlined in Chapter (1) Introduction.

Several self-rated health validation studies exist. Subramanian, Huijts (210) examined the relationship between years of schooling and self-rated health in 69 countries[60]. They found lower education attainment in adults was consistently associated with poor health compared to those with higher levels of education attainment independent of economic development or regional geography. Further, they found little evidence of under-reporting health in disadvantaged individuals. However, the study asserts their findings should be interpreted with caution as disadvantaged individuals may underestimate the extent of their poor health and heterogeneity in self-rated health measurements by country may vary. Miilunpalo, Vuori (204) investigated the predictive association between perceived health and future mortality in a prospective study in Finland, they found self-rated health assessments are valid health status indicators.

Further, "health" is inherently subjective. It is not merely a measure of disease prevalence (211) rather a state of complete physical, mental and social well-being (212). As such, self-rated health is a valid measure of health as it clearly captures the concept that health is not merely the absence of medical health conditions – making it a better measure of health than comorbidities.

2.2.4.3 Sample size and number of waves possible

Tables 2.6 and 2.7 indicate the actual sample size possible for each wave and identifies the number of waves for the repeated cross-sectional analysis dataset. Data will be drawn from the DYNOPTA contributory studies to self-rated health, as such non-contributory studies; BMES, MELSHA and SOPS will be excluded. Data for self-rated health were more consistently collected in most DYNOPTA contributory studies as opposed to chronic conditions (Table 2.6) and would possibly enable a large sample size to examine older migrants' health. After the 4th wave, there is a sharp reduction in the number of participants mainly due to the length of follow up available from the contributory studies and the non-inclusion of contributory studies in the harmonised variable, rather than participants withdrawing from the contributory studies

[60] Regional classifications for the 69 countries; Europe & Central Asia, Middle east & North Africa, South Asia, East Asia & Pacific, Sub-Saharan Africa and Latin America & the Caribbean

(Table 2.7). Therefore, only the first 4 waves will be included in my analysis dataset, whereby at wave 1, n=45,368[61] while at wave 4, n=35,522[62].

Data for the longitudinal analyses will be drawn from the HILDA study only. In line with my methodology HILDA included data for individuals aged 45 years or more as opposed to ALSA, CLS, ALSWH-old and MELSHA (Table 2.6). Compared to other nationally representative studies, HILDA collected data for both males and females as opposed to ALSWH mid and old cohort, which collected data from female participants only. Data were collected over four successive waves compared to AusDiab which collected data for two waves only. Compared to ALSA and CLS it excluded data for institutionalised older persons, who may report worse health than the non-institutionalised older population as key reasons for institutionalisation include underlying cognitive and/or functional impairment (213). Other DYNOPTA studies; BMES, PATH and MELSHA did not contribute data to the self-rated health variable. HILDA also collected data on duration of residence and some language proficiency variables, these would aid in a better description of the migrant population in addition to their country of birth (discussed further in subsequent sections).

[61] Including missing data
[62] Including missing data

Table 2.6: Distribution of health measures over DYNOPTA waves for specific contributory studies

Health measure	Study and wave (s)									
	ALSA	ALSWH-MID	ALSWH-OLD	AusDiab	BMES	CLS	HILDA	PATH	MELSHA	SOPS
Self-rated health	1-7	1-4	1-4	1-2	X	1-4	1-5	1-2	X	X
Medical conditions										
Endocrine, nutritional or metabolic disorderπ	1	1-4	1-4	1-2	1-3	X	X	X	X	X
	1,3,6	2,3,4	2,3,4	X	X	1-4	X	1-2	1,3,5,7,9	1,2,4
Eye conditionβ	1	X	4	X	1-3	X	X	X	X	1,2,4,5
	1,3,6	X	X	X	X	1-4	X	1-2	1,10	X
Musculoskeletal or connective or tissue condition∞	1	1-4	1-4	1	1-3	X	X	X	1,10	1,2,4
	1,3,6	2-4	2-4	X	X	1-4	X	1-2	1,3,5,7,9,10	1,2,4
Genito-urinary conditionsΩ	1	X	X	1	X	X	X	X	X	X
	1,3,6	X	X	X	X	X	X	X	1,3,5,7,9,10	X
Digestive conditions ⌂	X	X	X	X	X	X	X	X	X	X
	X	X	X	X	X	1-4	X	X	1,10	X

Table 2.6 continued										
Health measure	**Study and wave (s)**									
	ALSA	**ALSWH-MID**	**ALSWH-OLD**	**AusDiab**	**BMES**	**CLS**	**HILDA**	**PATH**	**MELSHA**	**SOPS**
Cancerα	1	1-4	1-4	X	X	X	X	X	X	5
	1,3,6	2-4	2-4	X	X	1-4	X	1-2	1,3,5,7,9,10	X
Respiratory diseaseμ	1	1-4	1-4	X	1-3	X	X	X	X	1,2,5
	1-6	2-4	2-4	X	X	1-4	X	1-2	1,10	1-2
Circulatory disease¥	1	1-4	1-4	1-2	1-3	1-4	X	2	1,10	1,2,4,5
	1,3,6	2,3,4	2,3,4	X	X	X	X	1,2	3,5,7,9	1,2,4
Parkinson's	1	X	X	X	X	1-4	X	X	X	1-5
	X	X	X	X	X	X	X	X	1,10	1-5

Data derived from (200)

Past chronic conditions
Nationally representative studies
Current chronic conditions

Table 2.6 continued

π Diabetes, thyroid etc[63]

β Glaucoma, cataract etc

∞ Arthritis, osteoporosis, gout etc

Ω kidney condition etc

⌂ liver condition etc

α Skin, breast and lung etc

μ Asthma, emphysema or bronchitis etc

¥ Hypertension, stroke, angina, transient ischemic attach, angina, heart attack, thrombosis etc

HILDA did not collect data for specific chronic conditions, while, AusDiab and BMES did not ask participants about current medical conditions.

Summary variables in bold are consistent with the International Statistical Classification of Diseases and Related Health Problems (the ICD-10) by the World Health Organization (WHO)

[63] etc. represents the category 'other conditions' in the DYNOPTA study

Table 2.7 Distribution of DYNOPTA participants by wave, study and self-rated health

Wave	Sample size[a]	Self-rated health	Studies that contributed data to the self-rated health variable
1	50652	45368	ALSA, ALSWH mid, ALSWH old, AusDiab, CLS, HILDA, PATH
2	50652	45368	ALSA, ALSWH mid, ALSWH old, AusDiab, CLS, HILDA, PATH
3	40806	35522	ALSA, ALSWH mid, ALSWH old, CLS, HILDA
4	37152	35522	ALSA, ALSWH mid, ALSWH old, CLS, HILDA,
5	9881	8251	ALSA, HILDA,
6	3087	2087	ALSA
7	3087	2087	ALSA
8	1000	-	-
9	1000	-	-
10	1000	-	-
11	1000	-	-

[a] overall DYNOPTA sample size for all waves

Findings include missing data

2.2.5 Choice of Independent variables

2.2.5.1 Rationale for choice of independent variables

As stated earlier, most migrant health studies largely focus on individual health determinants (132, 137). It is expected commonly assessed individual characteristics will be consistently described across the DYNOPTA contributory studies. Table 2.8 provides a summary of older migrant health determinants as identified from prior studies (Chapter (1) introduction) and similar or related health determinants from the DYNOPTA study.

Table 2.8: Determinants of migrant health identified from prior studies

Health determinants identified from prior studies	Summary of rationale	Related health determinants identified from the DYNOPTA study
Age	Though the probability of reporting poor health increases with age (1, 3, 74), the gradient to poor health is steeper for older migrants (3).	• Age at the time of observation
Sex	Women are more likely to report poor health compared to men (74). The roles played by some migrant women such as not being the principal visa applicant and caregiving (post migration) may have adverse effects on their health (102).	• Sex
Education and economic status	Though higher education attainment and economic status are linked to better health (9). They may not be important indicators for migrant health as migrant education attainment may not be highly recognised in their host country (112, 214).	• Education attainment • Main source of income, • Source of income (pension or government allowance) • Career occupation
Marital status	Marital status is an important form of social support which may increase individuals coping mechanisms for illnesses (74, 105).	• Marital status
Official language competency	Poor official language skills may result in social isolation, barriers in the labour market and in accessing health care services which results in poor health (73, 99).	• Official language competency

Table 2.8 continued

Health determinants identified from prior studies	Summary of rationale	Related health determinants identified from the DYNOPTA study
Region/country of birth	Similarities or differences between country of birth and the host country characterised by environmental, biological and dietary factors may result in differences or similarities in health between migrants and the host population (3, 110).	• Country of birth • Region of birth
Lifestyle patterns and risk factors	Lifestyle patterns such as diet (118), smoking status (120) and alcohol consumption (121) are key determinants of health, more so when migrants adapt or fail to adapt to lifestyle patterns that may result in a change in their health status.	• Current chronic conditions • Body mass index • Smoking status • Alcohol consumption risk factor • Physical activity (measures of moderate-vigorous activities) • Falls in the last 12 months and activities of daily living/instrumental activities of daily living

Table 2.8 continued

Health determinants identified from prior studies	**Summary of rationale**	**Related health determinants identified from the DYNOPTA study**
Health measures	Migrant health status and mortality rates are likely to change as migrants adapt to the different socio-cultural and environmental factors in the host country (119).	• Current chronic conditions • Past chronic conditions • Mental health
Duration of residence	Migrant health changes as their duration of residence increases as migrants adapt to the different socio-cultural and environmental factors in the host country (49, 70).	• Age arrived in Australia • Years lived in Australia • Decades lived in Australia • Decade arrived in Australia

2.2.5.2 Selection of independent variables

To complete the dataset for repeated cross-sectional analysis, data were drawn from the DYNOPTA contributory studies to self-rated health. An arbitrary threshold for including independent variables with less than 30% missing data to the dependent variable cut-off point was used. This was aimed at preventing a huge reduction in missing data in the subsequent DYNOPTA waves, due to variability in DYNOPTA contributory studies. The variables included in the analysis dataset are: - age at the time of observation, sex, partner status, education attainment, country of birth, current smoking status, language spoken at home, past chronic conditions and alcohol consumption (Table 2.9). The variables: current chronic conditions, BMI, date of death, main source of income, source of income (pension or government allowance), first, native or preferred language, mental health (CESD), mental health (GADS), age arrived in Australia, years lived in Australia, decades lived in Australia and decade arrived in Australia were excluded. The variables career occupation, physical activity (measures of moderate-vigorous activities), falls in the last 12 months and activities of daily living/instrumental activities of daily living were not assessed for possible inclusion in the analysis dataset. The DYNOPTA data dictionary[64] indicated few studies included data for these variables at the first wave indicating possibly a larger proportion of missing data in subsequent waves (200).

In the repeated cross-sectional analysis dataset, I will use "country of birth[65]" rather than "region of birth[66]" Though it might be important in accounting for the variations in health between heterogeneous migrant groups (215), the small numbers available for "region of birth" would not allow sufficient statistical power. These "small numbers" maybe indicative of the migrant composition at the period data were collected for the DYNOPTA contributory studies. European migrants (older established migrants[67]) comprised 72.5% of the total DYNOPTA migrant population; North-West European-57.1%, Southern and Eastern European-

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[64] Available on permission of the DYNOPTA committee
[65] Born in Australia and not born in Australia
[66] Inadequately described, Oceania and Antarctica, North-West Europe, Southern and Eastern Europe, North Africa and the Middle East, South-East Asia, North-East Asia, Southern and Central Asia, Americas and Sub-Saharan Africa
[67] A detailed description of their characteristics is provided in Chapter (1) Introduction

15.4%. This limitation is also common in other migrant health studies. Due to data limitations, Aglipay, Colman (38) & Gee, Kobayashi (20) were unable to determine migration categories[68] and ascertain different ethnicities of migrants other than by broad categories; “White” and “visible minority” and “recent” and “long-term” migrants. The variable “country of birth” maybe sufficient to address my objectives investigating possible variations in health status between migrants and the Australian-born population as disparities exists by overall migrant status. Anikeeva, Bi (75), the only systematic review[69] investigating the health status of all migrants’ groups between 1980-2008, found generally migrants had better health, an overall lower mortality and hospitalisation rates compared to the Australian-born population, thus “country of birth” may provide useful insights on older migrants’ health.

Data for some of the proposed independent variables were only recorded at the baseline. Language spoken at home will be included in the cross-sectional analysis of the relationship with baseline health status and as a baseline predictor of change in health status over time. I will not be able to investigate the relationship of *change* in these variables over time to *change* in health status over time. As prior stated (Chapter (1) Introduction), migrants may be proficient in more than one language, with the host country’s official language used as a medium of communication in the work and public places whilst a different language is used at home (Statistics Canada, 2015). Language spoken at home may also be an indicator of how different populations retain their culture, more so for older migrants, as some are likely to revert to their first language in later life (37). Language spoken at home may be a proxy for overall official language proficiency in older individuals. It may also be an important factor in understanding older migrants’ health, poor English language proficiency at home in elderly Iranian migrants increased their risk of psychological distress and physical functioning limitations (91).

The longitudinal analysis will include the variables; age at the time of observation, sex, partner status, education attainment, country of birth, current smoking status and alcohol

[68] Humanitarian, skilled migrants etc
[69] To my knowledge

consumption. Language spoken at home and past chronic conditions were excluded as their data are not included in HILDA. First, native or preferred language, region of birth and years lived in Australia were included in the longitudinal analysis as their data were available in HILDA. As data for ‘first, native or preferred language’ were collected in the first wave only the longitudinal analysis assumes the ‘first, native or preferred language’ of migrants does not change in the subsequent waves. Table 2.10 indicates by the 4th HILDA wave attrition/missing data was still less than 30% of the total sample size for the independent variables.

While country of birth remains the independent variable of interest, sub-group analyses using the variables “region of birth” and “years lived in Australia” to account for heterogeneity were included.

Table 2.9:Distribution of missing data for potential independent variables over four DYNOPTA waves, N=45,368

Variable name	Wave				
	DYNOPTA studies included in wave 1	**1 N (missing data%)**	**2**	**3**	**4**
Age at time of observation	All	45368 (≤30)	38729	26961	24534
Date of death∞	ALSA, AusDiab, CLS, PATH	6082 (≥30)	6082	5522	5522
Sex	All	45368 (≤30)	45368	35522	35522
Partner statusα	All	45058 (≤30)	37165	26897	24375
Education attainmentα	All	43981 (≤30)	43981	34200	34200
Main Source of income∞	Except CLS	14765 (≥30)	27987	13227	11317
Source of income; pension or government allowance∞	All	15427 (≥30)	29331	14694	11869
Labour force participation status∞	except ALSWH-old	31238 (≥30)	23178	17609	15487
First, native or preferred language spoken¥	ALSA, CLS, HILDA, PATH	11823 (≥30)	-	-	-
Language spoken at home¥	ALSA, ALSWH old, ALSWH mid, AusDiab	34047 (≤30)	-	-	-

Table 2.9 continued

	DYNOPTA studies included in wave 1	1 N (missing data%)	2	3	4
Country of birthα	All	43949 (≤30)	43949	34443	34443
Region of birthα	All	43914 (≤30)	43914	34428	34428
Chronic conditions currentΩ	ALSA, CLS, PATH	5722 (≥30)	29390[70]	21759	22577
Chronic conditions everΩ	ALSA, ALSWH old, ALSWH mid, AusDiab, CLS	36393 (≤30)	33487	20082	21074
Current smoking statusα	All	43387 (≤30)	32649	17344	15242
Alcohol consumption ◆	ALSA, ALSWH old, ALSWH mid, AusDiab, HILDA, PATH	41642(≤30)	27687	14672	15128
BMI¥	ALSA, AusDiab, PATH	11098 (≥30)	6546	1274	-
Mental health (CESD) ●	ALSA	2064 (≥30)	-	1565[71]	-

Table 2.9 continued

[70] In wave 2 the variable included data from ALSWH old and ALSWH mid hence the increased sample size

[71] Only the study ALSA contributed data to this variable

	DYNOPTA studies included in wave 1	1 N (missing data%)	2	3	4
Mental health (GADS) ●	CLS, PATH	3477 (≥30)	2808	8945[72]	18099[73]
Age arrived in Australia¥	ALSA, CLS, HILDA	2864 (≥30)	-	-	-
Years lived in Australia¥	ALSA, CLS, HILDA	2864 (≥30)	-	-	-
Decades lived in Australia ¥	ALSA, CLS, HILDA	2663 (≥30)	-	-	-
Decade arrived in Australia¥	ALSA, CLS, HILDA	2864 (≥30)	-	-	-

Missing data patterns indicated in Table 2.9 are for wave 1

α 'study not included in harmonised variable, ∞ 'study not included in harmonised variable' or 'no response' or 'response not compatible with variable', ¥ 'study not included in harmonised variable' or 'no response', Ω 'no response' or 'system missing', ◆ 'study not included in harmonised variable' or 'not asked by study' and ● 'no response'

[72] This wave included data for the study ALSWH old

[73] This wave included data for the study ALSWH old and ALSWH mid

Table 2.10: Distribution of data for participants over 4 waves

	Wave 1		Wave 2		Wave 3		Wave 4	
	N	**Missing N (%)**	**N**	**Missing N (%)**	**N**	**Missing N (%)**	**N**	**Missing N (%)**
Country of birth	6103	0	6103	0	6103	0	6103	0
Region of birth	6103	0	6103	0	6103	0	6103	0
Age at the time of observation	6103	0	6103	0	6103	0	6103	0
Sex	6103	0	6103	0	6103	0	6103	0
Marital status	6096	-7 (≤1)	5406	-697 (11.4)	5042	-1061 (17.3)	4723	-1380 (22.6)
Education attainment	5962	-141 (2.3)	5962	-141 (2.3)	5962	-141 (2.3)	5962	-141 (2.3)
Alcohol consumption long-term risk factor	5696	-407 (6.7)	4895	-1208 (19.8)	4680	-1423 (23.3)	4364	-1739 (28.5)
First, native or preferred language	6100	-3 (≤1)	6100	-3 (≤1)	6100	-3 (≤1)	6100	-3 (≤1)
Smoking status	5710	-393 (6.4)	4872	-1231 (20.2)	636	-1467 (24.0)	4362	-1741 (28.5)
Self-rated health	5715	-388 (6.3)	4795	-1308 (21.4)	4633	-1470 (24.0)	4408	-1695 (27.8)
Duration of residence	1862	∞	1615	∞	1478	∞	1377	∞

∞ data for migrants only

2.2.6 Statistical design for the data analysis

2.2.6.1 Repeated cross-sectional data analysis

A cross-sectional design is an observational study whereby the investigator measures the outcome (health) and the exposures (factors associated with health) for the participants at a particular time (139, 216). Cross-sectional studies provide useful information on the prevalence of health conditions which is essential for public health planning, they are also important in planning for longitudinal data analysis (216). Cross-sectional studies have several limitations. They cannot infer causality as outcomes are measured at one point in time across populations rather than repeated measures in individuals over time (1, 38, 216-218). As such they would not adequately inform on the changes in older migrants' health over time. Cross-sectional studies are often confounded by the cohort effect as factors or changes characterising a given population at a particular point in time and are not solely dependent on the ageing process (219). For example, a cross-sectional study whose results indicate a decline in the health of migrants presently may not necessarily provide additional evidence on migrant health for a cross-sectional study that observed a similar trend two decades ago in Australia. The two study findings may be indicative of different migrant cohorts as the migrant composition, socio-economic, demographic, health and risk factors vary over time.

On the other hand, in a repeated cross-sectional analysis the same information is asked from different samples of individuals in each successive wave (139). Repeated cross-sectional analysis findings can be used to consider changes in the study population behaviour or other study outcomes' patterns over time (139). The repeated cross-sectional analysis will aid in the description of the DYNOPTA data, outline baseline participants socio-demographic characteristics and possibly provide broad insights on the self-rated health of older migrants compared to the older Australian-born population. Further, the nine aspects of the Bradford Hill Criterion through which causality can be inferred from an association in epidemiological studies (177), shall be applied as and when appropriate in this thesis (Table 2.11).

Table 2.11: Bradford Hill Criteria

Bradford Hill Criteria	**Explanation**
Strength of Association	The larger an association between the exposure and the disease, the more likely it is to be causal
Consistency	Consistent findings from multiple studies can be used to infer causality
Specificity	There should be a clear and specific relationship between the cause and the outcome
Temporality	The cause should precede the outcome
Biological Gradient	The changes in disease prevalence should follow from matching changes in exposure
Plausibility	This indicates the presence of a potential biological mechanism
Coherence	The association should correspond to current knowledge on the biological nature of the disease
Experiment	Decline in the risk of disease as a result of an intervention or removal of exposure suggests causal inference
Analogy	When the study findings indicate weaker evidence for a particular causal relationship, researchers should be more accepting of it, if there exists stronger evidence of a causal relationship between the exposure and outcome

Data derived from (177, 220)

Drawing conclusions regarding causation is complex and researchers have pointed out several limitations to the Bradford Hill criteria over the years. The third aspect of specificity suggests a specific cause leads to a specific effect, however, some exposures such as smoking are associated with several diseases such as coronary heart disease and stroke (221). Similarly, for migrant health changes it is not simply the act of migration (exposure) that results in health changes. Migrant health could be a result of several interrelated factors such as age, age at migration, sex, education, marital status and varied lifestyle factors. For example, younger migrants may find it easier to adapt in their host countries relative to older migrants as they are subject to stringent selection measures based on language proficiency, age, education and health (74).

Some of the Bradford Hill criteria may be applicable to migrant health. The second aspect “consistency” is widely used in epidemiological studies. For migrant health, the healthy migrant effect is a widely accepted hypothesis as several studies have consistently found recent migrants have a health advantage which declines with increased duration of residence in countries such as Australia and Canada (3, 10, 68, 70, 73-77). However, when using consistency to infer causality in migrant studies cohort effects should be taken into consideration.

For the seventh aspect “coherence” changes in migrant health are not abstract and should correspond to current knowledge on the biological nature of the disease. Breast cancer mortality risk in Canadian and Australian migrant women converged towards the rate of the host population, the concomitant reduction or increase in risk may be as a result of adapting to environmental and lifestyle factors attributable to breast cancer in the host country (222). However, researcher’s knowledge on the biological nature of disease should correspond to their population of interest. Risk factors for migrants from hepatitis C endemic countries may vary from the Canadian population as they are less likely to present behavioural risk factors such as problematic alcohol or drug use (128).

For the ninth aspect “analogy” not all migrant studies may find strong evidence for a particular causal relationship but they may refer to existing studies providing stronger evidence of a causal relationship between the exposure and outcome. However, this aspect should be applied with caution i.e. when referring to similar migrant populations and also taking aspects such as age at migration and duration of residence into consideration.

2.2.6.2 Statistical methods for the repeated cross-sectional data analysis

Simple descriptive analyses will be used to provide basic summaries on the DYNOPTA study and participants baseline socio-demographic, risk and health characteristics.

I shall use logistic regression, a commonly used statistical procedure in epidemiologic studies, to investigate the association between the categorical dependent variable and the various independent variables. A key advantage of logistic regression is researchers can avoid any confounding effects by including all variables in a single model (223). However, as DYNOPTA consists of different studies which may have contributed to the independent variables at different time points, it will be important to pay attention to model building. This involves making informed decisions on what variables to include in the final logistic regression model based on factors such as availability of data for variables at different time points.

One of the methods of reporting and interpreting findings in logistic regression is by odds ratio (OR), a measure of association between an exposure and outcome (224). They provide estimates (with corresponding p values and/or confidence intervals) for the relationship between the two variables (225), signifying the likelihood of an outcome occurring given a particular exposure compared to the likelihood of an outcome occurring in the absence of that exposure. Odds ratio approximates the relative risk. For an OR of <1 the exposure is associated with lower odds of the outcome, OR>1 the exposure is associated with higher odds of the outcome while an OR =1 means the exposure is not associated with the outcome (224).

P-values are reported as a measure of evidence (226). In simple terms a p-value is the probability of a false-positive. An arbitrary level of 0.05 is usually chosen as the level of significance (227), if a p-value falls below the predefined value the findings are said to be "statistically significant" (227, 228). This aids in drawing conclusions about the statistical plausibility and significance of the study findings. Confidence interval is a range of values in which the true population value lies with a certain degree of probability (226, 229). The confidence level of 95% is usually selected, this simply means there is a 95% chance the indicated range includes the actual population value (229). Confidence intervals also indicate the direction and strength of the measured effect (226). Wider confidence intervals indicate less accuracy and stability and are largely as a result of small sample size (226). There has been much debate of the usefulness of a binary cut-point. P-values and confidence-intervals can yield distorted or misleading results, more so if the study data limitations are not considered (227). Further, study findings may rely on "statistical significance" which is inferred from arbitrary conventions. Statistically significant results do not always provide a meaningful or methodologically appropriate explanation to cause and effect (230) or in identifying possible associations. Small differences of no epidemiological interest may draw statistical significance from large sample sizes, while clinically important epidemiological differences may be statistically non-significant because of a small size (229).

The repeated cross-sectional findings will be reported using odds ratio alongside p-values and confidence intervals, as they provide complementary types of information (226). Other than statistical significance, my findings will be interpreted using existing criterion such as the Bradford hill criteria and prior studies in the context of study data and methodology.

Tests of interactions and multi-collinearity (excess correlation) will be carried out as necessary. An interaction is defined as the effect of the relationship between two or more independent variables that affect the dependent variable (195). Multi-collinearity may weaken the statistical significance of independent variables and subsequent interpretation of findings, it exists when independent variables in a model are correlated (231).

2.2.6.3 Longitudinal data analysis

Older migrants' health status will also be investigated using a longitudinal design. This is a study design which follows individuals over time and are particularly useful for evaluating the relationships between risk factors and health changes (218, 232). There are two types of longitudinal studies; prospective and retrospective. In the latter individuals are followed over a particular period of time during which a researcher uses a variety of measures to assess if they will develop the outcome of interest (233). In the former, individuals are followed retrospectively to determine if the outcome (disease) is as a result of any, some or all of the measures being investigated (233). Prospective studies are expensive to carry out as opposed to retrospective studies such as our data source; DYNOPTA which use already collected data (233). Retrospective studies may lack the relevant information necessary for future research as the data may have been collected for different purposes and may not include variables important to the topic under question.

Though a longitudinal study design offers a more comprehensive approach to research they also have disadvantages such as bias introduced by missing data (218).

2.2.6.4 Statistical methods for the longitudinal data analysis

The two commonly used methods for longitudinal data analysis are generalized estimating equations (GEE) and the mixed effects regression (MER) (199, 234). Table 2.12 summarises the general differences, advantages and disadvantages of the two statistical methods. Though the MER models are widely used for analysis of longitudinal data (234, 235), for this thesis GEE will be used. GEE models offer an alternate, simpler and direct approach to analysing correlated data for researchers interested in estimating population-level (marginal) parameters, with a lower risk of incurring computational, estimation and interpretational problems (236).

GEE is an approach that produces population-based estimates while accounting for possible correlations among the repeated measures of the outcome variable of a subject (237, 238). Accounting for possible correlation among the response observations of an individual is usually done by selecting a working correlation structure, however, this is often difficult as it requires extensive knowledge of dependence among study subjects (236, 238, 239). The commonly used working correlation structures are independent, unstructured, interchangeable and autoregressive (236, 237, 239, 240). The latter assumes homogenous correlation in responses from the same cluster, unstructured assumes the correlation between responses is relatively complex, the independent structure assumes none of the response measurements are correlated while the autoregressive assumes correlation between responses decreases over time (236, 237, 240).

The quasi-likelihood theory (no assumptions are made about the distribution of the response observations) under the quasi-information criterion (QIC) is used to select the best working correlation structure, usually the structure with the smallest QIC (241, 242). However, GEE estimates are robust to misspecification of the working correlation structure (236, 237). GEE also does not disregard for participants with incomplete data.

The findings will be presented using odds ratios (with their corresponding p-values and confidence intervals), tests of interactions will be carried out as appropriate.

Table 2.12 A summary description for GEE and MER statistical methods

GEE	MER
Differences	
• Estimates population average effects	• Estimates person specific and population effects
Advantages	
• Its robustness to misspecification of the repeated measures' correlation structure	• Allows multi-level hierarchical models that allow predictions for each level
• Its computational simplicity as GEEs analyses use quasi-likelihood methods as opposed to full-likelihood methods[74]	• Allows hypothesis testing on correlation parameters as they are directly estimated
• They do not disregard participants with incomplete data	• Uses full likelihood methods which are more robust to missing data and assumes missingness is MAR which is a more general assumption
• Easy to generalise to a wide variety of outcome measures with different distributional forms	• Full-likelihood methods provide estimates of person-specific effects which provide insights on inter-individual variability
Disadvantages	
• Cannot perform hypothesis testing on correlation parameters since these are not directly estimated (Likelihood-based methods are not available for statistical inference)	• Full-likelihood methods are computationally complex
• Quasi-likelihood methods are more limited in their assumptions on missing data than their full-likelihood counterparts	• Relies on correct specification of the mean and correlation structure of the repeated responses for valid hypothesis testing conclusions as such it is not robust to misspecification

Adapted from (199, 234, 235, 243)

[74] Includes methods such as maximum likelihood which estimates the parameter values that give the distribution that maximise the probability of making the observations given the parameters

2.3 Summary

This chapter describes and discusses the rationale for the methodological approach in addressing the stated objectives. The systematic review informs on what is currently known on older migrants' health in Australia and Canada and identifies the research gaps. The repeated cross-sectional analysis describes participants by their socio-demographic, risk and health factors at the baseline, uses logistic regression methods to examine the health status of older migrants compared to the Australian-born population and identify factors associated with health. The longitudinal data analysis will use generalised estimating equations to inform on older migrants' health status over time compared to the host population and possibly identify factors associated with health.

The following chapter presents the methods, findings and discussion in relation to the systematic literature review.

Chapter 3 Systematic review

3.0 Introduction

The previous chapters summarised various concepts on migrant health and highlighted thesis' research questions, aims and objectives. They also discussed the rationale and structure of the methods used to address the thesis' objectives.

This chapter examined the overall aim of the thesis focusing on the health status of older migrants relative to the Canadian and Australian-born population and possible health determinants over time by investigating the following research questions: -

1. What is the health status of older migrants compared to the Australian and Canadian-born population?

2. What is the relationship between potentially influential factors and the health of older individuals in Australia and Canada?

3. How does the health status of older migrants vary over time compared to the Australian and Canadian-born population?

4. What factors are associated with the health of older individuals over time in Australia and Canada?

To answer these research questions, the main objectives of this chapter are:

1. To summarise existing knowledge in older migrants' health in Australia and Canada.
2. To identify gaps in migrant health studies in Australia and Canada.
3. To identify variations in the health status of older migrants and the Australian and Canadian-born population.
4. To identify factors related to the health status of older individuals.
5. To identify variations in health status in older migrants compared to the Australian and Canadian-born population over time.
6. To identify factors related to older individuals' health over time in Australia and Canada.
7. Highlight implications for research, practice, and policy.

3.1 Research design and methods

A detailed description of the study design, a rationale for the search strategy including electronic databases, study participants and analysis are provided in Chapter (2) Methodology.

3.1.1 Study design

We conducted a systematic review from January 2018 to January 2020 to examine and summarise current knowledge on older migrants' health relative to the Canadian and Australian-born population, possibly identify factors associated with migrant health and highlight gaps in knowledge.

3.1.2 Search strategy

3.1.2.1 Protocol registration, study designs and searches

The protocol was published on the PROSPERO database prior to the start of the review; registration no. **CRD42018103742** (Appendix A). We included peer-reviewed quantitative observational studies whose outcome was the health status of any/all migrant populations relative to the host population. Reviews, theses', editorials, books, randomised and non-randomised control trials, conference abstracts, unpublished studies, qualitative studies and reports were excluded.

A search for studies published between 1960 and 2020 written in any language was conducted on Medline, EMBASE, Academic Search Premier via EBSCO, PsycINFO via EBSCO, CINAHL Complete via EBSCO and Web of Science, using a combination of Medical Subject Headings (MeSH): Australia AND/OR Canada AND (migrant OR foreign born OR country of birth) AND (health OR health status OR well-being). Backward and manual searches for potential studies by reviewing the bibliography of various reviews and literature were also conducted. Searches for full text were conducted online in the University of York and Hull libraries, Sci Hub and Google.

The results were transferred to Endnote for deduplication. Table 3.1 illustrates the search results obtained from the OVID Medline search, the results from other searches are reported in Appendix B.

Table 3.1: OVID MEDLINE results

	Search terms	Results	Search strand
1.	exp "Emigrants and Immigrants"/	9483	Migration
2.	(Migrant* or migrat* or Immig* or emigra* or "asylum seeker*" or Expat or "born abroad" or "Culturally and Linguistically Diverse" or "non-English speak*" or foreig*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	368015	
3.	1 or 2	368015	
4.	Exp Australia/	124824	Australia
5.	(Australia* or Aussie).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	141237	
6.	4 or 5	155984	
7.	exp Health/	315,457	Health
8.	(Health* or Well* or Diseas* or ill* or Morbid* or mortal* or "Life expectancy").mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	9375172	
9.	7 or 8	9386164	
10.	3 and 6 and 9	2643	Migration + Australia + Health
11.	exp Canada/	141704	Canada
12.	canad*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	132229	

Table 3.1 continued			
	Search terms	**Results**	**Search strand**
13.	11 or 12	173634	
14.	3 and 9 and 13	3185	Migration + Health + Canada
15.	6 or 13	324708	Australia or Canada
16.	3 and 9 and 15	5674	Migration + health + Canada or Australia

3.1.2.2 Study measures, participants and setting

The review included all objective and subjective measures of physical and mental health including; self-rated health, chronic conditions, functional limitations, disabilities, mental health and mortality. Studies that focused on indirect health measures; hospitalisation, health care access, risk factors, health screening and health measures prevalent in specific ethnicities such as multiple sclerosis[75] were excluded.

Studies with participants aged 45 years or more were included if the country of birth; born or not born in Australia and Canada were clearly stated and the health status for migrants and the host population were reported separately.

Canada and Australia were selected for their similarities as major migrant receiving countries with similar migrant selection policies. They are both diverse, with a migrant population that has evolved over time and they have universal healthcare. However, they also vary in terms of climate.

3.1.2.3 Screening, data extraction and quality appraisal

The review was conducted by two reviewers. The main reviewer[76] was responsible for identifying relevant studies from the electronic databases and manual searches, transferring them to Endnote for deduplication. Two reviewers independently screened the search results using Rayyan (Appendix C[77]) by title, then abstract, followed by full text if eligibility still could not be ascertained. The second reviewer screened 25% of the total search results. Any arising conflicts were resolved by consensus or consultations from thesis supervisors.

The quality of longitudinal studies was assessed using the Critical Appraisal Skills Programme tool (CASP) while the Axis tool was used for cross-sectional studies (Appendix D & E)[78]. After the quality assessment, we added an extra column in which the studies were ranked as having either low, medium or high quality. The ranking was based on quality of

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[75] Among young adults more so of European ancestry
[76] Mary Kariuki
[77] Summary of screening results
[78] Also includes the full quality appraisal results

data extracted and any study design or population issues that would limit the validity, reliability and generalisability of study findings. The aim of the ranking was not to "cherry pick" studies based on the strength of evidence but aid in the analysing and interpretation of findings in their specific study context while accounting for gaps in knowledge.

The main reviewer extracted data onto a standardised form. These included study design, migrant and comparator population, sample size, sex, aims, study duration, statistical analysis methods, study outcomes and independent variables included in the study (Appendix F[79]). The second reviewer independently extracted data from 25% of the random sample of included studies, both reviewers checked the extracted data for discrepancies.

3.1.3 Analysis

To account for heterogeneity and prevent misinterpretation and misapplication of findings to research, policy and practice, a narrative synthesis was used to investigate findings in relation to the review questions and assess the robustness of the evidence. Heterogeneity resulted from variations in migrants' ethnic composition, age and reason for migration, health measures and study design of the included studies.

The Economic and Social Research Council (ESRC) Methods Programme framework developed to provide guidance on conducting narrative synthesis in systematic reviews (173) was used to reduce researcher bias, increase transparency of the analysis and applicability of findings. Figure 3.1 summarises the ESRC framework prior described in Chapter (2) Methodology.

The review's narrative synthesis did not develop any theories but rather relied on existing theories, hypothesis and frameworks to assess their applicability to the interpretation of our findings on older migrants' health. This included acculturation theory, the healthy migrant effect hypothesis, determinants of health framework and the Bradford Hill Criteria.

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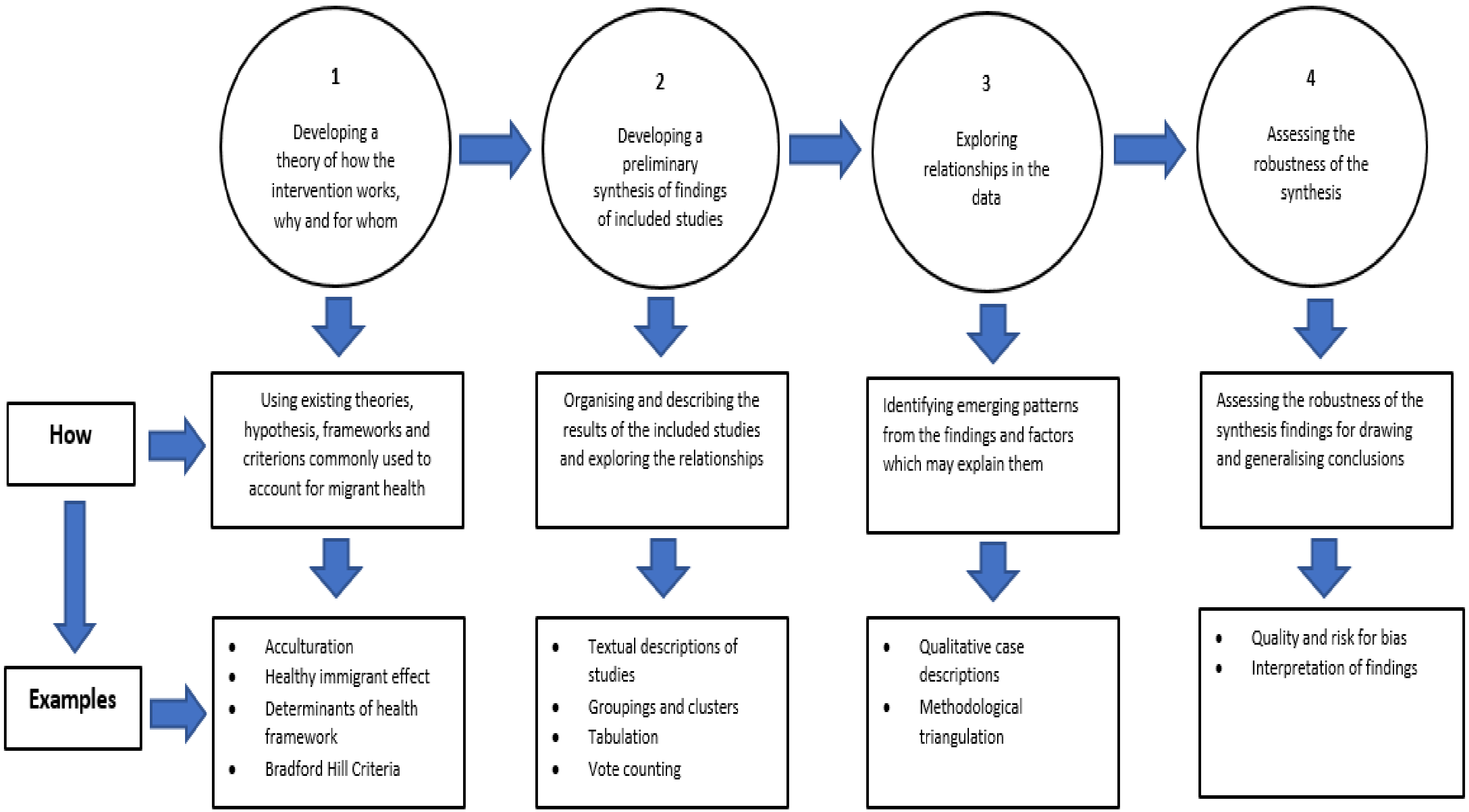
[79] Indicates the contents of the standardised data extraction form

A preliminary synthesis was developed by organising and describing the results of the included studies through tabulation and vote counting. Tabulation aided in the initial description of key characteristics of included studies such as number of studies, study design, use of self-reported data, nationally representative studies, older persons studies and age of participants in included studies which were disaggregated by host country: Australia or Canada. Simple vote-counting was used to tabulate the preliminary findings according to migrant health status (better, worse, similar or mixed relative to the host population) for all health measures in the included studies. Different colours, symbols and other measures indicated where findings varied by factors such as age, sex and country of birth and to indicate statistical or study design differences in the included studies i.e. whether data extracted were for adjusted/unadjusted coefficients or crude rates.

When interpreting data on older migrants' health, factors such as age at migration, specific health measures, specific migrant populations and other diverse factors that may result in differential health were considered, these data were visually presented in tables. Specific migrant populations may have differential risk to certain diseases as they originate from different socio-cultural, demographic and economic environments, study context was important in the interpretation of review findings. For the healthy migrant effect, the definition of recent and long-term migrants in the primary studies was included as it was important in making any inferences on the health status of older migrants.

All the studies included in the review were assessed for quality and risk of bias. Interpretation of our findings is initially based on the overall observed trend in older migrant health, then this is further disaggregated by specific health measures and varied determinants of health considering the theories, hypothesis and criterion mentioned earlier.



Adapted from the Economic and Social Research Council (ESRC) Methods Programme framework (173)

Figure 3.1: A summary of ESRC guidance on conducting narrative synthesis in systematic reviews

3.2 Results[80]

The searches identified 43,906 potential studies, resulting in 10,749 studies following deduplication[81]. After screening by title, abstract and full text, 44 studies (29 Australian and 14 Canadian and 1 both countries) satisfied the eligibility criteria. Figure 3.2, a Prisma diagram (244) shows the process for study inclusion with reasons for exclusion. The most common reason for study exclusion at the full text stage was lack of disaggregated data by country of birth and age.

[80] Additional study characteristics and results are presented in Appendix G

[81] A updated review of the same databases using the same search terms throughout 2019 found only one more paper for inclusion 61. Stanaway FF, Blyth FM, Naganathan V, Le Couteur DG, Ribeiro R, Hirani V, et al. Mortality Paradox of Older Italian-Born Men in Australia: The Concord Health and Ageing in Men Project. Journal of Immigrant and Minority Health. 2019.

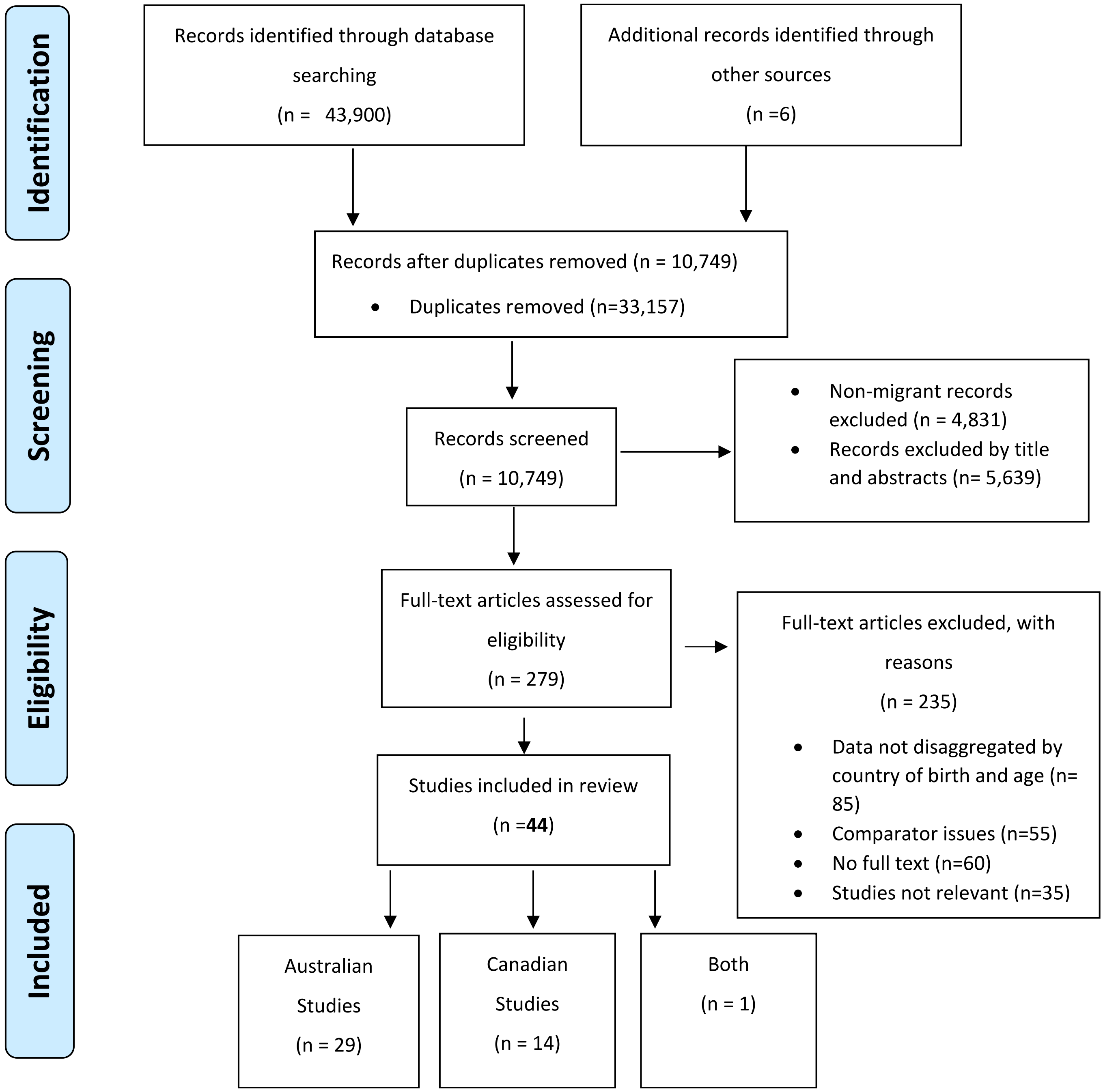


Figure 3.2: Prisma flow diagram of the selection of migrant health studies 1960-2020 (Canada and Australia)

3.2.1 Study characteristics and findings

3.2.1.1 Study design, setting and participants

Table 3.2 summarises key characteristics of studies included in the systematic review. Most of the studies included are cross-sectional, only one longitudinal study from Australia was included in this review. Roughly half of the studies included were nationally representative while others were regional (Sydney/New South Wales and Melbourne/South Australia in Australia; Alberta, British Columbia, Ontario, Quebec in Canada.) Studies were published after the year 2000 with almost half of the studies published between 2010 and 2020. These geographical settings are representative of areas settled by migrants to Canada (245) and Australia (246).

Data for the participants were mainly derived from general studies as there were few studies specifically relating to older migrants' health. There were even fewer studies focusing on participants aged 65 years or more.

Table 3.2: Summary of key characteristics of eligible studies

Study characteristics	N (Australia)	N (Canada)	Both[82]
Included studies	29	14	1
Study period publication			
Before 1990	3	2	
1991-1999	3	1	1
2000-2009	11	6	
2010-present	12	5	
Study design			
Cross-sectional	28	14	1
Longitudinal	1	0	
Self-reported data∞	11	6	
Nationally representative data∞	14	8	1
Older persons studies only∞	13	5	
Included studies by age group[83]			
45 years or older	16	4	
50 years or older	3	5	1
55 years or older	1	1	
60 years or older	2	1	
65 years or older	2	3	
70 years or older	4		
75 years or older	1		

∞ may not add up to study totals

[82] This indicates one study only 247. Kliewer E. Immigrant suicide in Australia, Canada, England and Wales, and the United States. Journal of the Australian Population Association. 1991;8(2):111-28. which included data for both Australia and Canada

[83] This indicates the age range in which data were extracted

3.2.1.2 Quality appraisal

Table 3.3 indicates the included studies were of low to medium quality. Studies were ranked as low quality as they largely used data that were derived from general migrant health studies, which included data for all age groups and lacked information on older persons socio-demographic characteristics[84]. The sample size for some of the studies were small and some were drawn from convenient samples. We also found study design and analysis factors that possibly biased the findings of some studies such as the use of different statistical significance levels to report the findings of a single analysis. The only data extractable for some of the studies were prevalence rates only, as the other data were not disaggregated by age. Some studies used data derived from different sources to compare the health of older migrants and the host population in a single analysis. Data for studies ranked as of medium quality were derived from databases that reported low response rates, others used broad descriptions of migrants. Some studies only assessed the health of one gender, while others could not determine if their older population included older indigenous Australians. However, compared to low quality studies some medium quality studies were migrant group specific, used a large sample size and included multiple health measures.

Overall, only a few of the included studies considered the migrating circumstances of older migrants. Silove, Steel (248) investigated the contribution of trauma and post-traumatic stress disorder to the overall prevalence of mental disorders in older Vietnamese individuals who had migrated as refugees compared to the Australian-born population. Though other studies included duration of residence measures, these measures were broadly defined to adequately inform on health differences. Gee, Kobayashi (20) & Aglipay, Colman (38) investigated the healthy migrant effect by assessing differences in the health status of recent migrants (migrated less than 10 years ago) and long-term migrants (migrated more than 10 years ago). These categories hardly considered the socio-demographic differences in heterogenous migrant groups and their migrating circumstances.

[84] Socio-demographic characteristics were indicated for the entire study population (not specifically for older persons) or they were not provided

Table 3.3: Summary for included studies quality appraisal

Study	Source of bias		
	Study limitations	**Study strengths**	**Ranking**
(Aglipay et al., 2013)	• Broad migrant categories	• Older persons study • Large sample size • Nationally representative	Medium
(Bareja et al 2014)	• Lacked basic data description (socio-demographic characteristics of participants) • No extractable data on older migrants by country of birth and only rates were derived for older individuals • Older adults sample size not stated • Used registry data	• Nationally representative	Low
(Barry et al., 2009)	• Lacked basic data description (socio-demographic characteristics of participants) • No extractable data on older migrants by country of birth and only rates were derived for older individuals • Older adults sample size not stated	• Nationally representative	Low
(Brock et al 2004)	• Small sample size • Not nationally representative as they were drawn from volunteer community elderly populations	• Older persons study	Low
(Burvill et al., 1973)	• Lacked basic data description (socio-demographic characteristics of participants) • No extractable data on older migrants by country of birth and only rates were derived for older individuals	• Nationally representative	Low
(Burvill, 1995)	• Lacked basic data description (socio-demographic characteristics of participants) • Old study • Used registry data	• Older persons study • Findings were country of birth specific • Nationally representative	Medium
(Camie et al 2001)	• Lacked basic data description (socio-demographic characteristics of participants) • No extractable data on older migrants by country of birth and only rates were derived for older individuals • Older adults sample size not stated	• Nationally representative	Low

Table 3.3 continued			
Study	**Source of bias**		
	Study limitations	**Study strengths**	**Ranking**
(Chen et al 1996)	• Lacked basic data description (socio-demographic characteristics of participants • Not an older persons' study • Broad categories • Old study • Used registry data	• Nationally representative • Used multiple health measures	Low
(Chen et al., 2013)	• Not migrant group specific • Not an older persons' study	• Relatively recent study • Nationally representative	Medium
(Dobson & Leeder, 1982)	• Data drawn from different census dates • Sample size for older adults unknown • Not nationally representative • Old study	• Moderately high sample size	Low
(Gee et al., 2004)	• Broad migrant categories	• Older persons study • Large sample size • Nationally representative	Medium
(Gray et al., 2007)	• Lacked basic data description of older migrants • Used registry data	• Nationally representative • Older persons study • Country of birth specific • Large sample size	Medium
(Greenaway et al. 2017)	• Not migrant group specific • Not nationally representative	• Large sample size • Relatively recent	Medium
(Guo et al., 2015)	• Low response	• Older adults' study • Adequate sample size • Used categories to assess migrant health	Medium
(Jensen et) al., 2012	• Lacked basic data description (socio-demographic characteristics of participants) • No extractable data on older migrants by country of birth and only rates were derived for older individuals • Older adults sample size not stated • Not nationally representative	• Covered a wide period	Low
(Kiropoulos et al., 2004)	• Small sample size • Convenient sample size • Not nationally representative • Used different significant levels	• Older persons' study • Migrant group specific	Low

Table 3.3 continued			
Study	**Source of bias**		
	Study limitations	**Study strengths**	**Ranking**
(Kiropoulos et al., 2012)	• Small sample size • Convenient sample size • Not nationally representative	• Older persons' study • Migrant group specific • Relatively recent	Low
(Kliewer and Ward 1988)	• Lacked basic data description (socio-demographic characteristics of participants) • No extractable data on older migrants by country of birth and only rates were derived for older individuals • Old study • Used registry data	• Nationally representative	Low
(Kliewer, 1991)	• Lacked basic data description (socio-demographic characteristics of participants) • No extractable data on older migrants by country of birth and only rates were derived for older individuals • Old study • Used registry data	• Nationally representative	Low
(Li et al., 2004)	• Lacked basic data description (socio-demographic characteristics of participants) • No extractable data on older migrants by country of birth and only rates were derived for older individuals • Older adults sample size not stated	• Nationally representative	Low
(Lin et al., 2016)	• Small sample size • Convenient sample • Not nationally representative	• Migrant specific study • Older persons study	Low
(Long et al., 2002)	• Lacked basic data description (socio-demographic characteristics of participants) • Old study • Not nationally representative	• Older persons study	Low
(Malenfant, 2004)	• Lacked basic data description of older migrants • Not an older persons' study • Not migrant group specific	• Nationally representative	Low

Table 3.3 continued			
Study	**Source of bias**		
	Study limitations	**Study strengths**	**Ranking**
(McCallum & Shadbolt, 1989)	• Lacked basic data description of older migrants • Data were derived from different datasets; Ageing and the Family Project survey and Ethnic Aged survey • Used broad migrants' categories to categorise migrants • Not nationally representative • Old study	• Tried to use categories to assess migrants' health • Large sample size • Included different health measures	Medium
(Minami et al., 1993)	• Not nationally representative • Old study • Lacked basic data description of older migrants	• Migrant group specific	Low
(Naja et al., 2007)	• Not migrant group specific • Not nationally representative	• Large sample size • Older persons study	Medium
(Neutel et al., 1989)	• Lacked basic data description (socio-demographic characteristics of participants) • No extractable data on older migrants by country of birth and only rates were derived for older individuals • Older adults sample size not stated • Old study	• Nationally representative	Low
(Newbold & Danforth, 2003)	• Not migrant group specific • Not an older persons' study	• Nationally representative • Used diverse health measures	Medium
(Newbold, K. B. & Filice, J. K. 2006)	• Not migrant group specific	• Nationally representative • Older persons study • Used diverse health measures	Medium
(Prus et al., 2010)	• Used broad migrant categories	• Older persons' study • Nationally representative • Large sample size	Medium
(Roche et al., 2006)	• Lacked basic data description (socio-demographic characteristics of participants) • No extractable data on older migrants by country of birth and only rates were derived for older individuals • Older adults sample size not stated	• Nationally representative	Low

Table 3.3 continued

Study	Source of bias		
	Study limitations	Study strengths	Ranking
(Roche et al., 2007)	• Lacked basic data description (socio-demographic characteristics of participants) • No extractable data on older migrants by country of birth and only rates were derived for older individuals • Older adults sample size not stated	• Nationally representative	Low
(Roche et al., 2008)	• Lacked basic data description (socio-demographic characteristics of participants) • No extractable data on older migrants by country of birth and only rates were derived for older individuals • Older adults sample size not stated	• Nationally representative	Low
(Samaan et al., 2003)	• Lacked basic data description (socio-demographic characteristics of participants) • No extractable data on older migrants by country of birth and only rates were derived for older individuals • Older adults sample size not stated	• Nationally representative	Low
(Silove et al., 2007)	• Small sample size • Not nationally representative	• Migrant group specific	Low
(Stanaway et al., 2010	• Not nationally representative • Gender specific	• Relatively large sample size • Migrant group specific • Older persons study • Relatively recent	Medium
(Stanaway et al., 2011a)	• Not nationally representative • Gender specific	• Relatively large sample size • Migrant group specific • Older persons study • Relatively recent	Medium
(Stanaway et al., 2011b)	• Not nationally representative • Gender specific	• Relatively large sample size • Migrant group specific • Older persons study • Relatively recent	Medium
(Stanaway et al., 2019)	• Not nationally representative • Gender specific	• Relatively large sample size • Migrant group specific • Older persons study • Relatively recent • Longitudinal study	Medium

Table 3.3 continued			
Study	**Source of bias**		
	Study limitations	**Study strengths**	**Ranking**
(Stewart et al., 2004)	• Australian-born population possibly included some indigenous population	• Nationally representative • Large sample size • Migrant group specific • Relatively recent • Study covered a wide period of time (1993-2001)	Medium
(Straiton et al., 2014)	• Not nationally representative • Used broad duration of residence categories	• Large sample size • Relatively recent study • Older persons study	Medium
(Toms et al., 2015)	• Lacked basic data description (socio-demographic characteristics of participants) • No extractable data on older migrants by country of birth and only rates were derived for older individuals • Older adults sample size not stated	• Nationally representative	Low
(Toms et al., 2017)	• Lacked basic data description (socio-demographic characteristics of participants) • No extractable data on older migrants by country of birth and only rates were derived for older individuals • Older adults sample size not stated	• Nationally representative	Low
(Tran et al., 2014)	• Low response rate • Not nationally representative	• Migrant group specific • Older persons study	Medium

3.2.1.3 Study measures

Table 3.4 shows the health measures, number of studies for specific health measures and whether migrants reported better (+), worse (-), mixed (+/-) or similar health relative to the host population in Australia and Canada. It also indicates; quality of studies included, migrant group specific studies[85] and whether data extracted were adjusted (to control for other health determinants), unadjusted or rates.

Relative to the Australian-born population, migrants had lower rates for cancer (breast, prostate and colon), CVD (self-reported heart disease, stroke or thrombosis), falls, overall mortality, mortality (malignant melanoma & circulatory disease and diabetes) and suicide. They had higher rates than the Australian-born population for psychosocial factors for coronary heart disease (depression, anxiety and physical health status), mental health, tuberculosis and vitamin D deficiency. Australian migrants had varying (mixed) health outcomes for the end-stage renal disease, mortality (brain cancer mortality), mental health and suicide as a result of factors such as age, sex and country of birth. There were no differences in the rates for back pain and the mental health (healthy migrant effect[86]) between migrants and the Australian-born population.

Meanwhile, Canadian migrants reported lower overall mortality, survival probabilities, dependency and disability rates and life expectancy than the Canadian-born population. They reported higher rates than the Canadian-born population for fall injury in association with mental health, hepatitis C and tuberculosis. Canadian migrants had varying (mixed) health outcomes for the healthy migrant effect (self-rated health, health utility Index and activity restriction), self-rated health, cognitive impairment, suicide, *H. pylori* and mental health as a result of factors such as age, sex and country of birth.

Table 3.4 highlights the limitations of vote counting specifically for migrant health. It is not possible to determine the full extent of differences in older migrants' health as Table 3.4 does not account for country of birth, age, sex and other factors. However, it has some advantages as well, to begin with it indicates the complexity of trying to interpret older

[85] Study assessing the health of a specific migrant group relative to the Australian born population
[86] They assessed for differences in mental health for recent migrants and long-term migrants relative to the host population

migrants' health using different health measures for specific and overall migrant populations. It also highlights the health measures commonly measured in the included studies for the two countries. Further, it highlighted the quality of studies and to an extent it indicated heterogeneity of migrant studies (country of birth and the different health measures) and the complex task of summarising migrant health.

Table 3.4: Health outcomes from derived studies for Canada and Australia

Health Measure	No of studies		Outcome							
	Australia	Canada	Australia				Canada			
			+	-	+/-	Similar/no differences	+	-	+/-	Similar/ no differences
Back Pain	**1** Stanaway, Blyth (249)					✓**				
Cancer (Breast, prostate and colon)	**1** Minami, Staples (250)		✓*							
Comorbidity	**1** (Psychosocial factors for coronary heart disease; depression, anxiety and physical health status) Kiropoulos, Meredith (251)			✓*						
		1 (Fall injury in association with mental health) Chen, Mo (252)						✓**		
CVD	**1** Guo, Lucas (45)		✓**							

Table 3.4 continued										
Health Measure	**No of studies**		**Outcome**							
	Australia	**Canada**	**Australia**				**Canada**			
			+	**-**	**+/-**	**Similar/no differences**	**+**	**-**	**+/-**	**Similar/ no differences**
Different health measures		**1** (Healthy migrant effect (Self-rated health, health Utility Index and activity restriction)) Gee, Kobayashi (20)							✓**	
		1 (Self-rated health and cognitive impairment) Prus, Tfaily (27)							✓**	
	1 (Self-rated health and mental health) McCallum and Shadbolt (253)				✓**					

Table 3.4 continued										
Health Measure	**No of studies**		**Outcome**							
	Australia	**Canada**	**Australia**				**Canada**			
			+	**-**	**+/-**	**Similar/no differences**	**+**	**-**	**+/-**	**Similar/ no differences**
		1 (Mortality rates, survival probabilities, dependency and disability rates and life expectancy) Chen, Wilkins (42)						✓*		
		1 (Health Utility Index Mark 3 (HUI3) and self-assessed health status) Newbold and Danforth (5)							✓**	
		1 (Self-assessed health, Health Utilities Index (Mark 3) (HUI3) and Chronic conditions) Newbold and Filice (67)							✓**	

Table 3.4 continued										
Health Measure	**No of studies**		**Outcome**							
	Australia	**Canada**	**Australia**				**Canada**			
			+	**-**	**+/-**	**Similar/no differences**	**+**	**-**	**+/-**	**Similar/ no differences**
End stage renal disease	**1** Stewart, McCredie (254)				✓**					
Falls	**1** Stanaway, Cumming (255)		✓**							
Healthy migrant effect	**1** (mental health) Straiton, Grant (26)	**1** (mental health) Aglipay, Colman (38)				✓**				✓**
Helicobacter pylori ***(H. pylori)***		**1** Naja, Kreiger (256)							✓**	
Hepatitis C (HCV)		**1** Greenaway, Azoulay (257)						✓**		
Mental health	**1** Kiropoulos, Klimidis (63)				✓*					
	1 Lin, Bryant (258)				✓*					
	1 Stanaway, Cumming (62)			✓**						

Table 3.4 continued										
Health Measure	**No of studies**		**Outcome**							
	Australia	**Canada**	**Australia**				**Canada**			
			+	**-**	**+/-**	**Similar/no differences**	**+**	**-**	**+/-**	**Similar/ no differences**
	1 Silove, Steel (248)				✓*					
Mortality	**1** (Malignant melanoma Dobson and Leeder (259))		✓*							
		1 (Brain tumour mortality Neutel, Quinn (260))							✓*	
	1(Circulatory disease and diabetes) Gray, Harding (49)		✓**							
	1 (Overall mortality Stanaway, Blyth (61))		✓**							
Suicide	**1** Burvill (261)	**1** Kliewer and Ward (93)			✓**				✓*	
	1 Kliewer (247)	**1** Kliewer (247)[87]			✓*				✓*	
	1 Burvill, McCall (262)	**1** Malenfant (263)	✓*						✓*	

[87] Study investigate suicide rates in both Australia and Canada

Table 3.4 continued										
Health Measure	**No of studies**		**Outcome**							
	Australia	**Canada**	**Australia**				**Canada**			
			+	**-**	**+/-**	**Similar/no differences**	**+**	**-**	**+/-**	**Similar/ no differences**
Tuberculosis (TB)[88]	**10**			✓*				✓*		
Type 2 Diabetes	**1** Tran, Jorm (264)			✓**						
Vitamin D deficiency	**1** (Brock, Wilkinson (265)			✓*						

study participants were men, one migrant group was assessed as opposed to different migrant populations, ✓ both adjusted and unadjusted effects, ✓ rates (prevalence and incident rates) and ✓ adjusted effects and ✓ unadjusted effects, * low quality, ** medium quality, *** high quality and ** longitudinal study

[88] See Tables 3.5 and 3.7

3.2.2 Australian cross-sectional and longitudinal findings

The health status of older migrants relative to the Australian-born varied depending on health measures, region of birth[89], age, sex and language proficiency (Tables 3.5 and 3.6). The migrant population in the older studies or those using historical datasets consisted mainly of Anglo-Celtic, other Northern, Southern and Eastern European migrants. In recent studies it included those from Asia and other countries.

Migrants were mainly categorised by their country of birth (i.e., UK, Germany), English proficiency (i.e., English speaking verses non-English speaking), by older established migrant populations (British migrants verses non-British migrants) and using general terms such as “immigrants”, “overseas born”. The host were defined using terms such as “host population”, “non-indigenous Australians” and “mainstream Australians”.

3.2.2.1 Mortality

Migrants had a lower risk of dying from malignant melanoma and circulatory disease and diabetes relative to the Australian-born. For the latter the advantage was more evident in migrants from New Zealand, UK/Ireland, Italy and South-East Asia. The sole longitudinal study provides additional evidence for the survival advantage as older Italian men had a lower mortality than the Australian-born. The participants in this study were followed from their baseline for a mean of 7.5 years for Australian-born men and 8.0 years for Italian-born men.

Other than age, causative agent, sex and country of birth, mortality rates were also influenced by duration of residence. For example, the risk of dying from malignant and circulatory disease and diabetes for British migrants increased over time.

3.2.2.2 Other health advantages and disadvantages

Migrants had a lower risk of CVD, cancer (breast, colon and prostrate) and a lower incidence from falls. Some health advantages were more evident in migrants from specific geographical areas. For example, the prevalence of CVD was particularly lower for migrants from North-East Asia (45).

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[89] Country of birth or broader geographical area of birth

Migrants had a higher risk of TB and vitamin D deficiency, psychological disorders, type 2 diabetes and end stage renal disease. They were also more likely to commit suicide, die from motor vehicle accidents and other forms of violent deaths. Though migrants had a generally higher risk of suicide, some migrants from Greece, Malta, India and England and Wales had a lower risk of suicide relative to other migrants and the Australian-born population (261).

Variations existed by self-rated health among different migrant groups. While British migrants reported better self-rated health compared to the Australian-born, non-British migrants especially those with poor English proficiency were more likely to report poor health relative to the Australian-born. British migrants and the Australian-born population had further health similarities including; better mental health and lower ESRD rates. However, they had a lower risk of suicide, melanoma, circulatory disease and diabetes mortality relative to the Australian-born.

Other studies found no apparent differences between migrants and the Australian-born in the health measures; back pain and in some measures of depression and anxiety.

3.2.2.3 Healthy migrant effect

We only found one study examining for the healthy migrant effect in older migrants, which indicated no evidence for the healthy migrant effect in the mental health of recent older migrants compared to the Australian-born (26).

Table 3.5: Characteristics and key findings of included cross-sectional studies (Australia)

Study	Sample	Methods	Results
Communicable and respiratory diseases			
(Camie, Christensen et al., 2001)	**Migrants:** Vietnam, Philippines, India, China, Indonesia, Hong Kong, UK and Ireland, Sri Lanka, Greece, Italy, Former Yugoslavia, New Zealand, Turkey, Malaysia, Poland, Fiji, Singapore, Germany and others **Comparator:** non-indigenous Australians **Total study population:** 923 **Total older population:** Not stated	Crude rates for tuberculosis (TB) in 1998 were calculated using data derived from the National Notifiable Disease Surveillance System (NNDSS) and the Australian Bureau of Statistics for participants aged 45 years and older in Australia.	Migrants had a higher risk of TB relative to the Australian-born population which increased with age.
(Samaan, Roche et al., 2003)	**Migrants**: India, Vietnam, Philippines, China, Indonesia, Papua New Guinea, Somalia, Thailand, Hong Kong, Korea, Malaysia, United Kingdom, Cambodia, Sri Lanka and others **Comparator:** non-indigenous Australians	Crude rates for TB in 2002 were calculated using data derived from the NNDSS and the Australian Bureau of Statistics for participants aged 45 years and older in Australia.	Migrants had a higher risk of TB relative to the Australian-born population which increased with age.

Table 3.5 continued

Study	Sample	Methods	Results
Communicable and respiratory diseases			
	Total study population: 1,028 **Total older population**: Not stated		
(Li, Roche et al., 2004)	**Migrants:** India, Vietnam, Philippines, China, Indonesia, Papua New Guinea, Somalia, Thailand, Hong Kong, Korea, Malaysia, United Kingdom, Cambodia, Sri Lanka and others **Comparator**: non-indigenous Australians **Total study population:** 1,028 **Total older population:** Not stated	TB incidence in 2003 was calculated using data derived from the NNDSS for participants aged 45 years or more in Australia.	Migrants had a higher risk of TB relative to the Australian-born population which increased with age.

Table 3.5 continued			
Study	**Sample**	**Methods**	**Results**
Communicable and respiratory diseases			
(Roche, Antic et al., 2006)	**Migrants**: India, Vietnam, Philippines, China, Sudan, Indonesia, Hong Kong (SAR of China), Somalia, Papua New Guinea, Ethiopia, Malaysia, Thailand, England and New Zealand **Comparator:** non-indigenous Australians **Total study population:** 1,076 **Total older population:** Not stated	TB epidemiology in 2004 was calculated using data derived from the NNDSS for participants aged 45 or more years in Australia.	Migrants had a higher risk of TB relative to the Australian-born population which increased with age.
(Roche, Bastian et al., 2007)	**Migrants**: India, Vietnam, Philippines, China, Indonesia, Sudan, Papua New Guinea, Somalia, Cambodia, Bangladesh, Pakistan, Hong Kong SAR, Greece, Thailand and Ethiopia **Comparator:** non-indigenous Australians **Total study population**: 1,072 **Total older population**: Not stated	TB epidemiology in 2005 was calculated using data derived from the NNDSS for participants aged 45 or more years in Australia.	Migrants had a higher risk of TB relative to the Australian-born population which increased with age.

Table 3.5 continued

Study	Sample	Methods	Results
Communicable and respiratory diseases			
(Roche, Krause et al., 2008)	**Migrants:** Somalia, Bangladesh, Ethiopia, Papua New Guinea, Indonesia, India, Vietnam, Pakistan, Cambodia, Zimbabwe, Philippines, Thailand, China, Sri Lanka, South Korea, United Kingdom and others **Comparator:** non-indigenous Australians **Total study population:** 1,201 **Total older population:** Not stated	TB epidemiology in 2006 was calculated using data derived from the NNDSS for participants aged 45 or more years in Australia.	Migrants had a higher risk of TB relative to the Australian-born population which increased with age.
(Barry, Konstantinos et al., 2009)	**Migrants:** Nepal, Somalia, Eritrea, Sierra Leone, Libya, Ethiopia, Papua New Guinea, Myanmar, Sudan, India, Liberia, Bangladesh, Albania, Pakistan, Indonesia, Nigeria, Kenya and others **Comparator:** non-indigenous Australians **Total study population**: 1,111 **Total older population:** 39.3%	Crude rates for TB in 2007 were calculated for data derived from the NNDSS and the Australian Bureau of Statistics for participants aged 45 years or more in Australia.	Migrants had a higher risk of TB relative to the Australian-born population which increased with age.

Table 3.5 continued			
Study	**Sample**	**Methods**	**Results**
Communicable and respiratory diseases			
(Bareja, Waring et al., 2014)	**Migrants:** India, Vietnam, Philippines, China, Nepal, Papua New Guinea, Indonesia, Pakistan, Malaysia, Sri Lanka, Cambodia and others **Comparator:** non-indigenous Australians **Total study population:** 1,385 **Total older population:** Not stated	Crude rates for TB 2011 were calculated from data derived for the NNDSS and the Australian Bureau of Statistics for participants aged 45 years or more in Australia.	Migrants had a higher risk of TB relative to the Australian-born population which increased with age.
(Toms et al., 2015)	**Migrants:** India, Vietnam, Philippines, China, Nepal, Papua New Guinea, Indonesia, Pakistan, Malaysia, Sri Lanka, Cambodia and others **Comparator:** non-indigenous Australians **Total study population:** 1,317 in 2012 and 1,263 in 2013 **Total older population:** Not stated	The incidence rates for TB in 2012 & 2013 were calculated for data derived from the NNDSS and the Australian Bureau of Statistics for participants aged 45 years or more in Australia.	Migrants had a higher risk of TB relative to the Australian-born population which increased with age.

Table 3.5 continued

Study	Sample	Methods	Results
Communicable and respiratory diseases			
(Toms et al., 2017)	**Migrants:** India, Vietnam, Philippines, China, Nepal, Papua New Guinea, Indonesia, Pakistan, Malaysia, Sri Lanka, Cambodia and others **Comparator:** non-indigenous Australians **Total study population**: 1,339 **Total older population:** Not stated	The incidence rates for TB in 2014 were calculated for data derived from NNDSS and the Australian Bureau of Statistics for participants aged 45 years or more in Australia.	Migrants had a higher risk of TB relative to the Australian-born population which increased with age.
(Brock, Wilkinson et al., 2004)	**Migrants:** Northern European, Vietnamese and Middle Eastern **Comparator**: Australian-born population **Total study population:** 457 **Total older population:** 100%	Odds for vitamin D deficiency were calculated using data collected from elderly individuals living in assisted care and elderly frail-aged volunteer individuals from the community aged 75 years or older living in Sydney.	Middle Eastern elderly were 3.5 (1.4–9.0) and Vietnamese 2.6 (1.1–6.9) times more likely to have marginal vitamin D status (<37 nmol/L) than their Australian-born counterparts. Overall, vitamin D deficiency (VDD) was more likely in the migrant elderly than in the Australian-born.

Table 3.5 continued			
Study	**Sample**	**Methods**	**Results**
Blood/metabolic diseases			
(Tran, Jorm et al., 2014)	**Migrants:** Vietnamese **Comparator:** Host Australians **Total study population:** 197,653 **Total older population:** 100%	The prevalence of Type 2 Diabetes in 2006 was calculated using data derived from the 45 and Up study for participants aged 45 years or more in New South Wales.	Vietnamese migrants had double the prevalence of T2D relative to the Australian-born.
(Guo, Lucas et al., 2015)	**Migrants:** Europe, North-East Asia, South-East Asia and others **Comparator**: Australian-born population **Total study population:** 263,356 **Total older population:** 100%	The adjusted prevalence ratio for self-reported CVD (heart disease, stroke or thrombosis) was calculated for the years 2006–2008 using data from the 45 and Up Study, for participants aged 45 years or more in New South Wales.	CVD prevalence was significantly lower for all migrant populations relative to the Australian-born, more so Asian migrants. Relative to the Australian-born the adjusted prevalence ratio for CVD for migrants from North-East Asia 0.61(0.54-0.68), South-East Asia 0.76(0.69-0.83) and Europe 0.92(0.90-0.94).

Table 3.5 continued

Study	Sample	Methods	Results
Mortality			
(Gray, Harding et al., 2007)	**Migrants:** New Zealand, United Kingdom (UK)/Ireland, Germany, Greece, Italy, East Asia (China, Singapore, Malaysia, Vietnam) and South Asia (India, Sri Lanka) **Comparator:** Australian-born population **Total study population:** 21,587 **Total older population:** 100%	The relative risk for circulatory disease and diabetes mortality for the years 1998–2002 and from 2001 were calculated using data derived from Australian Bureau of Statistics for participants aged 45–64 years in Australia.	Relative to the Australian-born population the relative risk of circulatory disease and diabetes mortality was lower for migrants born in New Zealand, UK and Ireland, Italy and South-East Asia. For Greek and German migrants' mortality was lower for participants aged 55-64 years only.
(Dobson and Leeder, 1982)	**Migrants:** New Zealand, United Kingdom and Eire, Germany, Italy, Netherlands, Poland, other European countries and elsewhere **Comparator:** Australian-born population **Total study population:** 2,243 **Total older population**: not stated	Mortality rate for melanoma between 1968-77 was calculated using data derived from the Australian Bureau of Statistics for participants aged 60 years or more in Australia.	Mortality from malignant melanoma was much lower in migrants relative to the Australian-born. The mortality rates for migrants increased with duration of residence in Australia.

Table 3.5 continued			
Study	**Sample**	**Methods**	**Results**
Suicide			
(Burvill, McCall et al., 1973)	**Migrants:** Hungary, Austria, Poland, Scotland, All Ireland, Germany, New Zealand, Greece, Wales, England, Netherlands, Scandinavia, Italy and Malta **Comparator:** Australian-born population **Total study population:** Suicide 7,499, motor vehicle 14,937 and other forms of death 15,202 **Total older population:** not stated	Age specific rates for mortality from all forms of violent death between 1962-1968 were calculated using data collected from the Commonwealth Bureau of Census and Statistics for participants aged 50 years or more in Australia.	Age-sex-specific rates for all forms of death (suicides, motor vehicle accidents, all other violent deaths) were higher in migrants than in the Australian-born.
(Kliewer, 1991)	**Migrants:** Not stated **Comparator:** Australian-born population **Total study population:** 3,274 Australian migrants **Total older population:** not stated	Age specific suicide rates were calculated for the years 1962-71 using data derived from the Australian Bureau of Statistics for participants aged 45 years or more in Australia.	Migrants had higher age specific suicide rates apart from male migrants aged 45-50 years. Though, males had a greater risk of suicide the increase in risk was higher in female migrants.

Table 3.5 continued

Study	Sample	Methods	Results
Suicide			
(Burvill, 1995)	**Migrants:** Africa, America, Asia, British Isles, Europe, Middle East and Oceania **Comparator:** Australian-born population **Total study population:** 3,240 **Total older population:** 100%	Suicide rates for the years 1979 to 1990 were calculated using data derived from the Australia Bureau of Statistics for participants aged 65 years or more in Australia	In most cases suicide rates were higher in migrants than in the Australian-born. Relative to the Australian-born population migrants from Greece, Malta, India and England and Wales had lower rates, those from New Zealand, Northern Ireland, United States, Austria, Czechoslovakia, Germany, Hungary, Italy, Poland, Scandinavia, USSR, Yugoslavia, China, Turkey and South Africa reported higher rates. However, taking individual country of birth into consideration the findings varied by sex.
Cancer			
(Minami, Staples et al., 1993)	**Migrants:** Italians **Comparator:** Australian-born **Total study population:** 17,370 **Total older population**: not stated	Cancer incidence rates (1982 to 1987) were calculated using data derived from the Victorian Cancer Registry for participants aged 45 years or more in Australia.	Migrants had a lower risk for cancer relative to the Australian-born population. Specifically, migrants had lower rates for colon cancer, male migrants had lower rates for prostate cancer while females had lower rates for breast cancer relative to the Australian-born population.

Table 3.5 continued

Study	Sample	Methods	Results
Mental health			
(McCallum and Shadbolt, 1989)	**Migrants:** British, non-British migrants with good English and non-British migrants with poor English **Comparator:** Mainstream Australians **Total study population:** 1,376 **Total older population:** 100%	Psychological distress was investigated using self-reported data derived from the 1981 Ageing and the Family Project survey and the 1984 Ethnic Aged survey for participants aged 60 years or more in Sydney and Melbourne.	Non-British migrants with poor English reported higher psychological distress relative to the Australian-born, British migrants and non-British migrants with good English.
(Kiropoulos, Klimidis et al., 2004)	**Migrants**: Greek migrants **Comparator:** Anglo-Australians **Total study population:** 292 **Total older population:** 100%	Odds for depression and anxiety were calculated using self-reported measures for participants aged over 50 years recruited from various social clubs in Melbourne.	There were no significant differences in depression scores between Greek migrants and the Australian-born, but the Greek migrants reported higher levels of anxiety compared to the Australian-born.

Table 3.5 continued			
Study	**Sample**	**Methods**	**Results**
Mental health			
(Kiropoulos, Meredith et al., 2012)	**Migrants**: Greek migrants **Comparator:** Anglo-Australians **Total study population:** 123 **Total older population:** 100%	Self-reported psychosocial risk factors for coronary heart disease (CHD) were measured in outpatients aged 50 years or more in two coronary care units in major hospitals in Melbourne in 2009 and 2011.	Greek migrants reported significantly higher scores for depression and anxiety. Overall, migrants had a greater incidence of psychosocial risk factors for CHD relative to the Australian-born population.
(Lin, Bryant et al., 2016)	**Migrants**: Chinese **Comparator:** Australian-born **Total study population:** 119 **Total older population:** 100%	Depression and anxiety scores were calculated using self-reported data collected from a convenient sample for participants aged 65 years or more living in Melbourne.	There were no significant differences in the median scores of depression and anxiety. When adjusting for socio-demographic factors, Chinese migrants were less likely to report anxiety relative to the Australian-born, for depression the odds remained statistically non-significant.

Table 3.5 continued

Study	Sample	Methods	Results
Mental health			
(Silove, Steel et al., 2007)	**Migrants**: Vietnamese refugees **Comparator:** Australian-born (non-indigenous population) **Total study population:** 9,122 **Total older population:** 12.1% (of 1,161 Vietnamese) and 26.1% (of 7,961 Australian born)	The prevalence for mental health was calculated from self-reported data collected by study and derived from the ABS mental health survey for participants aged 55 years or more in New South Wales.	The burden for mental illness was slightly higher in older Vietnamese refugees relative to the Australian population, 11 years after resettlement. Trauma accounted for a higher mental illness and PTSD rates among Vietnamese. PTSD made a substantial contribution to the overall burden of common mental illness, being present in 62.1% of those with any condition (relative to 15.2% for Australians).
(Stanaway, Cumming et al., 2010)	**Migrants**: Italian men **Comparator:** Australian-born men **Total study population**: 1,184 **Total older population:** 100%	The relative risks & odds ratios for self-reported depression scores were calculated using data from the Concord Health and Ageing in Men Project (CHAMP), for participants aged 70 years or more in Sydney.	Italian migrants were more likely to report depressive symptoms relative to the Australian-born.

Table 3.5 continued			
Study	**Sample**	**Methods**	**Results**
Self-rated health			
(McCallum and Shadbolt, 1989)	**Migrants:** British, non-British migrants with good English and non-British migrants with poor English **Comparator:** Mainstream Australians **Total study population:** 1,376 **Total older population:** 100%	The self-reported health status was investigated using data derived from the 1981 Ageing and the Family Project survey and the 1984 Ethnic Aged survey, for participants aged 60 years or more living in Sydney and Melbourne.	Australian-born and British migrants reported better health than non-British migrants, with non-British migrants with poor English reporting their health to be the worst.
Healthy migrant effect			
(Straiton, Grant et al., 2014)	**Migrants:** English speaking and non-English speaking who migrated ≤20 years or > 20 years **Comparator:** Australian-born **Total study population:** 2,605 **Total older population**: not stated	The differences in self-reported and diagnosed mental health in 2004 and 2006 were calculated using data derived from the North-West Adelaide Health Study, for participants aged 45-64 years in South Australia.	The study found no differences in mental health between migrants and the Australian-born.

Table 3.5 continued			
Study	**Sample**	**Methods**	**Results**
Falls and other conditions			
(Stanaway, Blyth et al., 2011)	**Migrants:** Italian men **Comparator:** Australian born men **Total study population:** 1,184 **Total older population:** 100%	The prevalence for back pain for 25 January 2005 to 4 June 2007 was calculated using self-reported data from the Concord Health and Ageing in Men Project (CHAMP), for participants aged 70 or more years in Sydney.	There were no statistically significant differences in the 12-month prevalence of back pain between Italian migrants and Australian-born men.
(Stewart, McCredie et al., 2004)	**Migrants:** British Isles, Southern Europe, Rest of Europe, Middle East, other Arabic nations, East, South-East Asia, Indian subcontinent, Pacific Island nations and Polynesian island nations **Comparator:** Non-indigenous Australians **Total study population:** 12,333 **Total older population:** 84.8%	The incidence rates of treated End Stage Renal Disease (ESRD) for the years 1993–2001 were calculated using data derived from the ANZDATA dataset & ABS, for participants aged 45 or more years.	Migrants born in Southern Europe, the Middle East, Indian subcontinent, East, South-East Asia and the Pacific Island nations had higher rates treated ESRD than their counterparts from the British Isles or the “rest of Europe” and the Australian-born population.

Table 3.5 continued

Study	Sample	Methods	Results
Falls and other conditions			
(Stanaway, Cumming et al., 2011a)	**Migrants:** Italian men **Comparator:** Australian-born men **Total study population:** 1,184 **Total older population:** 100%	The relative risks & incidence rate ratios (IRR) for falls, January 2005 to 4 June 2008, were calculated using self-reported data from the CHAMP study, for participants aged 70 or more years in Sydney, Australia.	Older male Italian-born migrants had a lower incidence of falls and a lower risk of having two or more falls relative to Australian-born men.

Table 3.6: Characteristics and key findings of included longitudinal studies (Australia)

Study	Participants	Methodology	Results
Mortality			
(Stanaway, Blyth et al., 2019)	**Migrants:** Italian men **Comparator:** Australian-born men **Total study population:** 1,183 **Total older population**: 100%	Hazard ratios for mortality were calculated for the period between January 2005 and June 2007 using data derived from the Concord Health and Ageing in Men Project (CHAMP) & NSW Registry of Births, Deaths and Marriages, for male participants aged 70 years or more in Sydney, Australia.	Italian migrants had a lower mortality relative to the Australian born, unadjusted hazard ratio (HR) = 0.67, 95% confidence interval (CI) 0.53–0.84). However, after adjusting for age, country of birth was no longer predictive of lower mortality (HR = 0.82, 95% CI 0.64–1.05). Further, after adjusting for source of income, being born in Italy was again associated with lower mortality (HR=0.71, 95% CI 0.55–0.92). In the final multivariate model adjusted for all predictors[90], being born in Italy was associated with a 25% lower mortality rate (HR=0.75, 95% CI 0.57–0.98).

[90] Includes adjustment for age, income source, social interactions score, cancer history, ADL (activities of daily living) disability, IADL (instrumental activities of daily living) disability, polypharmacy, walking speed, alcohol consumption, smoking history, body mass index and an interaction term of age and BMI

3.2.3 Canada cross-sectional findings

Table 3.7 highlights variations in the health status of migrants and the Canadian-born population. Migrant composition in the older studies mainly comprised of individuals of European descent while recent studies included migrants from Asia and other regions.

Migrants were categorised by broad racial/ethnic groups such as European/Non-European, Whites/non-Whites and visible minorities. They were also categorised by duration of residence, binary nativity status, region or specific country of birth. The comparator was categorised as “non-immigrants”, “host Whites” or “Canadian-born”.

3.2.3.1 Mortality

Though migrants had an overall lower mortality relative to their Canadian-born counterparts. The cause specific mortality rates varied by region/country of birth, age and sex. The risk of brain cancer mortality for migrants increased with age relative to the Canadian-born population i.e. female migrants from the USA and UK in the relatively younger age groups were less likely to die from brain cancer but their older counterparts had a greater risk of dying relative to the Canadian-born population, while for male migrants the reverse was true.

3.2.3.2 Other health advantages and disadvantages

Canadian migrants experienced more years free of disability and dependency relative to the Canadian-born population. Older migrants had higher rates of TB, suicide, *H. pylori*, hepatitis C, cognitive impairment, poor mental health, falls (associated with mental disorders) and poor self-reported health. Female migrants had a greater risk of suicide relative to their male counterparts, while male migrants had a higher risk for *H. pylori* relative to their female counterparts.

Using binary nativity status there were no variations in the health of older migrants and the Canadian-born population. The “no differences” were also observed for foreign born Whites and non-Whites aged 45-64 years and foreign-born Whites aged over 65 years and their White Canadian-born counterparts. However, foreign-born non-Whites aged over 65 years were significantly more likely to report poor health relative to the Canadian-born Whites.

Region of birth was significantly associated with health disparities among migrants. The risk of hepatitis C was higher for migrants from Sub-Saharan Africa, Asia and Eastern Europe relative to their counterparts from other regions and the Canadian-born population.

3.2.3.3 Healthy migrant effect

The healthy migrant effect was not apparent in older migrants' mental health. A health advantage for functional and self-rated health was seen in recent middle-age migrants (45-64 years) but not recent older migrants (65 years or more) who reported poorer health than their longer-term counterparts and the Canadian-born.

Table 3.7: Characteristics and key findings of included cross-sectional studies (Canada)

Study	Sample	Methodology	Results
Communicable and respiratory diseases			
(Jensen, Lau et al., 2012)	**Migrants:** Africa, Asia, Latin America and the Caribbean, Middle Eastern Crescent, Former Socialist Economies of Europe and Established Market Economies **Comparator:** Canadian-born **Total study population:** 1,576 in 1989–1998 and 1,295 in 1999–2008 **Total older population:** not stated	TB incidence rates for the years 1989-1998 and 1999-2008, were calculated using data derived from the Canadian Institute of Health Research and First Nations and Inuit Health Branch, for participants aged 65 years or more in Alberta.	Migrants had a higher TB incidence relative to the Canadian-born population.
(Long, Sutherland et al., 2002)	**Migrants:** Africa, Asia, Latin America and the Caribbean, Middle Eastern Crescent, Former Socialist Economies of Europe and Established Market Economies **Comparator:** Canadian-born **Total study population:** 1,608 **Total older population**: 100%	TB incidence rates for the years 1989-1998, were calculated using data derived from the Alberta Health and Wellness for participants aged ≥65 years in Alberta.	Migrants were at an increased risk of TB compared to the Canadian-born population.

Table 3.7 continued

Study	Sample	Methodology	Results
Communicable and respiratory diseases			
(Greenaway, Azoulay et al., 2017)	**Migrants:** Pacific, Eastern Europe and Central, Asia, Middle East and North Africa, Latin America and Caribbean, South Asia, Western Europe, Sub-Saharan Africa and others **Comparator:** Non-immigrants **Total study population**: 20,862, **Total older persons population:** 37.5% migrants and 24.9% non-migrants	The relative risk for Hepatitis C infection rates (HCV) was calculated for data derived from the Quebec public health mandatory reportable (notifiable) infectious disease (MADO) database, for participants aged 50 years or more in Quebec.	Relative to the Canadian-born population, the rate for reporting HCV was lower for migrants aged between 50-59 years but higher in their counterparts aged 60 years or more. Overall[91], the risk was higher for migrants from Sub-Saharan Africa, East Asia and Pacific, Central Asia, South Asia and Eastern Europe.
(Naja, Kreiger et al., 2007)	**Migrants:** Not stated **Comparator:** Canadian-born **Total study population:** 1,306 **Total older persons population:** 100%	The odds ratio for H. *pylori* infection were calculated from blood samples drawn from the Ontario Familial Colon Cancer Registry (OFCCR) for participants aged 50 to 80 years in Ontario.	The risk for H Pylori infection was higher in male migrants 2.2 (1.6–3.0) relative to the Canadian-born male population, the risk was particularly higher for those who migrated when they were 20 years or older. The differences in the risk in H pylori infection between female migrants and their Canadian counterparts was not significant.

[91] The finding includes migrants of all ages

Table 3.7 continued			
Study	**Sample**	**Methodology**	**Results**
Mortality			
(Neutel, Quinn et al., 1989)[92]	**Migrants:** USA, UK, Germany, Italy or Holland **Comparator:** Canadian-born **Total study population:** 5,218 **Total older population**: not stated	Brain tumour mortality rates were calculated for the years 1970-1973 from data derived from the Vital Statistics and Disease Registries Section of Statistics Canada for participants aged 50 years or more in Canada.	The relationship between brain cancer and country of birth was complex. It varied by country of birth, gender and age-group. • Amongst female migrants of different ages, where younger migrants (USA and UK) had a lower risk for brain cancer mortality relative to the Canadian-born, their older counterparts had a higher risk of brain cancer mortality relative to the Canadian-born. Where younger female migrants (Italy, Germany and Holland) had higher rates of brain cancer mortality relative to the Canadian, older female migrants often experienced a decline in their mortality risk from brain cancer relative to the Canadian-born population.

[92] The significant rates for the mortality rates for older participants are not reported

Table 3.7 continued			
Study	**Sample**	**Methodology**	**Results**
Mortality			
			Similarly, for male migrants, where younger migrants (USA, UK, Holland and Italy) had a higher risk of dying from brain cancer relative to the Canadian-born population, migrants in the older age populations experienced a decline in the risk relative to the Canadian-born population. Male German migrants had a lower risk for brain cancer mortality. The risk was higher in migrants in subsequent age-populations relative to the Canadian-born.
(Kliewer and Ward, 1988)	**Migrants;** Spain, Portugal, Greece, New Zealand, Italy, Netherlands, Australia, India, Pakistan, United Kingdom. Japan, Belgium, Yugoslavia, China/Taiwan, United States, South Africa, Denmark, Germany, Switzerland, Poland, Bulgaria, USSR, France	The crude mortality ratios for the years 1969-1973 were calculated from data derived from Statistics Canada for participants aged 45 years or more in Canada.	Age-specific suicide rates for migrants and their hosts varied by sex. For younger males (ages 45-64 years), the suicide rates were lower in migrants than in the host, whereas the reverse was true at older ages (65 years or more). The differences were not significant because of the small number of deaths involved.

Table 3.7 continued

Study	Sample	Methodology	Results
Suicide			
	Mexico, Czechoslovakia, Ireland, Hungary, Norway, Sweden, Albania and Finland **Comparator:** Host Canadian **Total study population:** 12,687 **Total older population:** not stated		Migrant females (45 years or more) had significantly higher rates than those of the host females. Female migrants had a greater increase in the risk of suicide than their male counterparts.
(Kliewer, 1991)	**Migrants:** not specified **Comparator:** native-born Canadians **Total study population:** 2,462 Canadian migrants (total not stated) **Total older population:** not stated	Age specific suicide rates for the years 1969-73, were calculated from data derived from Statistics Canada for participants aged 50 years or more in Canada.	Except for males aged 50-55 years, migrants had greater age specific suicide rates relative to the Canadian-born population. Though males had a higher risk of suicide, female migrants had a greater increase in risk.
(Malenfant, 2004)	**Migrants:** Poland, United Kingdom, Italy, Portugal, other Europe, Oceania and others **Comparator:** Canadian-born **Total study population:** 3,560 (1990 and 1992) and 3,863 (1995 and 1997) **Total older population:** not stated	Suicide rates for the years 1990-1992 and 1995-1997 were calculated from data derived from Statistics Canada for participants aged 45 years or more in Canada.	The risk for suicide in migrants increased with age. Migrants (except those aged 75 or more years) had lower suicide rates relative to the Canadian-born. However, the rates were only significant for migrants aged 45-54 and 55-64 years between 1995-1997.

Table 3.7 continued

Study	Sample	Methodology	Results
Suicide			
			In 1990-1992, male migrants had a lower rate for suicide (except those aged 75 years or more). In 1990-1992, female migrants aged 45-54 years had a significantly lower rate for suicide, while those aged 65 years or more had a significantly higher risk of suicide relative to Canadian-born counterparts[93]. In 1995-1997, male migrants had a significantly lower rate for suicide (except those aged 75 years or more and this was not significant). In 1995-1997, female migrants aged 45-54 years had a significantly lower rate for suicide, while those aged 55 years or more had a significantly higher risk of suicide relative to their Canadian-born counterparts.

[93] The significant rates for 1990-1992 suicide rates are not reported in the study

Table 3.7 continued

Study	Sample	Methodology	Results
Life Expectancy			
(Chen, Wilkins et al., 1996)	**Migrants:** European migrants (United States, Australia, New Zealand and Europe) and non-European migrants **Comparator:** Canadian-born population **Total study population**: not stated **Total older population**: not stated	Life expectancy and mortality rates were calculated for the years 1986 and 1991 for data derived from the Canadian Vital Statistics Data Base for participants aged 50 years or more in Canada.	Overall migrants had a lower mortality rate, higher survival probabilities and more years of life free of disability and dependency than the Canadian-born population. The gradient was higher for migrants from non-European countries. The rates for European migrants tended to converge towards the rates of the Canadian-born in later life.
Self-rated health			
(Newbold and Danforth, 2003)	**Migrants:** not specified **Comparator:** Non-immigrants **Total study population:** 13,653 **Total older population**: not stated	Odds ratios for self-rated health and mean HU13 scores, for the year 1998/99, were calculated for data derived from the Canadian Institutes of Health Research NPHS Cycle 3 for participants aged 50 years or more in Canada.	Migrants had a significantly lower HUI3 score relative to the Canadian-born. The self-rated health scores for migrants and the Canadian-born were not significantly different. Based on the HUI3 scores, migrants reported a poorer health status than the Canadian-born.

Table 3.7 continued

Study	Sample	Methodology	Results
Self-rated health			
(Newbold and Filice, 2006)	**Migrants**: not specified **Comparator:** Canadian-born population **Total study population**: 38,474 **Total older population**: 100%	The odds for reporting poor self-rated health and chronic conditions and HU13 mean scores were calculated from data derived from the Canadian Community Health Survey (CCHS, Cycle 1.1) in Canada for participants aged 55 years or more.	Migrants had a significantly lower HUI3 score relative to the Canadian-born. There were no significant differences in migrants' self-rated health and their likelihood of reporting chronic conditions relative to the Canadian-born.
(Prus, Tfaily et al., 2010)	**Migrants:** Foreign-born (whites and non-whites) **Comparator:** host whites **Total study population:** 3,505 **Total older population:** 100%	The odds for reporting poor self-rated health for the years 2002-2003 were calculated for data derived from the Joint Canada/United States Survey of Health (JCUSH), for participants aged 45 years or more in Canada.	There were no significant differences in the self-reported health of foreign born (whites and non-whites) and Canadian-born whites aged 45-64 years. Also, the differences in self-rated health for foreign-born Whites aged 65 years or more and their Canadian-born counterparts were not significant. Relative to Canadian-born Whites, Foreign-born Non-Whites aged 65 years or more were significantly more likely to report poor health.

Table 3.7 continued			
Study	**Sample**	**Methodology**	**Results**
Healthy migrant effect			
(Gee, Kobayashi et al., 2004)	**Migrants:** Recent migrants (those who migrated less than 10 years ago) and longer-term migrants (those who migrated 10 or more years ago) **Comparator:** Non-immigrant Canadians **Total study population:** 131,000 **Total older persons population**: 100%	Overall global measures of health status (Self-rated health, Health Utility Index and Activity restriction) in 2000–2001 were estimated from data derived from Statistics Canada's 2000–2001 Canadian Community Health Survey (CCHS) Cycle 1.1 for participants aged 45 or more years in Canada.	The healthy migrant effect was applicable to recent (migrated less than 10 years ago) mid-life migrants (45–64 years), they had better functional and self-rated health relative to longer-term migrants and the Canadian-born. Longer-term migrants (migrated more than 10 years ago 45-64 years) had similar health status to the Canadian-born. The healthy migrant effect was not applicable to older migrants (65 years or more), whereby, recent migrants had poorer health relative to longer-term migrants and the Canadian-born.
(Aglipay, Colman et al., 2013)	**Migrants:** Recent (0-9 years since migration) and long-term migrants (10 years or more since migration) **Comparator:** Canadian-born **Total study population:** 116,796 **Total older population:** 100%	Odds ratio for anxiety disorders in 2008 were calculated for data derived from the Canadian Community Health Survey for the year 2008 for participants aged 60 years or more in Canada.	There were no significant differences in the rates of anxiety disorders for recent migrants, longer term migrants and the Canadian-born population.

Table 3.7 continued

Study	Sample	Methodology	Results
Falls			
(Chen, Mo et al., 2013)	**Migrants:** Composition not stated **Comparator:** Non-immigrants **Total study population:** 15,405 **Total older population:** not stated	Odds ratio were calculated for fall injury in association with mental health, for the years 2007–2008 for data derived from the Canadian Community Health Survey (CCHS) for participants aged 65 years or more in Canada.	Mental disorders were strongly associated with an increased incidence of fall injury in migrants relative to non-migrants.
Cognitive impairment			
(Prus et al., 2010)	**Migrants:** Foreign-born (Whites and non-Whites) **Comparator:** host Whites **Total study population:** 3,505 **Total older population**: 100%	The odds for reporting cognitive impairment for the years 2002-2003 were calculated for data derived from the Joint Canada/United States Survey of Health (JCUSH), for participants aged 45 or more years in Canada.	There were no significant differences in the cognitive impairment between foreign born (Whites and non-Whites) and Canadian-born whites aged 45-64 years. Also, the differences in cognitive impairment for foreign-born Whites aged 65 years or more and their Canadian-born counterparts were not significant. Relative to Canadian-born Whites, foreign-born non-Whites aged 65 years or more had significantly greater odds of cognitive impairment.

3.3 Discussion

3.3.1 Summary of findings

The findings highlight the similarities and differences in health patterns between migrants and the host population in Australia and Canada from the 44 included studies (Australia – 29, Canada 14 – both – 1). Only one study evaluated longitudinal changes in older migrants' health status relative to the host population although an increasing number of studies published more recently suggests growing interest in older migrants' health.

Considering the first research question on how the health of older migrants' changes over time relative to the host population. We found older migrants had a lower risk of dying relative to the host population, this assertion is based on a singular longitudinal study.

For the subsequent research question investigating differences in the health status of older migrants relative to the host population. The health status of older migrants largely varied to that of the host population in Australia and Canada. Despite the differences in some of the health measures used in either country; differences in migrant health status relative to the host-population followed a similar pattern. For example, mortality measures differed in the two countries. Canadian studies examined the mortality of all migrant populations as well as cause specific mortality (brain tumour) in nationally representative studies. Australian studies investigated the overall mortality of a specific migrant group (Italian men) in a specific location (Sydney), they also investigated the cause specific mortality for circulatory disease, diabetes and melanoma mortality in nationally representative studies. Overall, migrants had a lower risk of dying than the host population, however cause-specific mortality varied by age group, country of birth and sex.

Older migrants reported lower rates for cancer, CVD and falls, they also had more years free of disability and dependency relative to the host population. Despite these health advantages older migrants reported a higher risk of TB, hepatitis C, vitamin D deficiency, poor mental health, *H. pylori* and end-stage renal disease relative to the host population. Comorbidities increased the risk of poor health in older migrants relative to their host counterparts; poor mental health was associated with an increase in incidence for falls in migrants relative to their host counterparts, while migrants reported greater psycho-social factors for coronary heart disease; poor mental and self-rated health. Differential health in specific older migrant groups relative to the host population was observed for suicide, cause specific mortality among other health measures. Other older migrant groups and the host population reported similarities in self-rated health, end stage renal disease and suicide rates. For example, British migrants (except those born in Northern Ireland and Ireland) reported a similar risk of suicide to the Australian-born population.

We found limited evidence for a "healthy migrant effect" in older migrants. Only recent migrants aged 45-64 years (≤9 years since migration) reported better functional and self-rated health relative to longer-term migrants (≥10 years since migration) and the Canadian-born. However, recent older migrants (65 years or more) reported no health advantage and were in fact more likely to report poorer health relative to longer-term migrants and the Canadian-born. Further, there were no differences in the mental health of recent older migrants, longer term migrants and the Canadian-born aged 60 years or more.

The other research questions examined the relationship between potentially influential variables (cross-sectionally and over time) and the health of older migrants. Differences in country of birth, age at migration, period of migration, age, sex, other health measures, risk and socio-demographic factors possibly accounted for differential health in specific older migrant groups relative to the host population. For example, migrants from specific regions/countries bear a disproportionate burden for diseases such as TB, *H. pylori,* hepatitis C and end stage renal disease. Migrants from Sub-Saharan Africa, Asia and Eastern Europe had an increased risk for hepatitis C relative to the Canadian-born (257). Australian migrants born in Southern Europe, the Middle East, Indian subcontinent, South-East Asia and the Pacific Island nations had higher rates of treated end stage renal disease than their counterparts from the British Isles, or the "rest of Europe" and the Australian-born population (254). Some health differentials were also positive; Greek and Maltese migrants[94] reported lower suicide rates, while Italian migrants reported lower mortality to the Australian-born population.

[94] Female migrants reported higher suicide rates relative to the Australian-born population

Lastly, we sought to identify gaps in knowledge in the published literature regarding the health status of older migrants in Australia and Canada. The evidence was mostly cross-sectional and at times available for singular health measures (*H. pylori* and hepatitis C), as such we could neither infer cause and effect or comprehensively explore emerging themes from singular health measures. Our systematic review found a paucity of evidence in relation to older migrants' health. Further, the quality of data of some included studies were questionable as they were old and lacked information on migrating circumstances as well as socio-demographic characteristics such as language and education attainment. Some included studies used small and convenient study populations. The quality of relatively large migrant studies was also questionable as some used broad descriptions of migrants from diverse ethnic backgrounds to measure health status.

3.3.2 Key findings

Our findings paint a complex picture of older heterogenous migrants' health in Australia and Canada as they are drawn from studies assessing individuals of varying ages and ethnicities using diverse health measures. For instance, we cannot suggest all migrants have a survival advantage over time as this was assessed for older Italian males only. Few data on older migrants' health and the influencing factors were available, especially for longitudinal studies that would inform change in health over time. Further, some cross-sectional data on older migrants' health were derived from general[95] migrant studies, assessing the quality of such data was complex. It was problematic to establish dose-response associations using our data singularly, other migrant health studies were used to infer on such associations.

Commonly postulated acculturation theory, determinants of health frameworks and the healthy migrant effect hypotheses may not account for differences in the health of older migrants and the host population. We found limited cross-sectional evidence (the strength of the evidence was weak) and no longitudinal evidence to support the theory of acculturation, which is said to result in convergence of migrants' health to that of the host population. Convergence in most of the studies was measured by assessing individuals in

[95] Migrants of all age groups

different age groups rather than following individuals over time. For example, in Gray, Harding (49) convergence was inferred from a slight decrease in the risk of dying from circulatory disease and diabetes in migrants from UK and Ireland relative to the Australian-born aged 55-64 years (RR= 0.71 (95% confidence interval (CI), 0.67–0.75)) relative to those aged 45-54 years (RR = 0.70 (95% confidence interval (CI), 0.64–0.76)). The findings in such studies assume the relative risk of mortality between migrants and the host population remains constant over different age groups.

Inferences for the healthy migrant effect were made from assessing the health of individuals of different age groups whose ethnic composition varied. For instance, in Gee, Kobayashi (20) three quarters of recent migrants (9 or more years since migration) aged 45-64 years were described as visible minority[96], while a greater proportion of their counterparts who had lived in Canada for 10 or more years (64.3%) were non-visible minority (White). Similarly, recent migrants aged 65 years or more were likely to be visible minorities while their longer-term migrants' counterparts were non-visible minorities. Such data maybe biased as differences in migration experiences more so in Australia and Canada, whereby migration policies have played an important role in migrant composition and socio-demographic characteristics may bias the findings (cohort effect).

The Bradford Hill Criteria used to infer causality in cross-sectional studies (177, 233) had broad implications for the findings. We could postulate on the overall health of migrants as studies consistently indicate there exists some variations in the health status of older migrants and the Australian and Canadian-born population, these variations and the extent of are migrant group specific. Other than TB[97], there lacked enough data to consistently draw any associations on other health measures and specific migrant populations from the included studies.

Other Bradford Hill Criteria (Chapter (2) Methodology) had limited applicability to older migrants' and by extension migrant health generally. For "specificity" it is said there should

[96] Defined in Chapter (1) Introduction

[97] 10 Australian studies assessing TB were included

be a clear and specific relationship between the cause and the outcome. The included longitudinal study provided limited evidence to support acculturation theories and the healthy migrant effect hypothesis which are associated with health changes over time, more so for older established migrants such as older Italians[98] who though lacked selection effects (compared to the Australian-born population reported lower a socio-economic status and higher morbidity) had lower mortality (61). The "coherence" criterion proposes the association in health should correspond with current knowledge on the biological nature of disease. However, current knowledge on disease aetiology may be specific to populations and may not account for differential risk factors in all populations.

Figure 3.3 summarises interrelated determinants of older migrants' health which we postulate are associated to their country of birth and/or host country as discussed in subsequent sections.

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[98] Men

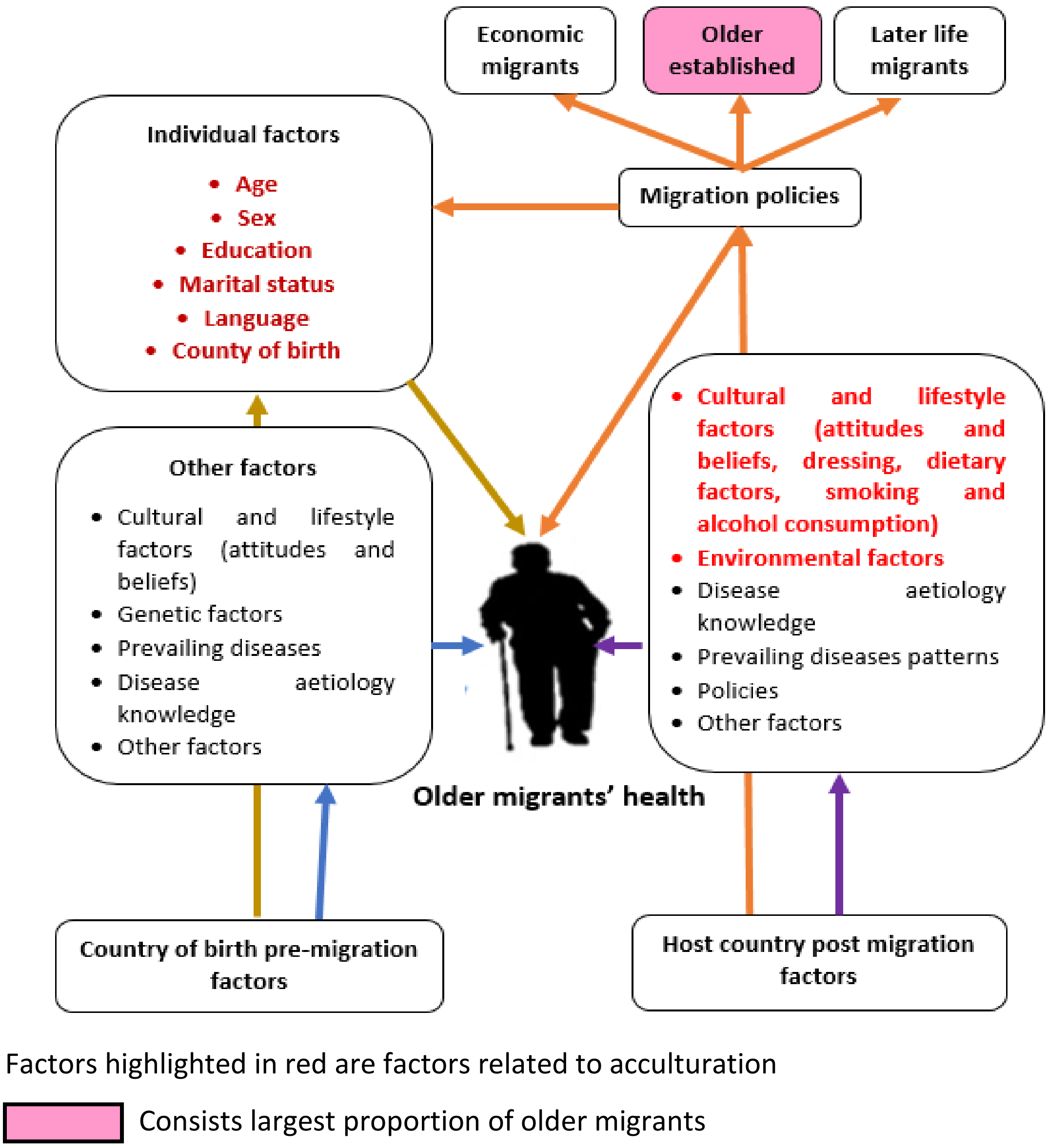

Figure 3.3: Summary of health determinants of older migrants' health

3.3.3 Country of birth as a health advantage or disadvantage

Different countries have varying types and prevalence of certain diseases. Migrants move from one set of risk/protective factors (developmental level, cultural patterns and physical environment) to another set of risk/protective factors while maintaining a certain degree of risk/protective factors from their country of birth which may impact their health.

3.3.3.1 Higher risk of infections in migrants

The higher risk of *H. pylori,* hepatitis C and TB in older migrants possibly stems from latent or asymptomatic infections in their country of birth. Hepatitis C (266, 267), *H. pylori* (268) and TB (245, 269-272) may have a long latency period in which infected individuals may remain asymptomatic for several years or even decades.

Migrant screening strategies are an important contributor for TB control in low incidence countries such as Canada and Australia. To reduce any additional burden to the health care systems, migrant applicants from high prevalence countries are screened for TB prior to migration (245) with a post migration follow up for individuals with an increased risk of developing TB in future (273). Post-migration follow-up procedures may have the potential to identify a substantial proportion of TB cases in high risk migrants (273-276). However, their effectiveness is confounded by factors such as low uptake/poor compliance, elderly migrants are less likely to comply with post migration TB surveillance (275). They may also fail to identify other migrants at a high risk of transmitting TB but not under surveillance. A recent Canadian study found, though individuals referred[99] for follow up had a higher risk of TB infection they are at a lower risk of transmitting TB relative to migrants not referred for follow up (273). However, the study could not determine whether this was as a result of effective TB follow-up programmes or migrants referred for follow-up had a disease phenotype associated with a lower risk of transmission (273). Possibly, the selective surveillance of migrants using their past TB history may not identify latent infections, low incidence countries are advised to consider the screening and treatment of latent TB infections in migrants from high risk countries (273).

For *H. pylori* and hepatitis C many individuals maybe unaware of their status and may have little knowledge on their modes of transmission due to varied factors in their country of birth and host country. Risk factors for migrants from hepatitis C endemic countries may differ from those of their host country. Canadian migrants at risk of hepatitis C may be older and less likely to have problematic drug use resulting from intravenous drug use which is a key risk factor in the transmission of hepatitis C in the Canadian-born population (257). The mode for transmission for migrants from countries with intermediate or high rates of hepatitis C are generally through unsafe medical procedures; the reuse or inadequate

[99] Usually migrants with inactive or old, healed pulmonary tuberculosis on chest radiograph, or a history of tuberculosis

sterilization of medical equipment i.e. contaminated needles and use of unscreened blood for transfusion (257).

Older migrants from countries where hepatitis C, TB and *H. pylori* are endemic bear a disproportionate risk for these infections in countries such as Canada and Australia. However, opportunities to address their risk and offer early treatment may be missed by current screening and treatment strategies as their risk factors may vary from the host population.

3.3.3.2 Increased/decreased risk of metabolic diseases

Our finding on Vietnamese migrants having a higher risk of type 2 diabetes is consistent with other Asian migrant health studies. South Asian[100] migrants in the United Kingdom, Norway, United States, Singapore and Canada had a higher risk of type 2 diabetes than their host populations (277). Some well-known risk factors may not be sensitive predictors for diabetes in some populations. Specific Asian migrant populations have a higher type 2 diabetes risk despite lower or similar body mass index (BMI) to their host population (45, 264). They are also likely to develop type 2 diabetes at a significantly younger age; 45.9 years for South Asians relative to 57.3 years in Caucasians (277).

Changes in dietary patterns is one of the indicators of acculturation in migrants, adopting an unhealthy diet, low in fibre but rich in total fat, saturated fat and refined sugar was said to result in the increased risk of diabetes in South Asian migrants as they reported higher rates compared to their country of birth and host populations (277). Other than unhealthy diets, sedentary lifestyles and limited knowledge on disease aetiology, genetic factors appear to play an important role in the increased risks of type 2 diabetes in certain populations (264, 277). South Asians have a higher prevalence of excess abdominal fat (central adiposity) at a lower body weight/BMI compared to other populations (278).

[100] Pakistan, India and Bangladesh

The differential risk factors may lead to delayed diagnosis, treatment and poor management of type 2 diabetes in migrants. Consequently, they may experience a higher risk of complications such as renal disease, CVD, visual impairment and foot ulcers. Migrants from Southern Europe, the Middle East, Indian subcontinent, South-East Asia and the Pacific Island nations had higher rates of treated end stage renal disease than their counterparts from the British Isles or the 'rest of Europe' and the Australian-born population (254). South Asian migrants in the United Kingdom, Norway, United States, Singapore and Canada with type 2 diabetes were more likely to develop foot ulcers relative to European migrants and the host populations (277).

Our findings indicate migrants from North-East Asia , South-East Asia and Europe had a lower risk of self-reported heart disease, stroke or thrombosis relative to the Australian-born population (45, 279). Though the reasons for this advantage are not comprehensively discussed, factors such as lower prevalence of obesity and lower smoking rates in some Asian populations may be positively associated (45, 279). However, as the lower risk is based on self-reported estimates it could indicate 'underreporting' of chronic conditions. Cultural, demographic and health care barriers may limit individuals knowledge on disease aetiology (85). Further, data were drawn from a study source with an estimated response rate of 17.9% and excluded Non-English-speaking migrants with limited English skills, limiting their generalisability.

Non-European migrants maybe at an increased risk of Vitamin D deficiency as they are likely to migrate from countries closer to the equator to countries in the higher northern or southern latitude such as Canada with less effective sunshine more so during the winter months (280). Migrants with darker skin pigmentation require longer sunshine exposure to produce a similar amount of vitamin D as their white skinned counterparts (281). However, for Australia cultural factors may play an important role in the increased risk of vitamin D deficiency. For some specific migrant populations shielding their skin from direct sunlight is necessary so as to maintain a desirable lighter skin complexion, some migrant populations wear concealing clothes for modesty or religious reasons (96). This may result in low sunlight exposure leading to sub-optimal vitamin D levels (265, 280-283). Lastly, some migrant group dietary patterns are calcium deficient (low calcium intake) (280, 281) and there is a low uptake of vitamin D supplements (281).

3.3.3.3 Increased/reduced risk of cancer

We found Italian migrants reported a lower risk for colon, breast and prostate cancer, though the study is over two decades old, the finding is consistent with other migrant health studies. For example, between 1981 and 2007 Southern European migrants reported a lower risk of colon cancer mortality relative to the Australian-born population (96). Differences in dietary patterns may account for part of the variation in the risk of certain cancers between migrants and the host population. Various aspects of the Mediterranean diet; increased vegetable and fruit consumption, lower intake of red meat, higher intake of fish, cereals, some refined carbohydrates, olive oil and other unsaturated fats, associated with some migrant populations such as Italians and Greeks has been linked to a lower risk of specific cancers (284).

Migrants may have a lower risk of melanoma as a result of several behavioural, environmental and genetic factors. Australia has the highest rates of age standardised melanoma in the world relative to other countries (285), for older Australians the risk of melanoma might arise from cumulative exposure to ultra-violet radiation (259, 286). Individuals who migrate in childhood may have an increased risk of melanoma (259, 287). Darker skin complexion maybe a protective factor for melanoma. The risk for melanoma has been found to be lower for migrants from Southern and Eastern Asia in Australia (287).

We found only one study on brain cancer mortality. Generally, the incidence of brain cancer is low, however, relative to other regions of the world; Europe, Canada, the United States and Australia have the highest incidences while occurrence is lower in East Asia, South-East Asia and India (288). Our findings indicate migrants from countries with relatively low rates of brain cancer experienced a higher risk relative to the Canadian-born population and their country of origin. For example, males from the UK, Germany, Italy and Holland experienced an increased risk relative to the Canadian-born and their country of birth. Similarly, female migrants from countries with a lower rate of brain cancer experienced an increase in their risk relative to the Canadian-born, though at a much lower rate to men (260). This possibly indicates environmental factors absent in their country of birth but present in their host country are somewhat associated with the increased risk. However, the study on brain cancer was almost three decades old and we found no updated studies on brain cancer mortality to support this. Though the causes of brain cancers are largely unknown some of the risk factors associated with it may not be unique to Canada or Australia such as older age, previous cancers such as leukaemia and non-Hodgkin lymphoma, exposure to medical radiation, family history, specific conditions such as tuberous sclerosis, neurofibromatosis type 1, neurofibromatosis type 2 and Turner syndrome, obesity and HIV/AIDS (289).

3.3.3.4 Mortality advantage

Studies suggest migrants may have a mortality advantage relative to the host population (10, 290, 291) which either declines with age (291) or is poorly understood in later life (10). Though the evidence was weak as it was deduced from two studies only; one published more than 20 years ago (42) and the other though longitudinal was gender specific and not nationally representative (61). We found some evidence of a mortality advantage in older migrants which was region/country of birth specific.

Non-European migrants are more likely to be relatively recent arrivals compared to European migrants in Canada and Australia. Their survival advantage could be due to positive selectivity based on skills and health (291, 292) and a relatively lesser duration of residence (42), all factors associated with the healthy migrant effect (Chapter (1) Introduction). The mortality advantage is said to decline as migrants adapt to their host country's environmental, dietary and other lifestyle patterns with increased duration of residence (291, 293).

Selection effects may not account for the presence of a mortality advantage in older established migrant populations such as South Europeans. For example, older Italian[101]

[101] Majority had lived in Australia for ≥ 60 years

migrant men reported higher rates of smoking and a lower socio-economic[102] status despite living in Australia most of their lives (61). This phenomenon in older Southern Europeans is referred to as the 'morbidity-mortality paradox'. Greek migrants had a lower mortality from CVD and overall mortality[103] relative to the Australian-born decades after migration despite having a high prevalence of cardiovascular disease (CVD) risk factors; obesity, diabetes, hyperlipidaemia, smoking, hypertension and sedentary lifestyles (294, 295). Southern European migrants are also observed to either maintain or return to traditional Mediterranean dietary patterns in old age (294) associated with longevity in older Southern European migrants (296), a lower risk of specific cancers (284) and cardio-vascular diseases (295).

The mortality advantage could be overstated as some migrant studies more so those using registry data (i.e. Statistics Canada and the Australia Bureau of Statistics) may not consider unhealthy, economically unsuccessful and/or older migrants who return to their country of birth. A phenomenon commonly referred to as the salmon bias (40, 290, 297). However, the longitudinal study in our review followed older Italian male migrants who had lived in Australia for close to six decades for a period of eight years with a relatively low loss to follow up and thus the salmon bias phenomenon was unlikely to contribute significantly to their mortality advantage. The mortality advantage could however be an indicator of the increased duration spent with morbidity for specific older migrant populations. Though older Italian migrants had a lower mortality rate they had a greater risk for depressive symptoms, chronic pain, cognitive impairment and dementia, functional limitations and poor self-rated health relative to the Australian-born population (61).

3.3.3.5 Poor mental health

Country of birth may also be a predictor of poor mental health as it indicates characteristics such as English proficiency. Some migrant populations like Greeks (63), Vietnamese (248) and Italians (62) demonstrated poor official language proficiency decades after migration.

[102] Italian-born men had lower levels of education and were less likely to have worked as managers or professionals and were more likely to be solely relying on a government pension relative to Australian-born men

[103] Mortality from other causes

This may lead to social isolation further confounded by a reduction of migrant social networks through death and emigration of their peers (63) increasing their risk of poor mental health (253).

Other factors associated with poor mental health other than country of birth include not being married (63, 298), being female and having a lower socio-economic status (63). Migrants' attitudes and beliefs towards mental health may not only increase their risk of poor mental health but also lead to reluctance in seeking appropriate treatment (299).

Poor mental health was also associated with increased co-morbidity in migrants. There was a stronger association for poor mental health and increased falls in migrants as opposed to their host population (252). Also, Greek migrants were found to have more psychosocial factors for CHD (higher depression and anxiety scores, lower reported physical health status, lower perceived social support and lower quality of life) relative to the Australian born population (251). Prevention and interventions for poor mental health may aid in the reduction of comorbidities in specific older migrants.

3.3.4 Host country factors

As discussed in Chapter (1) Introduction acculturation is a central theme in migrant health studies. Acculturation effects are usually reported in terms of a decline in the mortality advantage and an increase in morbidity in migrants relative to the host population. The declining mortality (292) and increasing morbidity (40) is often as a result of waning selection effects and loss of protective health behaviours possibly through the process of acculturation.

The findings on acculturation have several weaknesses. As earlier stated acculturation was hypothesised from old cross-sectional studies where data were derived from registry data[104]. Their findings often assume different cohort of migrants who may vary by age, ethnic composition, socio-economic status and other factors share a similar risk of

[104] i.e. Australian Bureau of Statistics and Statistics Canada

morbidity and mortality. As such, the role acculturation (or the lack of it) plays in the health status of older migrants is poorly understood.

Erosion of selection effects may not account for the differential health in older established migrants relative to the host population, who may not have been selected based on their skills. These migrant populations face lifelong hardships in their host countries. As they tend to report lower education and socio-economic status relative to the host populations, this was the case for Italian (61) and Greek[105] (63) migrants in Australia. This could also be an indicator of barriers to or the lack of acculturation for older established migrant populations in Australia and Canada. This suggests acculturation is not wholly an individual process but other factors may aid or act as a barrier to acculturation resulting in cumulative (dis)advantages which may influence health (Figure 3.4).

Some migrant populations may have similar health profiles to their host countries for specific diseases i.e. British migrants had a similar suicide risk to the Australian-born population (261). Compared to other migrants, British migrants are likely to have lived in Australia for a significantly longer period (48). Before changes in the migrant policies[106] in 1945, the Australian-born non-indigenous population largely consisted of British migrants or their descendants (48) as such they may possess cultural and linguistic similarities to the Australian-born population. Alternatively, due to their increased duration of residence, similarities in health may also be as a result of convergence. The circulatory disease and diabetes mortality risk of British migrants was said to converge towards that of the Australian-born with increased duration of residence (49).

[105] The study included migrants who were likely to have been excluded from the National Survey of Mental Health and Well-being due to their lack of fluency in the English language and for whom rates of mental disorder are unknown, this could introduce bias in our assumptions
[106] the Australian immigration policy of 1945

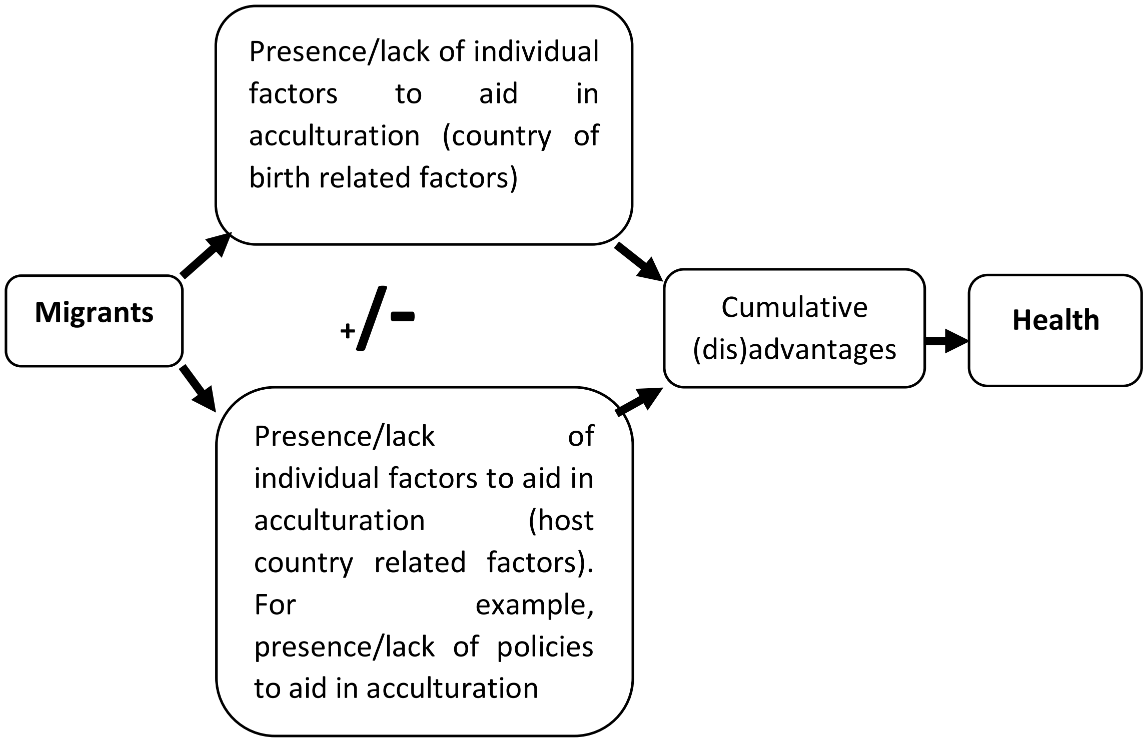

Figure 3.4: Barriers/aids to acculturation

3.3.4.1 Language proficiency

Language is an important measure of acculturation as language skills affect all aspects in the quality of life for migrants (108). Migrants' poor language skills may result in difficulties in adapting in their host country. It may also result in social isolation (36), difficulties in the labour market (51) and lower utilisation of health care services (91). Failure or difficulties in adapting increases the risk of poor mental health which was linked to an increased risk of suicide in migrants (93, 262, 300). Language proficiency is also an important indicator for successful migrant integration as it results in positive socio-economic outcomes (301) and facilitates access to health care services. For example, a study of Turkish migrants in the Netherlands found their increased proficiency in the Dutch language was associated with increased use of mental health care services for men and increased social interaction for women (302). Elderly Iranian migrants in Australia with better English proficiency reported lower levels of anxiety and depressive symptoms, required less support in activities of daily living and were more likely to access health care services (91).

All factors including language proficiency can affect the way people seek help for health concerns, navigate and engage with health services – known as "health literacy". The Australian Commission on Safety and Quality in Health Care (303) defines health literacy as "how people understand information about health and health care, and how they apply that information to their lives, use it to make decisions and act on it." At the individual level this includes application of skills and knowledge to make informed health and health care decisions, while at the health care system level it includes access to health care, infrastructure, policies, processes and health care professionals (303). Health literacy is also linked to the determinants of health, and those with the most health needs, may be those who are the least confident in accessing the help they require. This includes determinants such as age, country of birth, migrating circumstances, sex, education and English proficiency. For example, though being a Chinese migrant was associated with inadequate health literacy, the gradient was higher for those who were older, or had migrated to Australia in older ages, recent migrants, those with a lower education attainment or poor English proficiency and female migrants (304). Poor language proficiency impacts on the management of health conditions, prescribed medications (305) and health preventative behaviours including screening, diagnostic tests or vaccines (306).

Of interest, our findings indicate that some of the older migrant populations who have lived in Australia for decades still reported poor official language proficiency. Further, the same older migrant populations (Italian (61) and Greek[107] (63) migrants in Australia reported lower education and socio-economic status. This possibly indicates existence of barriers to increased language proficiency that need addressing. In Australia, some older migrants may not qualify for the free English language classes as applicants need to apply within six months of their visa being granted. Free English language classes are only offered to humanitarian migrants (301) and eligible migrants (307). In Canada, free French and English classes are offered to all permanent residents, more so new migrants (308), however, the effectiveness of these programs more so for older migrants is poorly understood.

[107] The study included migrants who were likely to have been excluded from the National Survey of Mental Health and Well-being due to their lack of fluency in the English language and for whom rates of mental disorder are unknown, this could introduce bias in our assumptions

3.3.4.2 Education and socio-economic status

Though education and socio-economic status are well-established social determinants of health (309), some of the review studies did not investigate the effects of socio-economic status on older migrants health. Difficulties in acculturation may also result from lower education attainment, as it may negatively impact on employment opportunities leading to a lower socio-economic status. For example, Italian migrants in our review were less educated and worked in non-professional occupations relative to the Australian-born population (62). Poor socio-economic status is consistently linked to poor health (63). Other than dietary factors, lower socio-economic status is also linked to colorectal cancer (286).

However, the relationship between socio-economic status and health is complex as it is interrelated with other factors such as ethnicity and migrating circumstances. Though, higher levels of education would be associated with an increased access to health information and an increased ability to adapt in their host country. Migrants with higher education levels may also face difficulties in acculturation if qualifications from their country of birth are not recognised or are under-utilized (89). Some black, Asian and other minority ethnic groups (BAME) had an increased risk of severe covid-19 (310) including increased mortality (311) compared to other populations in the UK. The specific BAME groups included individuals of Bangladeshi, Chinese, Indian, Pakistani, other Asian and Black origins (311). Razai, Kankam (312) postulated socio-economic status explained the ethnic disparities observed in the differences in covid-19 morbidity and mortality rates in diverse populations. However, Public Health England (311) found the higher mortality risk persisted after adjusting for age, sex, socio-economic status and region. It may be important to consider other biological, genetic as well as complex economic, social and behavioural differences (310). Other ethnic populations are also said to experience poor health regardless of high education attainment. For instance, Blacks in the US had a lower life expectancy compared to the White population at each level of income or education (313). Poor acculturation may be associated with structural factors including structural (institutional) racism in spite of education attainment (though high education may aid in integration).

3.3.4.3 Lifestyle patterns

Similarities and differences in environmental and cultural factors such as dietary and lifestyle patterns may result in differing health status for migrants and the host population. The greater the differences between migrants and the host population the greater the difficulty migrants may have in adapting in the host country. Migrating at a younger age and increased duration of residence are associated with greater adaptation to varied lifestyle patterns such as smoking status (45). Changes in dietary patterns are associated with a higher risk of diabetes in some migrants (277). However, migrants may also report positive changes in dietary patterns. Arab migrants reported living in Canada enabled them to make healthy dietary choices (71).

Acculturation is also associated with an increased prevalence of smoking in some migrant communities despite declining rates in Australia due to smoking cessation campaigns (45). In some Asian migrant populations increased duration of residence and migrating at a younger age was associated with increased CVD factors such as increased prevalence of smoking[108] and obesity[109] (45). Age at migration and increased duration of residence were also associated with some positive CVD protective factors such as increased physical activity[110] in some Asian migrant populations (45).

3.3.4.4 Variations by sex

Migration seems to carry greater health consequences for female migrants in some health measures. Female migrants in Canada and Australia experienced a greater increase in their risk for suicide relative to male counterparts (247). The study also found, female migrants in the United States shared a similar risk. Being female was also associated with a greater risk for depression (63).

Some researchers argue some gender roles played by women in the migration process, whereby pre-migration they are unlikely to be the principal decision makers (93), while

[108] North-East Asians and South-East Asian women
[109] North-East Asians
[110] North-East Asians

post-migration their role may be restricted to care giving at home, making assimilation and gaining language proficiency skills more difficult, which may adversely affect their health and health seeking behaviours over time (48, 100, 102, 247).

Though not in the review findings, acculturation may have some positive effects on women's health, as women also migrate for economic reasons. Over time, women from cultural backgrounds with restrictive roles may enjoy greater socio-economic freedom than they did in their country of birth. The rates of breast cancer screening for migrant women from East Asia, Middle East and North Africa converged towards that of the Australian born women with increasing duration of residence (314).

3.3.4.5 Ageing, age at migration and period at migration

Age at migration maybe an important factor in understanding the health of older migrants and possibly acculturation. For older migrants' migration may increase their risk of diseases and conditions associated with ageing. The risk of suicide (263, 315) and infections such as *H. pylori* (256, 268) increase with age. Aging is associated with a decreased ability to synthesize vitamin D (281), also older individuals are less mobile and this may result in low sunlight exposure. In addition, factors such as social isolation, socio-economic status, language proficiency, poor understanding of the host country's social and health systems, may increase the risk of poor health for older migrants.

Recent older migrants (later life migrants) are more likely to migrate for family reunification purposes (20, 316) unlike younger individuals who migrate for economic reasons and are subject to stringent skills and health selection criterion (207). The selection effects are said to result in a health advantage (healthy migrant effect) as observed in recent Canadian migrants aged 45-64 years, these effects may make the process of acculturation easier. The findings on healthy migrant effect in older migrants are consistent with a review examining the healthy migrant effect over the life-course in Canadian migrants, in whom they observed a strong health advantage in adulthood and a weaker advantage in later life (10). The weak advantage in later life may also be as a result of limited evidence of the hypothesis in old age.

The healthy migrant effect seems to be confounded by several factors. For older migrants, some studies[111] seem to be comparing the health of differential migrant populations[112]; recent older migrants (later life), recent migrants (economic migrants) and longer-term migrants (established older migrants). In Chapter (1) Introduction, we established these migrants vary by country of birth (by extension race and ethnicity) as well as selection effects due to differential migration policies. The resulting cohort effects may influence post-migration health as differential migration policies may have both (in)direct bearing on the health of individuals who migrate at different periods.

As the healthy migrant effect is grounded on health selectivity; comparing economic migrants, later life migrants and established older migrants would suggest they were all admitted under similar selection criteria, changes in their health would be cyclic (Figure 3.5). Some studies we reviewed did not consider how pre-migration factors (individual and risk factors from country of birth) interact with the host country's factors over time to influence health as migration was treated as a onetime life event with immediate consequences. The healthy migrant effect may possibly explain the health status of economic migrants and more so those from culturally dissimilar backgrounds (reflecting migrant policies). For older established migrants the effects of positive selection (if any) may be difficult to quantify, most likely due to lack of comparable data.

The healthy migrant effect may also be confounded by language and cultural barriers as recent migrants may be unfamiliar with the self-rated health measure (317). In older migrants, healthy migrant effect remains understudied and more longitudinal evidence may be needed considering period of migration.

[111] 20. Gee EM, Kobayashi KM, Prus SG. Examining the healthy immigrant effect in mid- to later life: findings from the Canadian Community Health Survey. Can J Aging. 2004;23 Suppl 1:S61-9. & 38. Aglipay M, Colman I, Chen Y. Does the healthy immigrant effect extend to anxiety disorders? Evidence from a nationally representative study. J Immigr Minor Health. 2013;15(5):851-7.

[112] Section 3.3.2 key findings

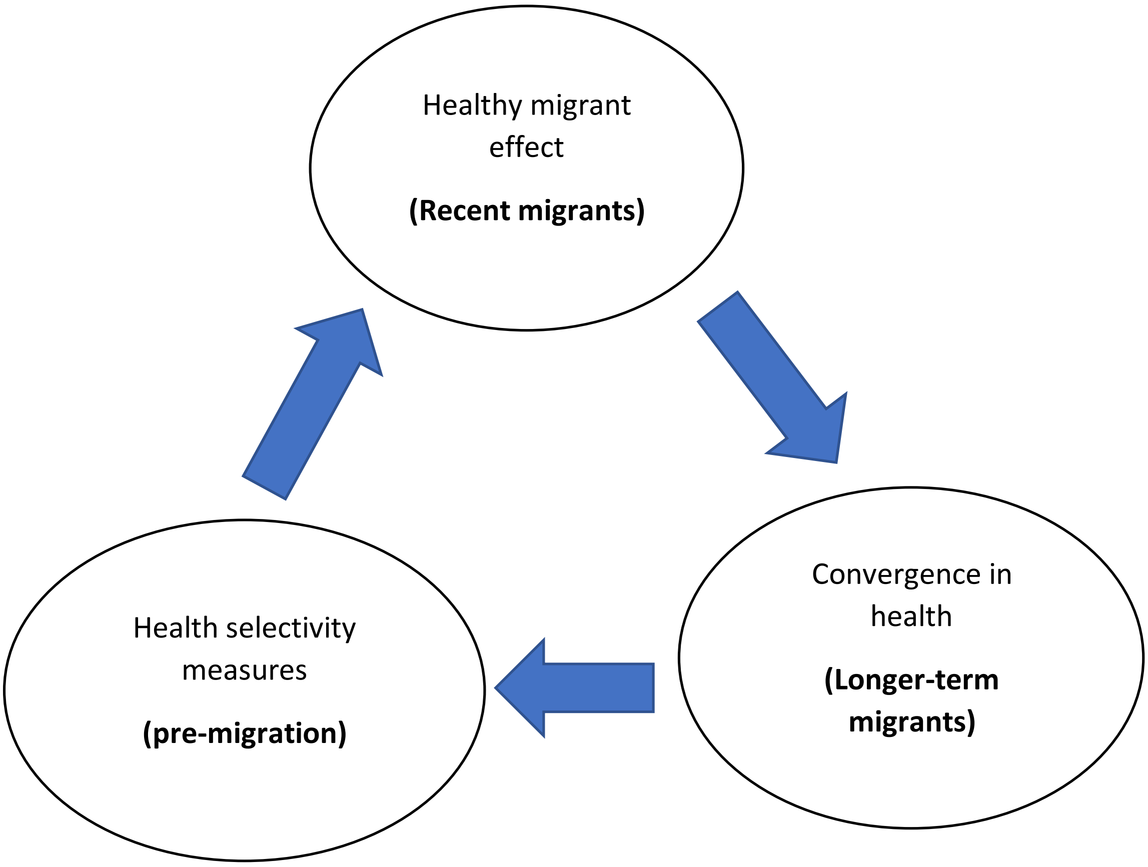

Figure 3.5: The healthy migrant effect cycle

3.4 Strengths and Limitations

The review has several strengths. This is the first known review to assess the health of older migrants in Australia and Canada. Multiple health measures were critically analysed to assess the health of older migrants. Their inclusion allowed a broader consideration of older migrants' health status. The review included both migrants and the host population, this enabled a direct comparison between these two populations and minimised the risk of bias by including studies, whereby the nativity status was clearly defined.

The review provides useful insights on the characteristics of older migrants, which may be important in unravelling their health. It identified gaps in knowledge and the complexity of making inferences from older migrant health studies. For instance, some health measures were included singularly in the review such as brain tumour and melanoma mortality as there were no follow up studies. Thus, this review possibly provides useful information for future older migrants' health studies.

Our review also has limitations. Most of the studies included in the narrative synthesis were cross-sectional and as a result could not infer on cause and effect. Also, given the heterogeneity of migrant populations composition in Canada and Australia, cross-sectional studies may not provide a representative sample of the migrant population and their findings may be biased by a cohort effect.

Some findings were inferred from data derived from the same databases, for mortality, data were often drawn from routinely collected data by either Statistics Canada or the Australian Bureau of Statistics. Though readily available, vital data may be limited in provision of diverse individual explanatory factors other than age and sex. In addition, we could not accurately capture data for some health measures as data were derived from studies that included participants of all ages. The same databases were used multiple times across many of the studies, consequently, our synthesis in some cases may have critically assessed different health measures but for the same individuals.

Some of the studies were migrant group specific and their findings may not be generalisable to entire migrant populations in either study country. A health (dis)advantage may only be applicable to specific populations and not whole migrant populations. Additionally, some studies had small non-representative sample sizes and their findings, may further bias the results presented in the review.

Our search revealed a lack of older migrants' health specific studies, more so longitudinal. Some of our findings on older migrants' health, are drawn from data derived from studies that included all age populations. We lacked the power to critically explore heterogeneity by investigating differences by country/region of birth other than using general categorisations such as European and non-European, migrant non-whites and migrant whites etc. A finer breakdown would have enabled further investigations into variations in health. Also, there was a paucity of data on diverse health measures, particularly those linked to aging, we found no studies on dementia and Alzheimer's relevant to this review.

The inferences made in this review are drawn from both adjusted and unadjusted coefficients and this may result in simplistic deductions. Due to heterogeneity of migrant data and diverse statistical analysis methods, pooling of data for a meta-analysis, were not possible. A narrative synthesis was used to summarise and investigate the similarities and differences in migrant health over time.

The differences in health, maybe as a result of drawing inferences from studies that were not nationally representative. Further, we did not include qualitative studies, which would have provided a contextualised understanding on older migrants' health (318). The review findings fail to provide older migrants' perspective of their health and experiences which they perceive to influence their health.

Lastly, there were no longitudinal data to inform on the healthy migrant effect, all inferences were drawn from studies which measured duration of residence cross-sectionally. There is a possibility the healthy migrant effect was measured using data from differential migrant populations.

3.5 Implications

3.5.1 For research

3.5.1.1 Subsequent inferential analysis

A prior descriptive analysis (results included in Chapter (2) Methodology) assessed the suitability of the DYNOPTA study established individual socio-demographic characteristics (age at the time of observation, sex, partner status, education attainment, country of birth and language spoken at home) and health as well as risk factors (smoking status, past chronic conditions and alcohol consumption) had adequate data for inclusion in the repeated cross-sectional analysis. In the longitudinal analysis dataset language spoken at home and past chronic conditions were excluded due to data constraints while first, native or preferred language, region of birth and years lived in Australia were included.

Table 3.8 summarises the independent variables assessed in the included systematic review studies. They provide additional evidence for my methodological approach outlined in Chapter (2) Methodology; age and sex were the most assessed individual factors as data were available even in registry data, followed by marital status and education attainment. Other factors included country of birth and duration of residence (migration related factors), socio-economic factors, health measures (specific and number of comorbidities) and risk factors (physical activity, BMI kg/m^2, current smoking and alcohol consumption).

The systematic review findings confirm a paucity of data to investigate the effects of race and ethnicity, genetic factors, migrant policies and environmental factors on health status. These measures were not assessed in most of the included studies in Australia and Canada. Even in the included studies some factors such as ethnicity were broadly described using terms such as “White” and “visible minority” (20). As previously described in Chapter (1) Introduction such broad categories hide health differences in diverse migrant populations. Similarly, such data were unavailable or inadequate in the DYNOPTA dataset.

Table 3.8: Independent factors assessed in included migrant health studies[113]

	No of Australian Studies	No of Canadian Studies	Both
Age & sex	≤29	≤14	≤1
Marital status & education	≤13	≤7	
Household related variables (household composition & number of children)	≤6	≤3	
Migrant related factors			
Country & region of birth	≤16	≤6	≤1
Race, ethnic background & migrant status	≤3	≤2	
Duration, period of residence & age at migration	≤11	≤1	
State of residence	≤3	≤1	
English proficiency	≤4	≤1	
Socio-economic status			
Occupation (Household annual pre-tax income, employment status, financial comfort & main source of income)	≤9	≤3	
Health measures			
Mortality, dementia, myocardial infarction history, stroke history, cancer history, self-rated quality of life & high blood pressure	≤1	≤1	
Diabetes	≤3		
Self-rated health	≤6	≤1	
Number of comorbid conditions	≤3	≤1	
Disability (IADL)	5		

[113] Some factors assessed in TB studies were excluded as they were specific to the spread of TB (Household or other close contact with TB, ever resided in a correctional facility, ever resided in an aged care facility, ever employed in an institution, currently or previously employed in health industry in Australia or overseas, ever homeless, past travel to or residence in a high-risk country, chest x-ray suggestive of old untreated TB, currently receiving immunosuppressive therapy, Australian-born child with one or more parent born in a high-risk country and HIV status)

Table 3.8 continued

	No of Australian Studies	No of Canadian Studies	Both
Mental health disorders & cognitive impairment	≤2		
Inflammatory bowel disease		≤1	
Risk factors			
Physical activity, BMI_25 kg/m2 & body fat	≤2	≤3	
Current smoking	≤3	≤6	
Alcohol consumption	≤2	≤6	
Dietary patterns & sunshine exposure	≤1	≤1	
Other factors			
Health insurance	≤2	≤1	
Social support, conversational ability and perceived life stress, experience of recent stressors & satisfaction with life in Australia	≤4	≤1	
Current treatment for hypertension, current treatment for hypercholesterolaemia, memory functioning & taking medication	≤1		

3.5.1.2 More longitudinal studies on older migrants' health

Though, our findings indicate some variations in the health status of older migrants compared to their host populations, our review only included one longitudinal study and our inferences are largely based on older cross-sectional studies. There is a need for more research examining health changes in older migrants using study designs that explore change over time. They should also emphasise on comparative research between migrants and the host population using a wide range of health measures.

Longitudinal studies should examine interrelated factors that influence older migrants' health such as country of birth, age at migration and by extension period of migration, language, age, sex, education and socio-economic status, marital status, varied lifestyle patterns and risk factors. This would not only result in greater understanding of older migrants' health but would highlight differential risk factors for certain diseases between migrants and the host population and identify any socio-cultural and structural barriers, aiding in the development of appropriate health policies, programmes and interventions for specific migrant populations.

Acculturation theories and the healthy migrant effect hypothesis need be critically re-examined. It is important to determine the nature and source of any existing health advantages in older migrants. Considerable attention is paid to negative acculturation which is said to be a barrier in maintaining health status, but positive attributes of acculturation may be important in the reduction of risk factors particularly those acquired from their country of birth. Longitudinal studies may aid in identifying positive health attributes as causality can be inferred (218).

Researchers should investigate some aspects of Berry (89) acculturation framework which appear important to migrants health. As stated in Chapter (1) Introduction changes in socio-economic status may result in a "loss of status" more so if their country of birth qualifications are not recognised in their host country, resulting in underemployment and unemployment (1). As education is an important social determinant of health, it is important to understand how it impacts on the health status of different older migrants' groups; older established migrants who migrated with low education attainment, later life migrants and emerging older economic migrants who though they migrated with high education attainment may have experienced a loss of status.

3.5.1.3 Inclusion of qualitative studies in future systematic reviews

Future reviews on older migrants' health should consider including qualitative studies to inform on factors which may influence their health.

3.5.1.4 Research on health screening programs effectiveness

Research on the effectiveness of the pre-migration and post migration screening programmes is needed. As screening of migrants for potential health threats should be based on proper disease aetiology. Some diseases which have severe consequences to individuals and the population in terms of health and economic cost such as hepatitis C, which may result in complications such as liver cancer (319, 320), are often diagnosed by chance many years after infection (321). Research is required to identify migrant populations who would benefit from early diagnosis and treatment.

3.5.2 For policy and practice

Policies on older migrants' health should be based on empirical research and should outline the basic principles for actions for funders, researchers, government bodies and health workers. While, public health programs and interventions need to be more sensitive to the diverse health needs of heterogenous migrant populations and should be disseminated through a multi-agency approach from government agencies to community organisations. They should take the following into account: -

3.5.2.1 Challenges faced by specific migrant populations

Policies need to be sensitive to the difficulties faced by older migrants such as poor socio-economic status, language and difficulties. Which may not only result in poor health but may hinder and restrict health seeking behaviours. For instance, if maintaining certain country of birth dietary patterns are important to either risk reduction to certain diseases or maintaining certain health advantages. Migrants should be provided with information/linkages on availability of such foods in their host country through community-based organisations or populations.

For older established migrant populations such as Greek (63) and Italian (62) migrants their lower education and lower socio-economic status should be considered when formulating appropriate health and social care policies. Policies need to address "under employment" and "unemployment" in migrants selected based on their skills. Interventions should provide linkages for increasing skills and languages where appropriate as this may be protective against poor health. For instance, older established migrant populations may benefit from free language courses offered in Canada and Australia which often target new migrants, this may increase their access to health care.

3.5.2.2 Attitudes, beliefs and knowledge of disease aetiology by migrants

Migrants need to be sensitized on certain diseases and infections they may be at risk of as a result of their country of birth. Specific migrant populations may not know they are at an increased risk of TB, diabetes, hepatitis C and *H. pylori* as a result of factors associated with their country of birth. Sensitisations, should therefore, increase migrants' awareness on modes of transmission, clinical progression, treatment, preventative measures and commonly known complications for diseases and untreated infections. As prior mentioned hepatitis C may progress to liver cirrhosis (127) and liver cancer (319, 320, 322) while *H. pylori* may lead to gastric cancer (256). Increased awareness on risk factors, disease transmission, progression and treatment may result in greater understanding and acceptability of treatment of certain diseases by migrants. This may help in the reduction of disease burden by identifying more individuals who would benefit from early treatment. Benefits of early treatment include increased survival rates for diseases such as cancer (323) and substantial gain in quality-adjusted life-years (QALY) as observed in elderly individuals treated for LTBI (324).

Migrants may not have enough knowledge on how acculturation or migrating increases their risk to certain diseases i.e. vitamin D deficiency and specific cancers. For example, despite high education levels, migrant Thai women in Australia demonstrated low knowledge on breast cancer and did not fully understand the importance of breast cancer screening initiatives such as mammograms (325). Sensitisation programs need to emphasise on specific health promotion information. More so for migrants whose health advantage is said to diminish as a result of adapting to the host country's lifestyle patterns. Health promotion should emphasize on retaining specific facets of migrant diets and lifestyles patterns such as low smoking prevalence which are associated with known health advantages. However, for some migrant populations adapting to some lifestyle patterns maybe beneficial, especially if they originate from countries with for example higher smoking or alcohol consumption rates relative to Australia or Canada.

Policies should also account for migrants' attitudes and beliefs, which may impact their health. For example, some migrants' attitudes towards sunlight (preference for lighter skin) and lack of dietary supplementation may increase their risk of vitamin D deficiency. Attitudes towards mental health problems may hinder certain migrant populations from seeking appropriate care (326). Innovative strategies such as disseminating information in languages migrants are familiar with and use of cultural mediators are important in addressing barriers resulting from attitudes and beliefs.

Migrants need to be sensitised on existing health programs. For example Australia fully subsidises the cost of screening and treatment of TB, independent of residency status (274). It also has several strategies aimed at the reduction of specific cancers incidence such as melanoma, which includes encouraging people to apply broad spectrum sunscreen and wear sun protective clothing (327).

The findings of one US study suggests primary health care providers may lack enough understanding on differential risk factors for infections such as hepatitis C (322). Considering changing migrant composition (267) host countries should increase awareness in medical/health practitioners on identification of differential risk factors to certain diseases for specific populations. This would aid in an increase in earlier identification of patients who would benefit from screening and treatment.

Host countries should use a variety of channels in the publication and dissemination of sensitisation materials to migrants. Published educational resources (audio, online, film or written) should be published in languages migrant are familiar with and possibly disseminated not only through government agencies but also through community organisations. To encourage screening for potential diseases in older migrants, programs should be implemented with the help of community organisations and skilled health care professionals to break down any potential language and cultural barriers. A Canadian website, CATIE suggests practical tools for hepatitis C screening for individuals and health care professionals such as using the Canadian collaboration for immigrant and refugee health (CCIRH) tool for assessing whether screening for hepatitis C is appropriate (267). It also provides tailored multi-lingual resources for individuals to learn about hepatitis C in their own language (267).

3.5.2.3 Improved surveillance and screening

Pre-migration and post migration policies should focus on detection and treatment of diseases commonly associated with the migrants' country of birth. For example, recent migrants in Australia and Canada are more likely to come from countries that have intermediate or high rates of TB. Strategies on TB should not only target migrants at a high risk of TB infection but also on early detection and treatment of LTBI. LTBI screening is one of the key intervention in the elimination of TB in England (328). An evaluation of latent TB screening program in a Newham centre, England, an area with a large concentration of migrants and high TB incidence relative to other areas, demonstrated the effectiveness of screening high risk migrants on TB control, however it also highlighted challenges encountered by such programs such as low uptake (329).

Canada and Australia currently recognise the importance of detection and treatment of latent TB. Australia has a strategic plan for TB control for the years 2016-2020 and whose aims include comprehensive pre-migration and post migration screening to detect and prevent active and latent TB, offer appropriate treatment through a multi-agency collaboration including non-health agencies such as the Department of Immigration and Border Protection, education and housing services and community-based organisations (330). Canada recognises the cost effectiveness of LTBI treatment (less than $1000 per patient) relative to active TB (approximately $47,000) (331).

These policies and strategies should extend to other infections and diseases migrants are at risk of, to possibly reduce any burden to the economy and individual. For example, research suggest screening Asian individuals with a BMI of ≥23 kg/m^2 for diabetes would enable early diagnosis and management in this population (332).

Policies and subsequent interventions should also focus on management of current conditions for specific migrants who are less likely to access health care for various reasons (language, socio-economic etc.) to reduce further complications from diseases. For example, increased sensitization among diabetic Asian migrants on foot care programs was associated with a reduction in amputations (277).

3.6 Conclusions

Our findings indicate variations in the health status of older migrants and their host population in Australia and Canada. Older migrants had both health advantages and disadvantages relative to the host populations which varied with increased duration of residence. The variations in the health status may be as a result of factors related to their country of birth or host country including lifestyle patterns (dietary and other risk factors), environmental factors, disease patterns, age and age at migration, period of migration, sex, marital status, education attainment, health literacy related factors and economic status.

We found limited evidence on older migrants self-rated health status, characterised by a few cross-sectional and no longitudinal studies investigating the self-rated health of older migrants compared to the Australian and Canadian born population. Though these studies provided some useful insights on older migrants' health status compared to their host populations, they did not inform on health status over time. Further, some studies were older and used broad migrant categorisations, limiting the generalisability of their findings. The next chapter addresses some of these limitations by investigating older migrants self-rated health status and associated health determinants at repeated time points using a large Australian study; DYNOPTA.

Chapter 4 Repeated cross-sectional analysis

4.0 Introduction

The first two chapters provided a background to migrants' health, highlighted research questions, aims and objectives and discussed the rationale and structure of the methods used to address them. Chapter (3) systematically reviewed existing cross-sectional and longitudinal studies published between 1960-2020 on older migrants' health in Australia and Canada using a prior written search strategy and identified gaps in knowledge. It also highlighted implications for research, practice and policy.

The review findings indicate there are differences between the health status of older migrants and the host population in Australia and Canada. Older migrants had a lower risk for mortality, cancer, cardiovascular diseases and falls, they also had more years free of disability and dependency relative to the host population. However, despite these health advantages, older migrants had a higher risk of TB, hepatitis C, vitamin D deficiency, poor mental health, *H. pylori* and end-stage renal disease relative to the host population. A detailed discussion of other older migrants' health (dis)advantages are reported in Chapter (3) Systematic review.

The review findings identify a gap in knowledge as migrant health determinants remain poorly described as some of the studies used registry data that were largely restricted to individual factors such as age, sex and country of birth, and inform the choice of potential variables from the DYNOPTA study.

This chapter will present the methods, findings of the cross-sectional analysis to address the following research questions, aims and objectives.

1. Research questions
    a) What is the health status of older migrants compared to the Australian-born population?

b) What is the relationship between potentially influential factors and the health of older individuals in Australia?

2. Objectives
   a) To provide a baseline description of participants.
   b) To identify variations in the health status of older migrants and the Australian-born population.
   c) To identify factors related to the health status of older individuals in Australia.
   d) Highlight implications for research, practice, and policy.

4.1 Methods

The subsequent sections outline the chapter methods. The rationale and description for the dataset and study design (repeated cross-sectional analysis) is reported in Chapter (2) Methodology.

4.1.1 Dataset for this analysis

Data were drawn from DYNOPTA contributory studies which included the dependent variable; self-rated health, whereby at wave 1 n=44,215. Figure 4.1, summarises how the cross-sectional analysis dataset was created, other details are provided in Chapter (2) Methodology.

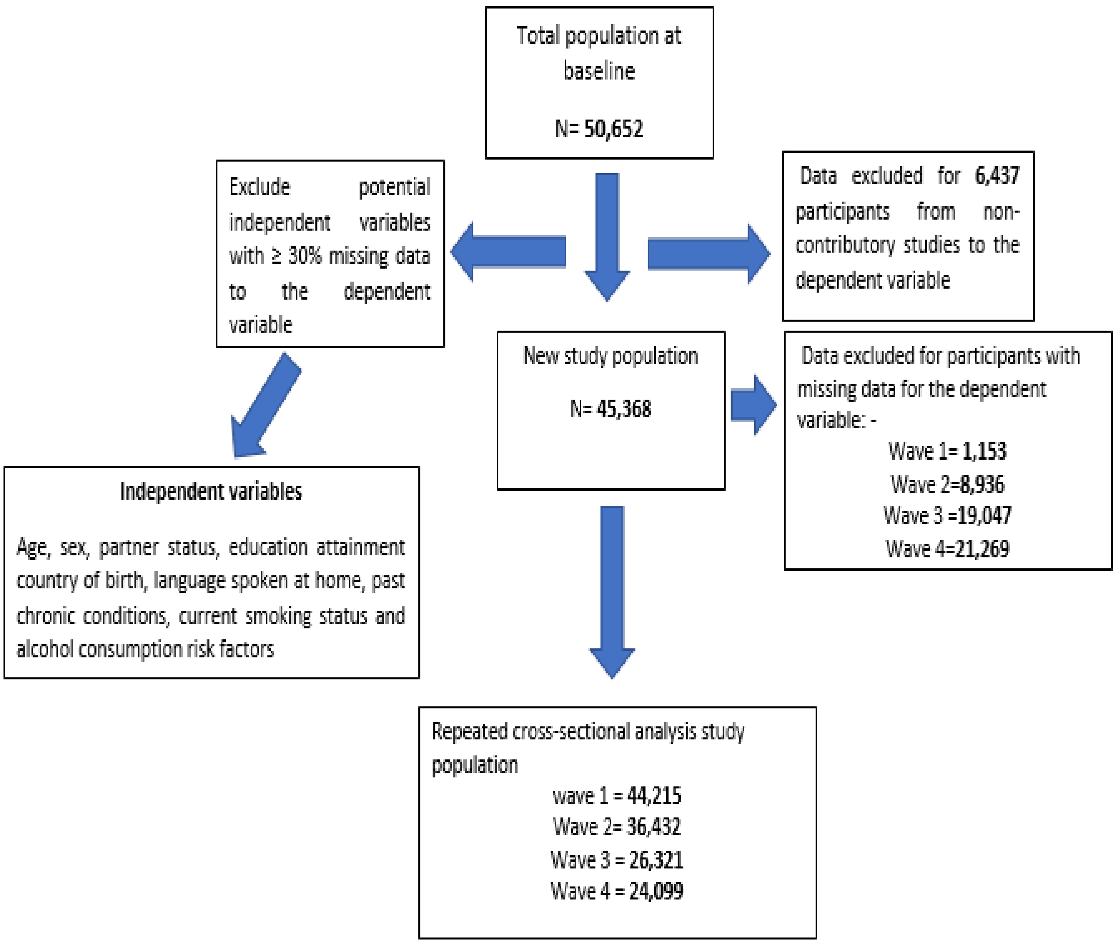

Figure 4.1: Study population for present analysis as derived from total sample size of the self-rated health variable

4.1.2 Study outcomes

4.1.2.1 Dependent variables

The proposed dependent variable is self-rated health, a subjective measure of health. The rationale for this choice is given in Chapter (2) Methodology.

In the DYNOPTA study participants reported their health as either excellent/very good, good, fair or poor. The current analysis collapsed self-rated health into bivariate divergent groups distinguishing between those who rank themselves as "healthy" (excellent, very good, or good) and "unhealthy" (fair or poor) to contrast changes in health status between migrants and the Australian-born.

4.1.2.2 Independent variables

The selection of independent variables was derived from prior knowledge on determinants[114] of migrant health, which indicate migrant health studies lack broader societal factors, as determinants assessed are generally focused on the individual. A detailed description for methods and methodology defining the dataset for my cross-sectional analysis is summarised in Chapter (2) Methodology. All variables apart from age at the time of observation, country of birth and past chronic conditions are included in the analysis using their original categories as per the pooled DYNOPTA study (Table 4.1).

To ascertain any differential distribution of participants by age, age at the time of observation was also included as a categorical variable with five levels; 45-54, 55-64, 65-74, 75-84 and ≥ 85 years, however, the categorical variable was only used in describing the participants socio-demographic, health and risk factors. An additional category for country of birth "unknown nativity" was created to account for participants whose nativity was unknown, in the DYNOPTA study this category was listed as "no response."

As the cross-sectional analysis used a broad definition of migrants[115] and the data available varied across different contributary studies, specific past chronic conditions would provide limited insights. I computed the total score for past chronic conditions and created three new arbitrary categories; no chronic conditions, ≤ 5 past chronic conditions and ≥ 6 past chronic conditions. In migrant health studies there is no standard criteria for inclusion of chronic conditions, some studies examine the presence of chronic conditions (78, 125) others evaluate the presence, number and type of chronic conditions (4) and its association with self-rated health between or within populations. The presence of chronic conditions is said to increase the risk of reporting poor self-rated health (125). Possibly, the more chronic conditions you have the higher your chances of reporting poor health. As such "past chronic conditions" will assess if reporting more prior chronic conditions increases the risk of reporting poor health.

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[114] Highlighted in Chapter (1) Introduction and Chapter (3) Systematic Review

[115] Born or not born in Australia

Table 4.1: Potential variables and their sub-categories

Variable	Categories
Age at the time of observation	• Continuous variable
Country of birth	• Born in Australia • Migrants • Unknown nativity
[116]**Region of birth**[117]	• Inadequately described • Oceania and Antarctica • North-West Europe • Southern Eastern Europe • North Africa • The Middle East • South-East Asia • North-East Asia • Southern and Central Asia • Americas • Sub-Saharan Africa
Education attainment	• No formal education • Some or all of primary school or secondary school • Non-tertiary (i.e. apprenticeship/trade, certificate) • Tertiary
Sex	• Male • Female
Partner status	• Married • Divorced or separated • Widowed • Never married
Language spoken at home	• English • Other

[116] Variable only included to provide basic characteristics of migrants' specific geographic region of birth

[117] The Standard Australian Classification of Countries (SACC) which classifies countries into broader geographic areas using their social, cultural, economic and political similarities 333. ABS. Standard Australian Classification of Countries (SACC), Second Edition- 1269.0 2008 [Available from: https://www.abs.gov.au/ausstats/abs@.nsf/0/C8B8914F6C683351CA25744D00818CED.

Variable	Categories
Table 4.1 continued	
Alcohol consumption long-term risk factors[118]	• Non-drinker • Low risk • Risky • High risk
Current smoking status	• Never smoker • Former smoker • Current smoker
Past chronic conditions	• Yes • No

4.1.3 Repeated cross-sectional analysis methods

I conducted a repeated cross-sectional analysis design and used logistic regression models to examine older migrants' health status relative to the Australian-born. The analyses followed the steps: -

1. I present descriptive statistics to summarise the characteristics of participants in my dataset for analysis.
2. I used a univariable analysis in which separate analyses were carried out for self-rated health and each independent variable for each DYNOPTA wave, to identify variables that were significantly associated with self-rated health ($p < 0.05$). The unadjusted coefficients described the differences in health for each of the independent variables.
3. I used a multivariable analysis to assess the factors associated with self-rated health for each DYNOPTA wave. Adjusted coefficients described the fundamental differences in self-rated health considering the different independent variables. To determine the relationship between candidate independent variables and the health of older migrants, all variables were

[118] These are 2001 guidelines alcohol consumption aimed at reducing the risk of harm from alcohol-related disease or injury proposed by the National Health and Medical Research Council (NHMRC). To reduce the long-term (lifetime) risks from alcohol-related disease or injury a maximum of four drinks for men and two standard drinks for women were recommended 334. NHRMC. Who we are Australia 2020 [cited 2020 22/01]. Available from: https://www.nhmrc.gov.au/about-us/who-we-are. & 335. Bowden JA, Delfabbro P, Room R, Miller CL, Wilson C. Alcohol consumption and NHMRC guidelines: has the message got out, are people conforming and are they aware that alcohol causes cancer? Aust N Z J Public Health. 2014;38(1):66-72.

added into the multivariable model and their impact on the country of birth variable was assessed even where the association was not statistically significant (if they had a plausible biological rationale), as stated in Chapter (2) Methodology; statistical significance does not equate to practical significance. In wave 1 all variables were included in the logistic regression model. However, in subsequent waves including all the variables resulted in either some or all variables being automatically excluded from the results or imprecise odds ratios and corresponding confidence intervals. For example, in some waves including all the variables in the analysis resulted in sex being deleted or in the odds ratios for education attainment categories listed as .000 (.000) (Appendix H[119]). This may indicate a reduction in the sample sizes or the difference in the length of data collection for specific variables in individual DYNOPTA contributory studies which may have increased the number of incomplete cases in subsequent waves. Logistic regression is not able to reasonably deal with missing values, therefore incomplete cases are usually deleted (336, 337). From wave 2, alcohol consumption risk factors and chronic conditions were excluded while current smoking status was excluded from analysis in wave 4.

4. As the univariable and multivariable findings varied greatly for specific independent variables, tests of interactions were carried out to assess the effect of one variable on the value of other variables (338). The effect of country of birth on either language spoken at home and sex on the value of the dependent variable self-rated health at the baseline were independently assessed.
5. Two sensitivity analyses were carried out to determine the robustness of the multi-variate findings. Firstly, participants with unknown nativity were assumed to be migrants, in the second analysis they were assumed to be Australian-born. The sensitivity analysis findings are reported in Appendix I.

[119] Summarises the effects of including all variables in the four DYNOPTA waves which subsequently informed the models included in this chapter

All analyses were performed using SPSS statistical software (version 25). The results are presented in terms of odds ratios (point estimates), whereby an OR<1 means “not healthy”, OR> 1 means “healthy” and OR =1 means “no differences in health”. The results are displayed by figures, graphs and tables.

4.2 Results

4.2.1 Description of participants

Participants characteristics are shown in Figure 4.2 and Tables 4.2 and 4.3. At the baseline there were 44,215 participants with a mean age of 60.4 years (*SD= 12.4*) for the Australian-born and 60.8 years (*SD= 12.2*) for migrants, participants were largely female (81.2% for the Australian-born and 75.0% migrants) (Table 4.2). Migrants are more likely to have originated from North-West Europe and Southern and Eastern Europe, while, they are unlikely to have originated from North Africa, the Middle East and Sub-Saharan Africa (Figure 4.2).

There were minimal variations in the age of migrants and their Australian-born counterparts. Contrastingly, participants whose nativity was unknown were more likely to be older (Table 4.2). Similarly, when disaggregated by sex, there were no differences by age at the time of observation between female and male Australian-born and migrants (Table 4.3).

Sex disaggregation indicates the age distribution of migrant and Australian-born males was more likely to be evenly spread across age groups compared to their female counterparts (Table 3). There was a high proportion of Australian-born and migrant females in the 45-54 and 65-74-years age-groups, however, participants whose nativity was unknown are over-represented in the 55-64 and 65-74-years age-groups for males and females respectively.

Compared to the Australian-born, migrants were more likely to be married and have a higher education attainment (tertiary and non-tertiary education). Participants whose nativity was unknown were less likely to be married compared to participants with known nativity. They were also less likely to have a higher education attainment (tertiary and non-tertiary education) but more likely to have some or all primary/secondary education compared to migrants. English language proficiency at home was lower for migrants and participants whose nativity was unknown than the Australian-born participants (Table 4.2).

Variations in long-term alcohol consumption risk for Australian-born and migrants were minimal. However, participants with unknown nativity had a higher alcohol consumption long-term risk factor. Interestingly, migrants reported a moderately high proportion of current and former smokers than the Australian-born participants, while participants whose nativity was unknown were less likely to be former smokers. For past chronic conditions, migrants were more likely to report fewer past chronic conditions compared to the Australian-born and participants with unknown nativity.

Disaggregation by sex however indicates some important differences (Table 4.3). Males were more likely to be married compared to females, while females were more likely to be widowed. Males were more likely to have non-tertiary or tertiary education compared to females who generally reported some or all of primary or secondary education, the gradient for higher education was higher for migrant males. Males and females born in Australia were more likely to speak English at home compared to their migrant counterparts, however, female migrants were more likely to speak English at home compared to male migrants. The language spoken at home variable had a large proportion of participants whose language preference was unknown.

Table 4.2: Baseline socio-demographic characteristics of the study population, N=44,215

	Australian-born (31752)	Migrants (11196)	Unknown Nativity (1267)
	N %	**N (%)**	**N (%)**
Age at the time of observation (mean (SD[120]) (years))	60.4 (12.4)	60.8 (12.2)	66.2 (8.7)
Age at the time of observation (age-groups)			
45-54 years	13894 (43.8)	4643 (41.5)	167 (13.2)
55-64 years	3795 (12.0)	1749 (15.6)	302 (23.8)
65-74 years	11191 (35.2)	3616 (32.3)	758 (59.8)
75-84 years	2360 (7.4)	944 (8.4)	40 (3.2)
>85 years	512 (1.6)	244 (2.2)	0 (≤1.0)
Sex			
Male	5956 (18.8)	2801 (25.0)	174 (13.7)
Female	25796 (81.2)	8395 (75.0)	1093 (86.3)
Partner status			
Married	22571 (71.1)	8189 (73.1)	737 (58.2)
Divorced or separated	2861 (9.0)	1053 (9.4)	120 (9.5)
Widowed	4964 (15.6)	1591 (14.2)	318 (25.1)
Never married	1203 (3.8)	298 (2.7)	37 (2.9)
No response	153 (≤1.0)	65 (≤1.0)	55 (4.3)
Education			
No formal education	46 (≤1.0)	78 (≤1.0)	5 (≤1.0)
Some or all of primary school or secondary school	19936 (62.8)	5877 (52.5)	747 (59.0)
Non-tertiary study (i.e. Apprenticeship/trade, certificate)	7703 (24.3)	3421 (30.6)	151 (11.9)
Tertiary study	3327 (10.5)	1611 (14.4)	99 (7.8)
No response	740 (2.3)	209 (1.9)	265 (20.9)

[120] Standard deviation

Table 4.2 continued			
	Australian-born (31752)	Migrants (11196)	Unknown Nativity (1267)
	N %	N (%)	N (%)
Language spoken at home			
English	24868 (78.3)	6354 (6.8)	207 (16.3)
Other	125 (≤1.0)	1946 (17.4)	24 (1.9)
No Response**α**	6759 (21.3)	2896 (25.9)	1036 (81.8)
Alcohol consumption: long-term risk factor group (NHMRC guidelines 2001)			
Non-Drinker	5873 (18.5)	2020 (18.0)	219 (17.3)
Low Risk	21947 (69.1)	7700 (68.8)	774 (61.1)
Risky	1301 (4.1)	394 (3.5)	71 (5.6)
High Risk	538 (1.7)	181 (1.6)	34 (2.7)
No Response**α**	2093 (6.6)	901 (8.1)	169 (13.3)
Current Smoking Status			
Never Smoker	17766 (56.0)	5302 (47.4)	505 (39.9)
Former Smoker	9263 (29.2)	4074 (36.4)	324 (25.6)
Current Smoker	3849 (12.1)	1537 (13.7)	158 (12.5)
No Response	874 (2.8)	283 (2.5)	280 (22.1)
Past Chronic Conditions			
No past chronic conditions	9205 (29.0)	3639 (35.0)	230 (18.2)
1-5 past chronic conditions	15113 (47.6)	4737 (42.3)	601 (47.4)
6 or more past chronic conditions	1776 (5.6)	408 (3.6)	78 (6.2)
No response**α**	5658 (17.8)	2412 (21.5)	358 (28.3)

α Includes data missing as result of "not asked in study" or "study not included in harmonised variable."

Table 4.3: Baseline socio-demographic characteristics of the study population disaggregated by sex, N=44,215

	Male			Female		
	Australian-born (N %)	**Migrants (N %)**	**Unknown Nativity (N %)**	**Australian-born (N %)**	**Migrants (N %)**	**Unknown Nativity (N %)**
Age at the time of observation (mean (SD)) (years)	63.0 (11.7)	63.9 (11.3)	65.4 (7.4)	60.0 (12.6)	59.9 (12.4)	68.0 (10.1)
Age at the time of death (mean age (SD)) (years)	83.7 (8.0)	83.8 (8.5)	72.9 (11.0)	85.2 (8.4)	86.3 (8.1)	81.0 (13.4)
Age at the time of observation (age-groups)						
45-54 years	1791 (29.4)	713 (24.5)	0 (≤1.0)	12300 (46.8)	4040 (46.7)	174 (14.4)
55-64 years	1840 (30.2)	953 (32.8)	153 (73.6)	2013 (7.7)	852 (9.9)	150 (12.4)
65-74 years	1289 (21.2)	658 (22.6)	29 (13.9)	10185 (38.7)	3084 (35.7)	787 (65.0)
75-84 years	917 (15.1)	443 (15.2)	17 (8.2)	1507 (5.7)	542 (6.3)	63 (5.2)
>85 years	255 (4.2)	139 (4.8)	9 (4.3)	299 (1.1)	129 (1.5)	37 (3.1)
Partner status						
Married	4854 (79.7)	2407 (82.8)	151 (72.6)	18095 (68.8)	6022 (69.6)	629 (51.9)
Divorced or separated	496 (8.1)	209 (7.2)	27 (13.0)	2421 (9.2)	875 (10.1)	97 (8.0)
Widowed	447 (7.3)	182 (6.3)	19 (9.1)	4678 (17.8)	1477 (17.1)	390 (32.2)
Never married	289 (4.7)	104 (3.6)	11 (5.3)	942 (3.6)	206 (2.4)	30 (2.5)

Table 4.3 continued						
	Male			Female		
	Australian-born (N %)	Migrants (N %)	Unknown Nativity (N %)	Australian-born (N %)	Migrants (N %)	Unknown Nativity (N %)
No response	6 (≤1.0)	4 (≤1.0)	0 (≤1.0)	168 (≤1.0)	67 (≤1.0)	65 (5.4)
Education						
No formal education	17 (≤1.0)	20 (≤1.0)	0 (≤1.0)	31 (≤1.0)	71 (≤1.0)	5 (≤1.0)
Some or all of primary school or secondary school	2182 (35.8)	833 (28.7)	59 (28.4)	18187 (69.1)	5257 (60.8)	717 (59.2)
Non-tertiary study (i.e. Apprenticeship/trade, certificate)	2736 (44.9)	1393 (47.9)	62 (29.8)	5100 (19.4)	2113 (24.4)	90 (7.4)
Tertiary study	1048 (17.2)	599 (20.6)	53 (25.5)	2316 (8.8)	1046 (12.1)	46 (3.8)
No response	109 (1.8)	61 (2.1)	34 (16.3)	670 (2.5)	160 (1.9)	353 (29.1)
Language spoken at home						
English	3034 (49.8)	1136 (39.1)	0 (≤1.0)	22217 (84.5)	5307 (61.4)	213 (17.6)
Other	6 (≤1.0)	242 (8.3)	0 (≤1.0)	123 (≤1.0)	1745 (20.2)	24 (2.0)
Study not included in harmonised variable	3052 (50.1)	1525 (52.5)	208 (100)	3414 (13.0)	1421 (16.4)	228 (18.8)
No response	40 (≤1.0)	3 (≤1.0)	0 (≤1.0)	550 (2.1)	174 (2.0)	746 (61.6)

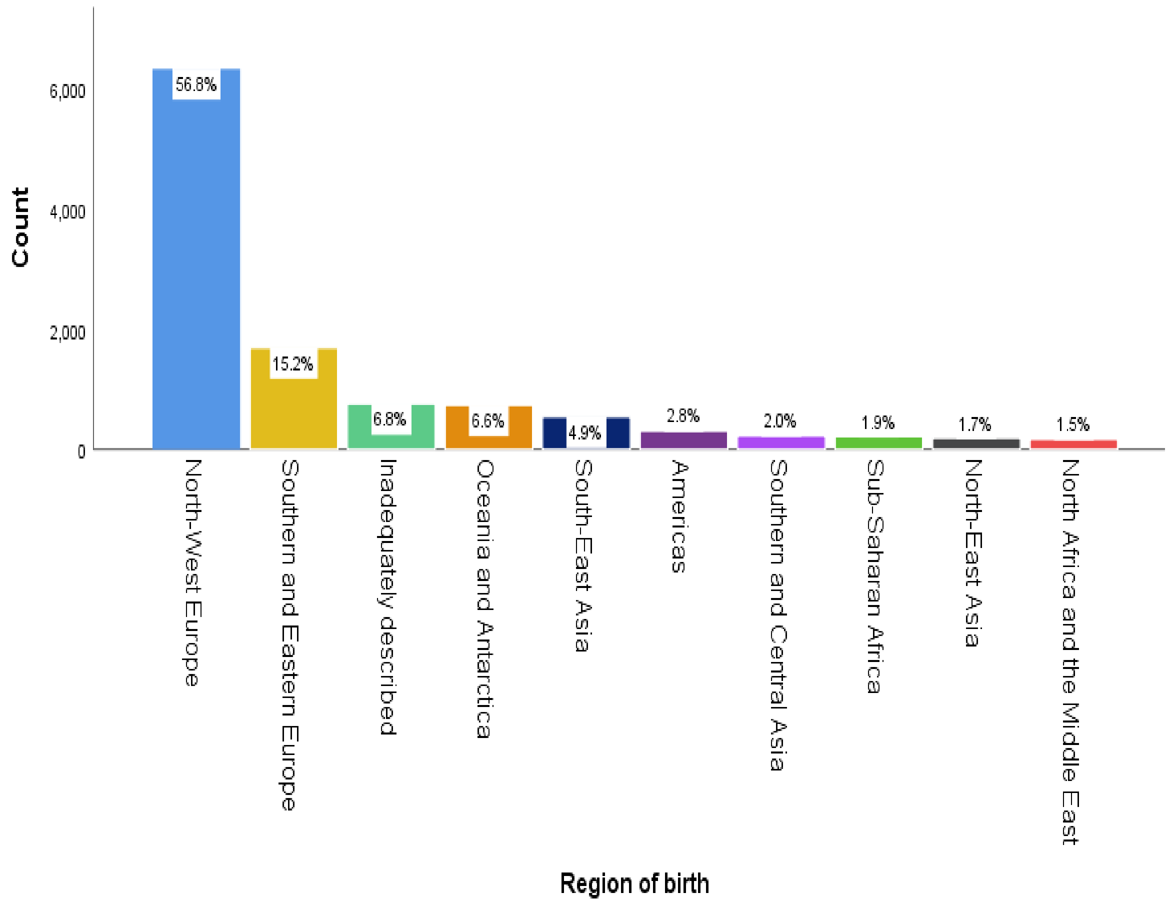

Figure 4.2: Distribution of migrants by region of birth N = 44,215

4.2.2 Repeated cross-sectional analysis findings

4.2.2.1 Univariable regression

Table 4.4 provides a summary of the unadjusted odds for health status and for specific independent variables. The investigation for the association between each variable and self-rated health was carried out separately for the four waves.

The point estimates suggest, migrants and participants with unknown nativity had lower odds of reporting better health compared to the Australian-born. For example, in wave 1 the point estimates for migrants was 0.927 and those with unknown nativity 0.599, as this is less than 1, it indicates lower odds of reporting better health compared to the Australian-born population. However, for migrants other than wave 1, the 95% confidence intervals included 1, meaning the results for waves 2-4 were not statistically significant. The strength of association was greater for participants whose nativity was unknown as their likelihood of reporting poor health was 40% (1-0.599*100) higher than the Australian-born population, while for migrants the likelihood was only 7.4% (1-0.927*100) in Wave 1. This pattern is repeated in subsequent waves.

Concerning other independent variables; divorce, widowhood and never married, current and former smokers, past chronic conditions and not speaking English at home were strongly associated with higher odds of reporting poor health in the four DYNOPTA waves. Further, their 95% confidence intervals were narrow indicating higher precision of the ORs (point estimates) (224). There was little change in how participants reported their health with increasing age across the waves. Though age was not strongly associated with self-rated health across the four DYNOPTA waves (i.e. OR for wave 1, 0.926), the narrow confidence intervals indicate high precision for the odds ratios. Past chronic conditions had the strongest association with self-rated health, in wave 1 the odds of reporting poor health for individuals with past chronic conditions were 67.4% higher than those who did not report past chronic conditions. The likelihood of reporting poor health for individuals with past chronic conditions increased in subsequent waves; wave 1=67.4%, wave 2=67.8%, wave 3=72.3% and wave 4=71.0%. Past chronic conditions and self-rated health had an inverse relationship, the more chronic conditions you had the more likely you were to report poor health. The odds of reporting poor health for current smokers and participants who did not speak English at home also increased in subsequent waves.

High education attainment, being female and low risk, risky and very risky alcohol consumption were independent indicators of reporting better health. Though education was strongly associated with self-rated health, the wide confidence intervals indicate imprecision, for example, in wave 4 the odds of reporting better health for highly educated individuals could be as high as 19.776 or as low as 5.084. Education and self-rated health had a direct relationship, that is the higher your education attainment the greater your odds of reporting better health. The points estimate and subsequently the strength of association for sex and alcohol consumption varied across the waves. For example; female sex was strongly associated with self-rated health in the 3rd wave (56.6%) compared to the other waves (wave 1=14.9%, wave 2 =12.5% and wave 4= 28.9%).

Table 4.4: Unadjusted Odds ratio (OR) for self-rated health (univariable model)

	Wave 1 Unadjusted OR (CI)	Wave 2 Unadjusted OR (CI)	Wave 3 Unadjusted OR (CI)	Wave 4 Unadjusted OR (CI)
Country of birth				
Migrants	.927 (.879 to .978*)	.956 (.901 to 1.015)	.959 (.894 to 1.028)	.959 (.893 to 1.030)
Unknown nativity	.599 (.529 to .679*)	.597 (.511 to .697*)	.657 (.552 to .782*)	.626 (.518 to .756*)
Reference is born in Australia				
Age at the time of observation	.960 (.958 to .962*)	.962 (.960 to .964*)	.970 (.967 to .972*)	.962 (.960 to .965*)
Sex				
Female	1.149 (1.086 to 1.216*)	1.125 (1.054 to 1.200*)	1.566 (1.441 to 1.702*)	1.289 (1.181 to 1.408*)
Reference is males				
Partner status				
Divorced or separated	.713 (.659 to .771*)	.719 (.658 to .784*)	.672 (.609 to .741*)	.688 (.622 to .761*)
Widowed	.542 (.511 to .576*)	.541 (.508 to .577*)	.631 (.588 to .676*)	.503 (.470 to .539*)
Never married	.682 (.604 to .769*)	.694 (.606 to .796*)	.761 (.647 to .895*)	.616 (.522 to .727*)
Reference group is married				

Table 4.4 continued				
	Wave 1 Unadjusted OR (CI)	Wave 2 Unadjusted OR (CI)	Wave 3 Unadjusted OR (CI)	Wave 4 Unadjusted OR (CI)
Education attainment				
Primary or secondary education	3.252 (2.300 to 4.598*)	3.710 (2.397 to 5.743*)	4.162 (2.277 to 7.605*)	4.567 (2.335 to 8.935*)
Non-tertiary	4.636 (3.271 to 6.571*)	4.986 (3.214 to 7.735*)	4.929 (2.691 to 9.027*)	6.090 (3.106 to 11.941*)
Tertiary	8.455 (5.915 to 12.083*)	8.580 (5.493 to 13.401*)	8.805 (4.773 to 16.244*)	10.027 (5.084 to 19.776*)
Reference is no formal education				
Language spoken at home				
Other	.495 (.449 to .545*)	.542 (.483 to .607*)	.519 (.455 to .592*)	.576 (.501 to .662*)
Reference is English				
Past chronic conditions				
1-5 Past chronic conditions	.326 (.305 to .349*)	.322 (.300 to .346*)	.277 (.252 to .304*)	.290 (.261 to .322*)
+ 6 Past chronic conditions	.100 (.090 to .111*)	.092 (.080 to .107*)	.083 (.071 to .096*)	.085 (.075 to .097*)
Reference is no past chronic conditions				
Current smoking status				
Former smoker	.795 (.754 to .838*)	.824 (.775 to .876*)	.779 (.716 to .848*)	.755 (.686 to .830*)
Current smoker	.648 (.604 to .694*)	.733 (.672 to .799*)	.600 (.538 to .669*)	.481 (.429 to .539*)

Table 4.4 continued

	Wave 1 Unadjusted OR (CI)	Wave 2 Unadjusted OR (CI)	Wave 3 Unadjusted OR (CI)	Wave 4 Unadjusted OR (CI)
Reference is never smoker				
Alcohol consumption: long-term risk factor group (NHMRC guidelines 2001)				
Low risk	2.174 (2.056 to 2.300*)	2.210 (2.066 to 2.364*)	1.510 (1.395 to 1.635*)	2.280 (2.063 to 2.520*)
Risky	2.239 (1.956 to 2.562*)	2.343 (2.003 to 2.740*)	2.094 (1.824 to 2.402*)	2.478 (2.005 to 3.061*)
High risk	1.555 (1.300 to 1.859*)	1.425 (1.116 to 1.818*)	1.422 (1.105 to 1.831*)	1.392 (.968 to 2.001)
Reference category is non- drinker				
*** represents p < 0.05**				

4.2.2.2 Multivariable regression

In this section, the analysis used multivariable methods to evaluate the relationship between health status as measured by self-rated health and potential determinants of health. Table 4.5 presents the results of the multivariable regression for specific DYNOPTA waves.

After adjusting for the independent variables in the logistic models, the point estimates indicate that migrants moved from having higher odds for reporting poor health in Wave 1 to higher odds of reporting better health in subsequent waves relative to the Australian-born, however the association was not statistically significant for waves 1, 3 and 4. Participants with unknown nativity were still more likely to report poor health than the Australian-born population, but the findings are less precise and become statistically insignificant in waves 3 and 4.

Similar to the univariable analyses, increasing age, not speaking English at home, being divorced or separated or never married were associated with higher odds of poor self-reported health in the four waves. However, the strength of association was greater for language spoken at home across the waves, for example the likelihood of reporting poor health was 53% higher in wave 1 for participants who did not speak English at home than participants who spoke English at home. For partner status, the category “widowed” was no longer strongly associated with poor self-rated health as the point estimates were either close to or slightly above 1, in wave 2 and 3 they were not statistically significantly associated with health.

Higher education attainment was associated with being healthy in all the four waves, the strength of association was not as high as in the univariable analysis. Further, the wide confidence intervals and the lack of statistical significance in some waves suggest some imprecision of the point estimates (for the category primary or secondary school education the point estimates for wave 1 and 3 were not significant as the 95% confidence intervals cross 1).

The point estimates for sex varied across the waves. Females appear to lose their health advantage from the 2nd wave in the multivariable analysis as they had higher odds of reporting poor health. The results were not statistically significant for waves 3 and 4.

Current or former smokers and past chronic conditions were strongly associated with poor health, while low risk or risky alcohol consumption were associated with reporting better health as opposed to non-consumption of alcohol. However, as prior stated these variables were only included in some of the waves only.

Further analysis indicated a statistically significant interaction between country of birth and language spoken at home (Figure 4.3). Australian-born participants who spoke languages other than English at home had lower odds of reporting better self-rated health compared to English speaking Australian-born participants. The confidence intervals were however wide indicating imprecision, probably stemming from a small sample size for Australian-born individuals who spoke languages other than English at home (as indicated prior by Table 4.2). For migrants speaking English at home was associated with higher odds of reporting better self-rated health than their non-English speaking counterparts. There were no interaction effects between country of birth and sex on self-rated health (Figure 4.4).

Table 4.5: Adjusted Odds ratio for good self-rated health (multivariable model)

	Wave 1 Adjusted OR (CI)	Wave 2 Adjusted OR (CI)	Wave 3 Adjusted OR (CI)	Wave 4 Adjusted OR (CI)
Country of birth				
Migrants	.997 (.919 to 1.081)	1.140 (1.041 to 1.249*)	1.093 (.962 to 1.243)	1.092 (.990 to 1.203)
Unknown nativity	.652 (.449 to .945*)	.632 (.435 to .918*)	.670 (.304 to 1.475)	.840 (.563 to 1.254)
Reference is born in Australia				
Age at the time of observation	.975 (.973 to .978*)	.961 (.958 to .964*)	.959 (.952 to .965*)	.963 (.959 to .966*)
Sex				
Female	1.250 (1.130 to 1.384*)	.874 (.763 to 1.000*)	.924 (.733 to 1.166)	.961 (.806 to 1.145)
Reference is males				
Partner status				
Divorced or separated	.734 (.657 to .818*)	.651 (.579 to .731*)	.587 (.507 to .680*)	.633 (.557 to .720*)
Widowed	.945 (.867 to 1.030)	.947 (.864 to 1.038)	1.025 (.838 to 1.253)	.875 (.795 to .962*)
Never married	.717 (.606 to .848*)	.708 (.588 to .851*)	.568 (.439 to .735*)	.650 (.525 to .805*)
Reference group is married or de-facto				

Table 4.5 continued

	Wave 1 Adjusted OR (CI)	Wave 2 Adjusted OR (CI)	Wave 3 Adjusted OR (CI)	Wave 4 Adjusted OR (CI)
Education attainment				
Primary or secondary education	1.342 (.836 to 2.155)	2.340 (1.259 to 4.351*)	2.617 (.866 to 7.912)	2.790 (1.359 to 5.732*)
Non-tertiary	1.776 (1.102 to 2.864*)	3.032 (1.625 to 5.659*)	3.281 (1.082 to 9.945*)	3.551 (1.722 to 7.323*)
Tertiary	2.432 (1.491 to 3.968*)	3.730 (1.983 to 7.017*)	4.283 (1.401 to 13.088*)	5.007 (2.406 to 10.417*)
Reference is no formal education				
Language spoken at home				
Other	.470 (.413 to .534*)	.479 (.412 to .557*)	.526 (.424 to .653*)	.544 (.461 to .641*)
Reference is English				
Past chronic conditions				
1-5 Past chronic conditions	.394 (.363 to 427*)			
+ 6 chronic conditions	.137 (.121 to .154*)			
Reference is no past chronic conditions				
Current smoking status				
Former smoker	.794 (.738 to .854*)	.792 (.734 to .854*)	.886 (.790 to .993*)	
Current smoker	.523 (.475 to .576*)	.598 (.534 to .670*)	.567 (.492 to .654*)	

Table 4.5 continued				
	Wave 1 **Adjusted OR (CI)**	**Wave 2** **Adjusted OR (CI)**	**Wave 3** **Adjusted OR (CI)**	**Wave 4** **Adjusted OR (CI)**
Reference is never smoker				
Alcohol consumption				
Low risk	1.596 (1.482 to1.718*)			
Risky	1.753 (1.458 to 2.107*)			
High risk	1.229 (.958 to 1.576)			
Reference category is non- drinker				

*Represents $p < 0.05$

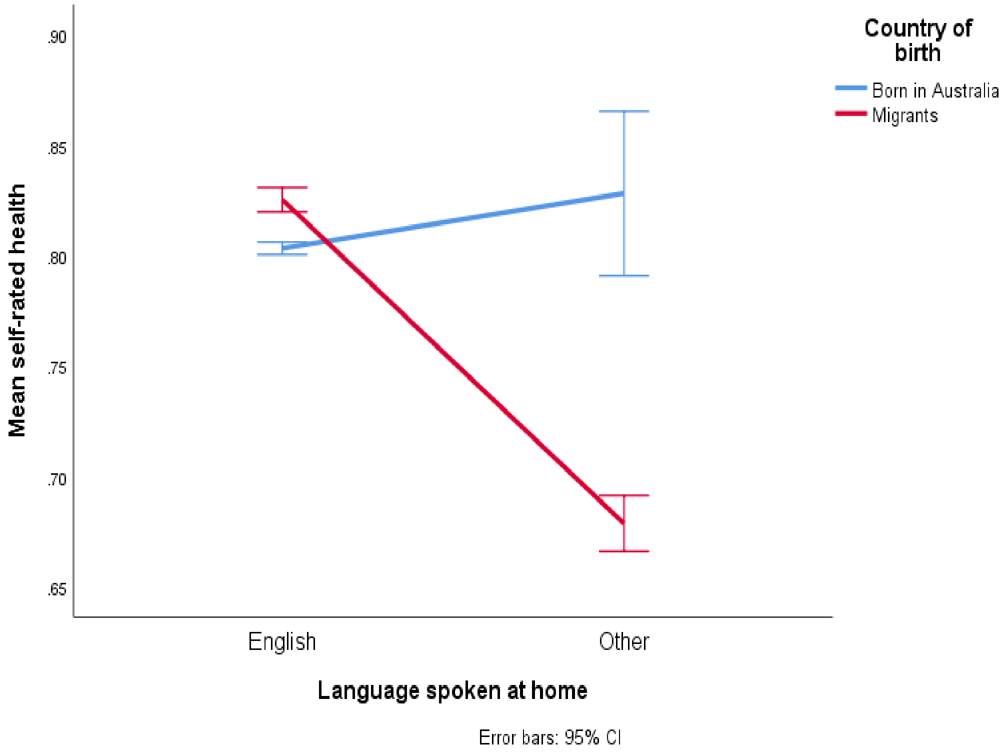

Figure 4.3: Line graph indicating the interaction between country of birth and language spoken at home on self-rated health at the baseline

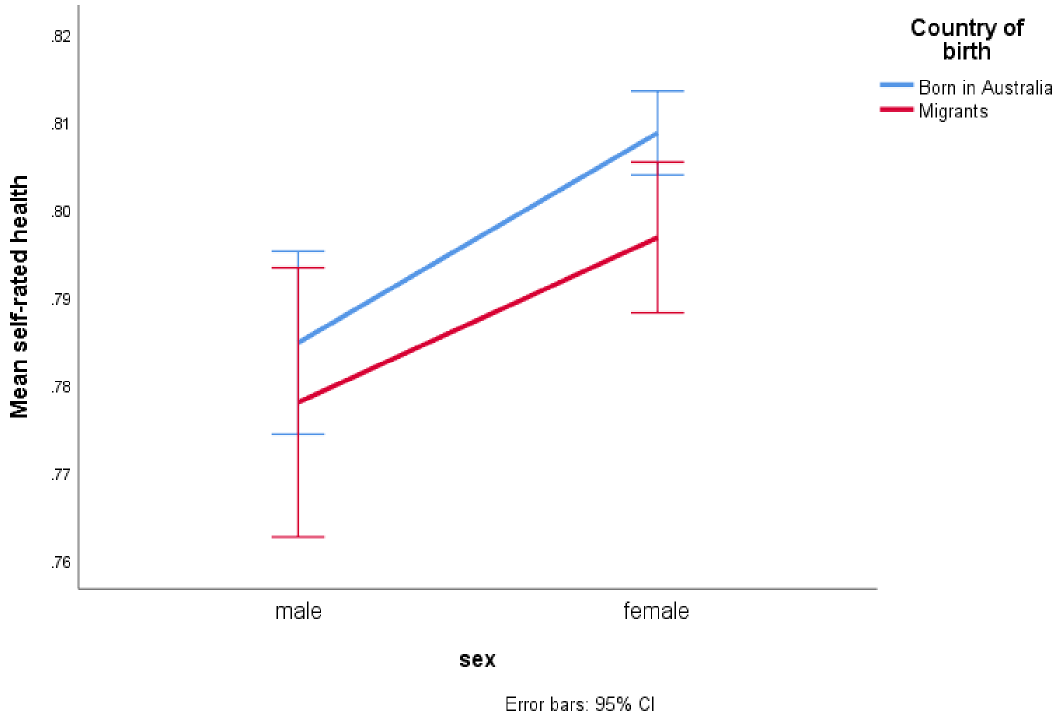

Figure 4.4: Line graph investigating no interaction between country of birth and sex on self-rated health at the baseline

4.3 Discussion

4.3.1 Summary

In the unadjusted analysis the point estimates indicated migrants had higher odds of reporting poor health compared to the Australian-born. However, apart from wave 1, the findings were not statistically significant. Participants with unknown nativity were also more likely to report poor health to a much greater degree than the Australian-born across all waves and these findings were statistically significant.

However, in the adjusted analysis the point estimates changed the findings for both migrants and participants with unknown nativity. Starting from the second wave migrants had greater odds of reporting good health than the Australian-born. However, this was only statistically significant in wave 2, the odds only increased by a small degree and the confidence intervals were narrow suggesting a marginal, if any, difference. For those of unknown nativity, the disadvantage remained but to a lesser magnitude, and by waves 3 and 4 this was no longer statistically significant. It is important to note, that although a relatively small proportion, the unknown nativity group appear to have worse reported health. However, when this group were all treated as “migrants” in a sensitivity analysis (Appendix I), this did not change the findings; migrants still had greater odds of reporting better health compared to the Australian-born population from wave 2 onwards (still only statistically significant in wave 2). When participants with unknown nativity were treated as “Australian-born”; migrants had greater odds of reporting better health across all waves, although only statistically significant in wave 2.

Other variables which remained as predictors of reported poor health in the adjusted model were: being older, being divorced or never married, having a lower level of education, being a current or former smoker, having past chronic conditions and not speaking English at home. Compared to most other variables, not speaking English at home (all waves) and being a current smoker (three waves) were strongly associated with poor self-rated health. The odds of reporting poor health were almost 50% greater in participants who did not speak English at home or current smokers compared to those who spoke English at home and non-smokers respectively, alongside age they were also precise measures of self-rated health as indicated by narrow confidence intervals. Higher levels of education were also strongly associated with the odds of reporting better health – and got stronger in each successive wave -, though the point estimates are imprecise (as indicated by the wide confidence intervals), by wave 4, even the odds ratio lower confidence interval of 2.5 represents significant benefit, and may be as high as 10 times the odds of reporting better health. As expected, a history of more comorbid conditions was strongly associated with poorer health, although again with imprecise point estimates.

Alcohol consumption (low, risky and very risky) was associated with greater odds of reporting better health while past chronic conditions was associated with greater odds of reporting poor health in the first wave only. The relationship with self-rated health in subsequent waves is unknown as these variables were excluded from analysis. The relationship between female sex and self-rated health is not clear – apart from wave 1, where women have statistically significant increased odds of reporting good health, thereafter, they appear to be disadvantaged, but the confidence intervals cross 1 and the magnitude is small and of dubious clinical significance.

4.3.2 Key repeated cross-sectional findings on older migrants' health

My findings suggest that migrants have a marginal, if any, improved odds of reporting better health in successive waves compared to the Australian-born population. Some other migrant studies report a similar pattern; older Chinese-Canadians aged 55 years or more reported better physical health than their overall older Canadian counterparts (339). Though, their findings were statistically significant they cannot be related to all migrants as other older migrant populations were included in the comparison group (overall older Canadians) and "Chinese-Canadians" included individuals of Chinese descent born in Canada. Furthermore, their findings could be biased as the health estimates of the comparator group were derived from other studies. Using data from the 1994/95 and 2000/01 National Population Health (NPHS) surveys, Newbold (208) found migrants aged 20 years or older were less likely to report poor health compared to the Canadian-born population. However, as the point estimates were not significant (1994/95 OR[121], 0.912 *(p>0.05)* and 2000/01 OR, 0.904 *(p>0.05)*), consistent with my findings, they concluded

[121] In this study OR >1 means an increased likelihood of reporting poor health while an OR <1 means a decreased likelihood of reporting poor health

when controlling for other effects, there were no universal differences in how migrants rank their health relative to the Canadian-born population. Similarly, there were no significant differences in the self-assessed health of older migrants aged 55 years or older (67), long-term European migrants[122] (68) and the Canadian-born population. The trend extends to other health measures, after 20 years of residence, no differences were observed in reporting a chronic condition and number of chronic conditions between migrants and the Australian-born population (41).

I found no evidence of a "healthy migrant effect", but my subjects had already lived in Australia for many years. Therefore, the "no differences" may be indicative of convergence in health over time that had already occurred. As discussed in Chapter (1) Introduction, at the time of arrival, migrants are said to possess a health advantage which declines or converges towards that of their host population with increasing duration of residence (3, 10, 68, 70, 73-78).

However, patterns of migration and consequently migrant composition differ over time as the goals of Australia's migration policies changed. Those of my study participants who had been in Australia for many decades are most likely to be English speaking Northern European (e.g. British and Irish), having migrated during race restrictions in the Australian migration law at that time. As a group my older migrant population are also unlikely to be recent migrants and are less likely to have migrated under the skills-based policies' which are largely linked to the healthy migrant effect (Chapters 1 and 2). As such, as well as any convergence occurring earlier (most of my study population had lived in Australia for over three decades (Appendix J), any convergence in health resulting from acculturation perhaps is less likely, coming from relatively similar cultures and socio-demographic characteristics – including similar risky health behaviours such as smoking; smoking and smoking related diseases (both identified as independent predictors of ill-health in the group as a whole in my analysis).

[122] Those who migrated to Canada before 1984

The systematic review (Chapter 3) found little supporting evidence for the healthy migrant effect in accounting for differences in the health of older migrants and the host population. Further, Chapter (1) Introduction highlighted other conceptual and methodological limitations for the healthy migrant effect hypothesis and its associated concepts. The hypothesis proposes a simplistic view on complex migrant health changes mechanisms (130). As migrants' knowledge on disease aetiology may vary from their host populations, the hypothesis maybe confounded by a reporting bias, it may be an indicator of "perceived" as opposed to "actual" health changes (85, 208). Lastly as some assertions on the healthy migrant effect are mainly derived from cross-sectional studies, it may also be confounded by a cohort bias (1, 4, 130).

My findings are consistent with the "social determinants of health perspective," as they demonstrate a strong association between some socio-economic factors and health. Education attainment was consistently and strongly associated with health across all waves. My findings also suggest a dose response relationship whereby an increase in education attainment was associated with greater odds of reporting better self-rated health. Additionally, the magnitude in the odds of reporting better health in individuals with higher education attainment strengthened in subsequent waves. For instance, by wave 4 the odds of reporting better health for individuals with tertiary education had doubled from OR 2.432 (CI, 1.491 to 3.968) in wave 1 to OR 5.007 (CI, 2.406 to 10.417) in wave 4. Though well established and grounded in robust evidence, the social determinants of health studies may not consider how they are influenced by societal structures, political, economic and social forces (340).

My findings should be interpreted with caution. The changes in migrant health in subsequent waves may reflect the increasing proportion of missing data over time. Migrant composition may have varied over time as DYNOPTA contributory studies had differential data collection periods and lengths (Chapter (2) Methodology). Limitations pertaining the statistical analysis software may have further contributed to missing data (Appendix K & L). SPSS by default excludes any incomplete variables, if a participant has any missing values in some specific variables, the entire case will be excluded from the analysis (341). Participants whose nativity was unknown may bias my findings as they were older, less likely to be married, less likely to have a higher education attainment (tertiary and non-tertiary education) but more likely to report poor health compared to participants whose nativity was known. However, my sensitivity analyses did not materially change the pattern of findings.

4.3.3 Factors affecting older individuals' health

Though the socio-demographic, risk and health factors measured in this analysis seem to have very little effect on older migrants' health, they were associated with the self-rated health of older individuals generally and when accounted for in the adjusted analysis changed the direction of the point estimate from poor to good health.

4.3.3.1 Ageing and past chronic conditions

Being older was significantly, but marginally, associated with poor self-rated health; this has also been observed in other studies. Using data from the Comparison of Longitudinal European Studies on Aging (CLESA), age was found to be significantly associated with better self-rated health of older individuals in the Netherlands and Spain (203)[123]. Older age was similarly associated with self-rated health in older individuals in Taiwan (342) and Canada (5, 68, 134, 208). However, studies of older individuals in Finland, Israel, Italy, Sweden (203), Thailand and the Philippines (342) did not show such an association.

Older age increases the likelihood of having diseases (3, 9, 100, 119, 134) such as diabetes (54, 343), tuberculosis (344), chronic obstructive pulmonary disease, dementia and depression (343). This may be due to biomedical factors associated with ageing such as molecular and cellular damage (343) aggravated by unhealthy behaviours such as smoking and lack of physical activity (54) over time.

Issues relating to social support are important to the health and general well-being of older individuals. Growing older increases the likelihood of living alone and a decline in social support networks which are associated with an increased risk of social isolation. Retirement, death of friends and partners (343, 345) and an increased life expectancy more so among women (346) are associated with loss of social networks in later life. In 2020,

[123] When adjusting for age and sex only

24% of individuals aged 65 years or older in Australia lived alone (347). Older migrants, more so those from culturally and linguistically diverse backgrounds are particularly at risk of social isolation (43, 347), often exacerbated by poor English proficiency skills, lack of knowledge on old age related services, lack of specific services for older culturally and linguistically diverse migrants (43) and migrating circumstances (348). Social isolation is associated with increased morbidity and mortality (349, 350) including depression (351), disability (352) and cardiovascular disease (353).

The marginal differences in the odds of reporting poor health by age across all waves may reflect the "levelling off effects". It is suggested that the effects of age on self-rated health may level off in very old ages or may even reverse (individuals in later life reporting better health) as those surviving represent a subgroup of very healthy individuals (342). This is also consistent with my finding that having medical conditions was associated with poorer self-rated health; those who did not have them are likely to live longer and report better health in their very old age.

The presence of medical conditions in older individuals increases their probability of reporting poor self-rated health (203, 342). Heart disease, diabetes, respiratory, musculoskeletal diseases and functional limitations (activities of daily living) were associated with poor self-rated health for older individuals in the Netherlands, Spain, Finland, Israel, Italy and Sweden (203). Similarly, older individuals in Taiwan, Philippines and Thailand with existing medical conditions were likely to report poor self-rated health compared to their countrymen without (342). Though, this chapter was investigating the association between self-rated health and past chronic conditions as opposed to explicit variables of current or existing medical conditions, chronic conditions by definition are also likely to be current.

4.3.3.2 The influence of sex on self-rated health

From my findings the effect of sex on self-rated health is marginal, more so when adjusting for other socio-demographic, risk and health factors. Other studies observed females reported better health with increasing age. The Survey of Health, Ageing and Retirement in Europe longitudinal study (SHARE) found that female sex had a strong protective effect against a decline in self-rated health in Scandinavia (Denmark and Sweden), Central Europe (Austria, France, Germany, Switzerland, Belgium and the Netherlands) and the Mediterranean (Spain, Italy and Greece) compared to their male counterparts aged 50 years or more (354). Differences in health behaviours, patterns of chronic conditions and changes in gender roles possibly account for the variations in self-rated health between males and females. Females better health in older age may reflect changing gender roles as adult children leave home giving more time to invest in their health (355). However, older women reporting better health may present a paradox as they are more likely to be socio-economically disadvantaged in later life compared to men (356). They are also more likely to live longer compared to men, though with a greater period of morbidity and functional limitations and are more likely to provide than receive care from their spouses (356, 357); all of which may impact on self-reported health as distinct from objective measures of health.

There was no interaction between country of birth and sex on self-rated health, but this does not rule out the possibility of other unmeasured factors interacting with sex, which might affect how women and men perceive their health. Some researchers suggest variations exists in the use of health-related information by men and women in assessing their own health (133, 357-361). Men and women appear to draw on the same health related information but it may be interpreted differently or similarly but not to the same extent in regards to their health. For instance, women are said to use a wider range of health and non-health related factors spanning their life-course to assess their health compared to men who are said to draw mainly on life threatening health related factors (362). Others propose minimal gender variations exist, men and women appear to largely consider a wide range of health-related information in a similar pattern in evaluating their health (355, 356, 363).

4.3.3.3 Education and partner status

Similar to other studies (5, 208, 342, 364, 365), education attainment was highly correlated with self-rated health. Further, the relationship between education and health strengthened with time, signifying the differences in education disparities that persist throughout the life-course may place individuals at an increased risk of poor health. Higher education attainment was strongly linked with better self-rated health in older Japanese individuals aged 50–59 years; this relationship strengthened over a 9-year period (366).

Partner status is associated with self-rated health (208, 367, 368) as it is assumed to be a proxy for social support (208). Married individuals may receive support during sickness (51) which may influence their ability to cope effectively with disease (105). Marriage is also said to improve an individual's socio-economic position (367). It may also aid in health promotion behaviours such as compliance with medical regimens and in avoidance of risky behaviours such as over indulgence of alcohol and smoking (368). However, some studies do report married individuals or those living with a partner reporting lower self-rated health, suggesting marriage may result in the loss of independence and autonomy (364).

4.3.3.4 Language spoken at home

Similar to my findings, prior studies report a strong association between poor English language proficiency at home and poor health (91). The interaction plot (Figure 4.3) indicates non-English-speaking at home was more deleterious to migrants' self-rated health compared to English speaking. Some studies indicate English proficiency is relatively low in some migrant groups, even those who have lived in Australia for many years (61, 63, 64). Chapter (1) Introduction and Chapter (3) Systematic review outlined the negative impact of poor language proficiency in older migrants including reduction of social networks (37), difficulties in establishing social contacts (36, 134, 334), difficulties in accessing health care (134) and financial services (253). The combination of poor education, inadequate social support, and lack of English for the older migrant could be seen as a mix of circumstances rendering this group as vulnerable (62). Of interest, is the concept of "health literacy" mentioned in Chapter (3) Systematic review initially developed from educational literacy (ability to write) and health care. As health literacy is linked to other determinants of health including English proficiency and education attainment. Individuals with low health literacy though vulnerable to poor health may face additional barriers in accessing health services and health related information (306) in the management of health conditions more so through prescribed medications and treatment (305).

English speaking at home was more deleterious to the self-rated health of Australian-born participants compared to speaking in other languages. Possibly, this resulted from age differences, as Australians who spoke a language other than English at home were relatively younger (56 years) than their English-speaking counterparts (60 years) (Appendix M). As discussed earlier growing older is associated with an increased likelihood of poor health. However, my findings are likely biased as Australians who spoke a language other than English at home was disproportionately smaller compared to their English-speaking counterparts.

4.3.3.5 Current smoking status and alcohol consumption risk factor

As observed in other studies, past and current smoking is associated with reporting poor health (67, 68, 208). For alcohol consumption, I found both low risk and risky drinkers were more likely to report better health compared to non-drinkers which is surprising. Alcohol consumption appears to be a protective factor to an extent by its positive association with self-rated health (67, 365). However, in some studies heavy[124] drinking is associated with poor health (67).

There is an established causal link between unhealthy lifestyle patterns and poor health; however, they may not necessarily impact on an individual's perception of their health. Alcohol consumption is said to increase the risk of alcohol-related injury and health problems across the life-course (369). This includes an individual's risk to specific cancers (54, 335), cardiovascular disease, chronic kidney disease, type 2 diabetes, influenza and high blood pressure (54). The positive correlation between self-rated health and alcohol consumption may indicate the presence of other unmeasured factors that possibly alter an individual's perception of their health. Some individuals may lack sufficient knowledge on their disease risk linked to specific lifestyle patterns. The Australian population was found to have little knowledge on the link between alcohol consumption and cancer, they also had low awareness on the NHMRC guidelines on alcohol consumption (335). It is possible individuals may be ranking their health based on information they consider to affect their health which may not directly correlate with disease aetiology.

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[124] For males consuming more than 14 drinks per week, for females more than nine drinks per week

There is also a possibility of "abstainer biases" in my analysis, more so as this is an ageing study. It is unclear if "alcohol consumption long-term risk factors" accounted for individuals at risk of poor health because of past harmful alcohol consumption behaviours but are more likely to be included in the "non-drinkers" category. The presence of diseases may result in a reduction or cessation of alcohol consumption by individuals, which may negatively impact on the health profile of "non-drinkers". The findings of a systematic review and meta-regression analysis found abstainer biases and other study characteristics influenced the shape of the risk relationship between mortality and rising alcohol consumption (370). Studies that did not misclassify past and occasional drinkers were less likely to report the protective health benefits (reduced mortality) of "moderate drinking".

4.4 Strengths and limitations

4.4.1 Strengths

My analyses use a large sample size (44,215 participants) drawn from the DYNOPTA study, to investigate the association between self-rated health and various independent variables, including the independent variable of interest; country of birth. I conducted repeated cross-sectional analyses over successive waves giving an indication of <u>population</u> changes over time, albeit not <u>individual</u> changes over time.

The findings contribute to older migrants' health knowledge addressing the evidence gap highlighted in Chapter (3) Systematic review. They provide additional evidence on interrelated and unmeasured[125] factors associated with older individuals' self-rated health and provide useful considerations for future research (Figure 4.5). They indicate possible analyses on the health of older migrants using the DYNOPTA study by highlighting its strengths (longitudinal, large sample size and varied socio-demographic factors)).

[125] Unmeasured factors constitute factors which may influence health but were not included in the analysis

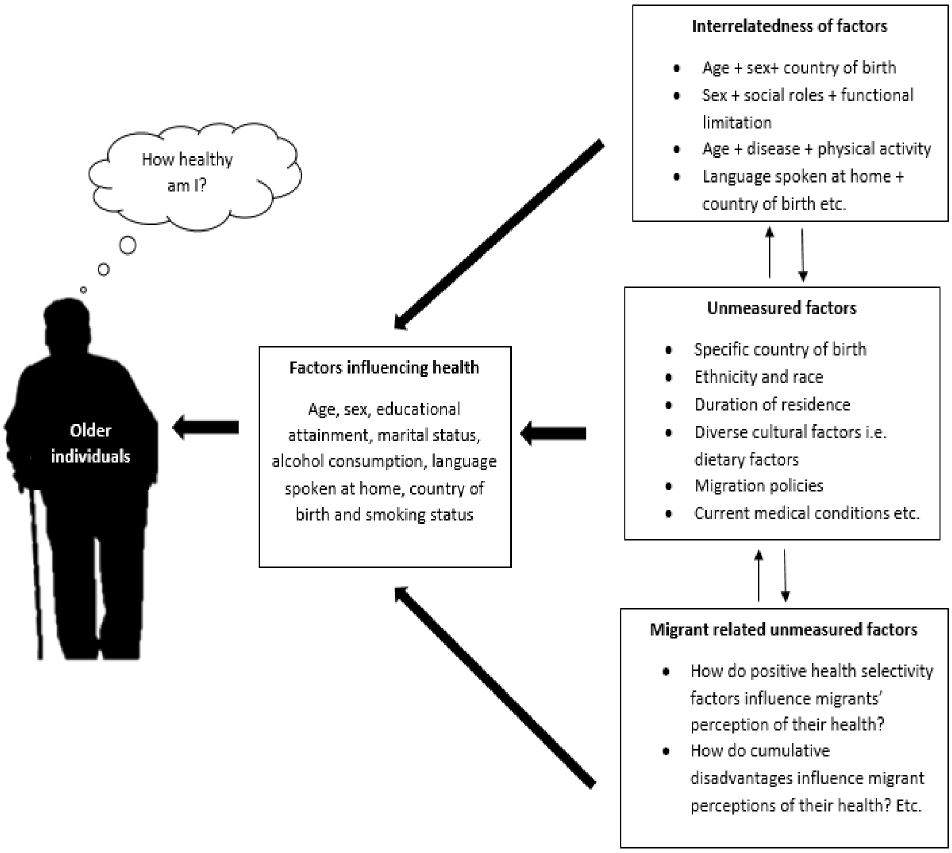

Figure 4.5: Factors associated with older individuals self-rated health

4.4.2 Limitations

All the analyses carried out were cross-sectional and no causality can be implied (364). The preceding discussion presents hypotheses that change in the associated variables explain a change in health relative to the Australian-born population. My study findings may be biased. My data were derived from the DYNOPTA study, an amalgamation of different studies whose data were collected at varying time-points, with data variability for diverse factors across DYNOPTA waves. The missing data was highly dependent on the length of contributory study and whether it collected data for specific variables. This limited my options of dealing with missing data to largely removing affected variables. A particular limitation was missing data regarding nativity status, in a subgroup who appeared to have worse self-rated health. Although sensitivity analyses did not materially affect my findings, it still limits them.

My findings could not be segregated by specific country/region of birth due to sample size constraints. This may have masked the health differences between dissimilar migrant populations (75). Similarly, duration of residence variables; age arrived, years and decades lived in Australia were excluded due to sample size limitations (Chapter (2) Methodology). These variables may have been useful in disentangling health differences in heterogenous migrant groups, as they are indicators of the changing migrant composition and maybe a proxy for migrating circumstances.

Due to time constraints I was not able to investigate some of the observed differences and their relationship to migrant health. For example, migrant males were more likely to be highly educated compared to the Australian-born but in some instances, they were more likely to report poor health. In Chapter (1) Introduction, I discussed the complex relationship between education and economic status of migrants highlighting challenges such as unemployment or under-employment regardless of high education attainment (111, 112). The observed differences by education attainment between migrant males and females may highlight the socio-economic challenges migrant women face, more so in the context of the DYNOPTA study period. Though women migrate for diverse reasons including under skills-based policies, historically in Australia, women were more likely to migrate for family reunification purposes (101, 371)[126] but may be as intellectually able, though with fewer opportunities. In addition, in this older generation, educational attainment may represent curtailment of educational opportunities by wars, lack of finance or expectations regarding social mobility rather than lack of ability. This may contribute to the wide confidence intervals in my findings around tertiary education.

4.5 Implications

4.5.1 For other research

As my findings only paint a partial picture of older migrants' health, they highlight the importance of investigating pathways linked to health in later life. As stated in Chapter (3) Systematic review, longitudinal research is needed to investigate any health advantages or disadvantages, as well as identify differential factors which may influence their health compared to their host population.

[126] 61.7% of family reunification entrants to Australia in the year 2002 were women

4.5.2 For longitudinal research (Chapter (5) Longitudinal analysis)

This chapter provides important considerations for my next chapter. As mentioned, some of the constraints encountered included an increasing proportion of missing data over time mainly influenced by differential data collection periods for the DYNOPTA studies, particularly for key variables such as country of birth. Missing data and statistical analysis limitations may have impacted the findings of the sensitivity analysis examining the effect of participants with unknown nativity on older migrants' health. A longitudinal analysis is not only needed to confirm the findings of the current analysis more so on older migrants' health over time but also in addressing the constraints.

The next chapter will extract data from one DYNOPTA study only; HILDA which has no missing data for place of birth, or for self-rated health for four waves. This will help reduce bias resulting from participants whose nativity was unknown. It may also allow for the inclusion of duration of residence and region of birth variables, aiding in a better definition of migrants to understand heterogeneity in migrant health. A further rationale for the use of the HILDA study data is provided in Chapter (2) Methodology.

4.5.3 For policy and practice

Poor English proficiency may limit older Australians access to appropriate and adequate government services including health care resulting from poor health literacy, as well as limit their opportunities to participate in community life. As such multi-lingual resources specifically for the elderly populations are necessary and serious consideration given to policies regarding helping new migrants (or of any duration) to become proficient in the primary language of their host country.

My findings suggest education is an important pathway to health in later life. Some older Australians are likely to report low education attainment including Greek and Italian migrants (61, 63, 64) who are likely to have migrated as unskilled young adults (64). As highlighted in Chapter (3) Systematic review policies should provide linkages for increasing education attainment and improving English competency for Australians where necessary. For example humanitarian and later life migrants may benefit from such linkages as they are less likely to be as educated or have a comparable level of English proficiency to economic migrants (74). Older Australians, particularly those with low literacy and poor English proficiency may benefit from community-based programs disseminating social and health issues such as providing linkages to smoking cessation programmes. This issue of language is discussed further following my longitudinal analysis.

4.6 Conclusion

This chapter investigated the health status of older migrants compared to the Australian-born population and associated factors. The findings indicated there were no convincing differences between older migrants and the Australian-born population. Age, partner status, sex, education attainment, smoking status, language spoken at home and past chronic conditions were associated with the self-rated health of older individuals. Particularly, never/past smoking status, not speaking English at home and a history of chronic conditions were strongly associated with the odds of reporting poorer self-rated health while higher education attainment was strongly associated with reporting good health. The relationship with some variables, such as education attainment, appeared to strengthen in successive waves, but confidence intervals remained wide.

As these findings do not infer on health changes over time of individuals and may have been biased by missing data due to variability in the DYNOPTA studies, they highlight the importance of longitudinal research. The next chapter tests my findings by investigating the changes over time in individual migrant's self-reported health relative to the Australian-born longitudinally using a single contributory dataset with no missing data for country of birth, and identifies factors which may lead to changes in health over time.

Chapter 5 Longitudinal analysis

5.0 Introduction

Using data from the DYNOPTA studies; ALSA, ALSWH-mid, ALSWH-old, AusDiab, CLS, HILDA, and PATH, the previous chapter presented a serial cross-sectional analysis investigating the health status of older migrants compared to the Australian-born population and identified factors associated with their health. I found no clear differences in health status between older migrants and the Australian-born population across the four waves. However, the findings were cross-sectional, and were potentially biased by an increasing proportion of missing data over subsequent waves largely resulting from variability in the DYNOPTA contributory studies data collection periods and methodological limitations. A particular issue relates to missing data regarding place of birth given a group with unknown nativity. This group appeared to have particularly poor health, and thus could have biased my findings significantly although sensitivity analyses did not find major changes.

This chapter reports a longitudinal analysis using data from one DYNOPTA contributory dataset; HILDA, which has no missing data for nativity and may reduce bias (see rationale in Chapter (2) Methodology and Chapter (4) Repeated cross-sectional analysis).

This chapter will investigate the following research questions regarding older people in Australia: -

1. What is the health status of older migrants compared to the Australian-born population over time?
2. What factors are associated with the health of older individuals over time in Australia?

The objectives include;

1. To identify variations in the health status of older migrants compared to the Australian-born population over time.
2. To identify factors related to the health of older individuals over time in Australia.
3. Highlight implications for research, practice, and policy.

5.1 Methods

5.1.1 Data source

Data were drawn from HILDA a nationally representative study of Australians living in private dwellings. In the DYNOPTA study data for HILDA were collected in four successive waves from 2001-2004 for 6,103 participants (4,236 Australian-born and 1,867 migrants) at the baseline.

The sample excluded data for 60 participants described as indigenous Australians and one participant whose years of residence (89 years) were greater than his actual age (67 years)[127].

Detailed characteristics of HILDA are provided in Chapter (2) Methodology and Chapter (4) Cross-sectional analysis.

5.1.2 Study outcomes

5.1.2.1 Dependent variable

As before, I collapsed the dependent variable self-rated health into bivariate divergent groups distinguishing between those who rank themselves as "healthy" (excellent, very good, or good) and "unhealthy" (fair or poor) to contrast changes in health status between migrants and the Australian-born.

5.1.2.2 Independent variables

The analysis included the variables; age at the time of observation, sex, partner status, education attainment, country of birth, current smoking status, alcohol consumption, first, native or preferred language, region of birth, waves and years lived in Australia. Other than age at the time of observation, region of birth and years lived in Australia all variables are included in the analysis using their original categories as per the pooled DYNOPTA study (Chapter (2) Methodology). Region of birth was recoded to include a category for participants born in Australia only, previously they were included in the Oceania and

[127] Year of birth or actual year of arrival are not provided in the HILDA dataset

Antarctica[128] category. The rest of the participants in Oceania and Antarctica were included in a new category; other regions which also included participants from North Africa and the Middle East[129], Americas[130] and Sub-Saharan Africa[131]. All Asian participants (South-East Asia[132], North-East Asia[133], Southern and Central Asia[134]) were included in a single category, while participants from North-West Europe[135] and Southern and Eastern Europe[136] maintained their individual categories.

To examine for differences in the self-rated health of participants by age, age at the time of observation was categorised into five age groups; 45-54, 55-64, 65-74, 75-84 and ≥ 85 years. Data for "years lived in Australia" were collected in the first wave only, it was assumed for the subsequent waves: -

Current years lived in Australia= previous years lived in Australia (i.e. wave 1) + 1

As mentioned in Chapter (1) Introduction, some migrant health studies categorise duration of residence into <10 years, 10–19 years, and ≥ 20 years (20, 38, 41). As older migrants are likely to have lived in Australia for a considerable period, it is expected to have fewer participants in the < 10 years category, therefore I categorised years in Australia into; 0-19 years and 20 or more years in Australia.

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[128] New Zealand, Papua New Guinea, Cock Islands, Fiji, Samoa, Tonga, Adelie Land France and Australia
[129] Egypt, Sudan, Iran, Iraq, Israel, Lebanon and Turkey
[130] Canada, USA, Chile, Farklands Islands, Peru and Uruguay
[131] Ghana, Kenya, Mauritius, Seychelles, Somalia, South Africa, Tanzania, Zambia and Zimbabwe
[132] Burma (Myanmar, Cambodia, Thailand, Vietnam, Indonesia, Malaysia, Philippines, Singapore and East Timor
[133] China (Excludes Taiwan), Hong Kong, Taiwan, Japan and South Korea
[134] Bangladesh, India, Pakistan, Sri-lanka, Afghanistan and Azerbaijan
[135] United Kingdom, Ireland, Austria, Belgium, France, Germany, Netherlands, Switzerland, Denmark, Finland, Sweden and Iceland
[136] Italy, Malta, Portugal, Spain, Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Former Yugoslav Republic of Macedonia, Greece, Romania, Slovenia, Yugoslavia Federal republic of, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Russia, Slovakia and Ukraine

5.1.3 Statistical analysis

Generalized estimating equations (GEE) assuming an independent correlation structure were used to estimate older migrants' health compared to the Australian-born population. I used the quasi-information criterion (QIC) to select the independent correlation structure as it produced the smallest QIC values (Table 5.1). A detailed description of GEE is provided in Chapter (2) Methodology.

The analysis was as follows: -

1. I described participants by their socio-demographic and risk factors over four waves.
2. Univariable analyses were carried out to assess the differences in the health status of older migrants and the Australian-born by their country and region of birth only (models 1 and 2).
3. Multivariable analyses were conducted to assess the fundamental differences in the health status of older migrants and the Australian-born by their country and region of birth (models 3a and 4). All the socio-demographic and risk factors were added simultaneously in the GEE analyses.
4. As the unadjusted and adjusted country of birth estimates varied, tests of interactions were carried out to examine for any interactions between country of birth and sex on the value of the dependent variable self-rated health. An interaction term "country of birth*sex" was included in the analysis to examine any relationships that changed as a result of the interaction (model 3b).
5. No tests were carried out to assess the effect of an interaction between country of birth and first, preferred or native language on the self-rated health values as all participants born in Australia indicated their first, preferred or native language was English (Figure 5.1). As such, an interaction was not statistically possible.
6. Lastly, univariable and multivariable analyses were carried out to assess the health status of older migrants by years lived in Australia compared to the Australian-born population.

All analyses were performed using SPSS statistical software (version 25). The results are presented in terms of odds ratios (point estimates), whereby an OR<1 means “not healthy”, OR> 1 means “healthy” and OR =1 means “no differences in health”. Statistical significance was determined using 95% confidence intervals (95% CIs) and p values (p<0.05). The results are displayed by figures, graphs and tables. The subsequent syntax[137] for the longitudinal analysis is highlighted in Appendix N.

Table 5.1: Quasi-information criterion values for the working correlation structures

	Independent	**Exchangeable**	**Unstructured**	**AR (1)**
Quasi Likelihood under Independence Model Criterion (QIC)	19732.102	19772.258	19775.079	19763.745
Corrected Quasi Likelihood under Independence Model Criterion (QICC)	19687.352	19744.786	19747.967	19733.888
Dependent variable: self-rated health **Model: country of birth, age groups, sex, partner status, highest education attainment, first, native or preferred language, current smoking status and alcohol consumption**				

[137] SPSS programming language that allows data analysis and future reproducibility of study findings

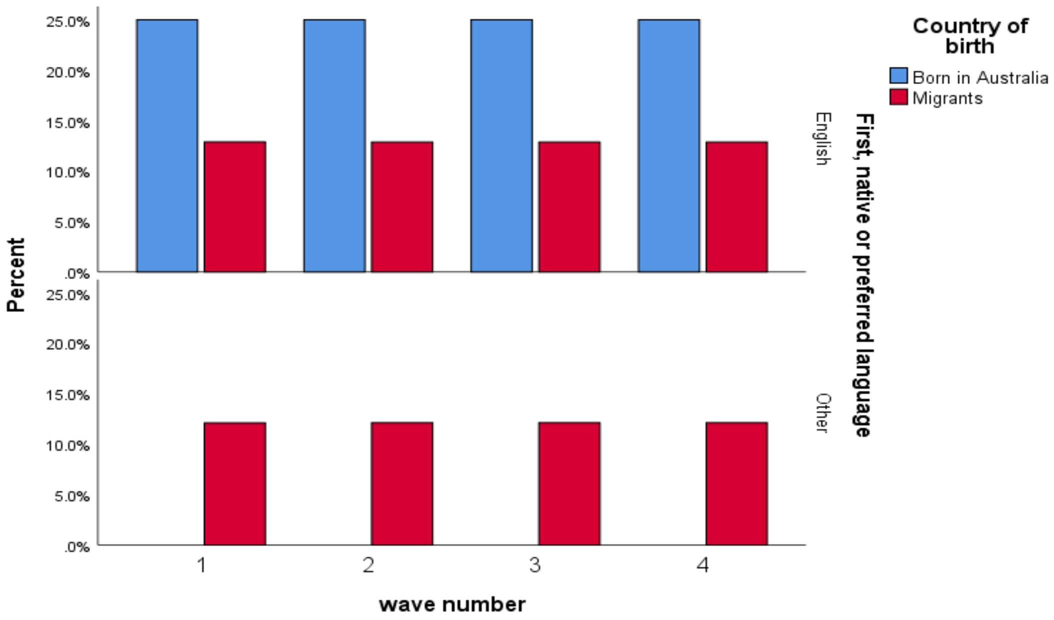

Figure 5.1: Participants first, preferred or native language over subsequent waves

5.2 Results

5.2.1 Descriptive analysis

Table 5.2 describes participants by their socio-demographic and risk factors. Overall, there were minimal variations between the mean age of older migrants and the Australian-born. Age group differences emerge in waves 2-4 as the proportion of migrants aged 85 years or more was higher compared to the Australian-born, the proportion of older migrants also increased in subsequent waves. Migrants were more likely to be of European descent and had lived in Australia for 20 years or more. There were minimal variations by gender and alcohol consumption. Migrants were more likely to report higher education attainment (tertiary education) compared to the Australian-born in all waves, however, they were less likely to rank English as their first, native or preferred language.

In the 1st and 2nd wave migrants were more likely to be married compared to the Australian-born, by the 4th wave the Australian-born were more likely to be married. In all waves Australian-born participants were more likely to be divorced or separated, widowed and never married. There were minimal variations by current smoking status, Australians were more likely to have never smoked compared to migrants who were more likely to be former smokers. For smoking status and alcohol consumption long-term risk factors, migrants had a higher proportion of missing data compared to their Australian-born counterparts.

Table 5.2: A description of participants characteristics over 4 waves

	Wave 1		Wave 2		Wave 3		Wave 4	
	Born in Australia N (%)	Migrants N (%)	Born in Australia N (%)	Migrants N (%)	Born in Australia N (%)	Migrants N (%)	Born in Australia N (%)	Migrants N (%)
Age at the time of observation (years (SD[138]))	60.2 (11.5)	60.1 (10.7)	61.1 (11.3)	61.0 (10.5)	61.9 (11.1)	61.8 (10.4)	62.8 (11.0)	62.7 (10.2)
Years lived in Australia (years (SD))		33.2 (15.1)		34.3 (15.2)		35.6 (15.1)		36.7 (14.8)
Age groups								
45-54 years	1671 (39.4)	723 (38.7)	1368 (32.3)	547 (29.3)	1155 (27.3)	427 (22.9)	981 (23.2)	341 (18.3)
55-64 years	1135 (26.8)	538 (28.8)	1084 (25.6)	480 (25.7)	1088 (25.7)	476 (25.5)	1062 (25.1)	468 (25.1)
65-74 years	830 (19.6)	377 (20.2)	788 (18.6)	359 (19.2)	763 (18.0)	339 (18.2)	723 (17.1)	324 (17.4)
75-84 years	497 (11.7)	194 (10.4)	479 (11.3)	174 (9.3)	496 (11.7)	172 (9.2)	508 (12.0)	177 (9.5)
85 or more years	103 (2.1)	35 (1.9)	517 (12.2)	307 (16.4)	734 (17.3)	453 (24.3)	962 (22.7)	557 (29.8)
Region of birth								
Born in Australia	4236 (100)	0 (≤1.0)	4236 (100)	0 (≤1.0)	4236 (100)	0 (≤1.0)	4236 (100)	0 (≤1.0)

[138] Standard deviation

Table 5.2 continued

	Wave 1		Wave 2		Wave 3		Wave 4	
	Born in Australia N (%)	**Migrants N (%)**	**Born in Australia N (%)**	**Migrants N (%)**	**Born in Australia N (%)**	**Migrants N (%)**	**Born in Australia N (%)**	**Migrants N (%)**
North-West Europe	-	926 (49.6)	-	926 (49.6)	-	926 (49.6)	-	926 (49.6)
Southern and Eastern Europe	-	412 (22.1)	-	412 (22.1)	-	412 (22.1)	-	412 (22.1)
Asia	-	248 (13.3)	-	248 (13.3)	-	248 (13.3)	-	248 (13.3)
Others	-	281 (15.1)	-	281 (15.1)	-	281 (15.1)	-	281 (15.1)
Sex								
Male	1961 (46.3)	936 (50.1)	1961 (46.3)	936 (50.1)	1961 (46.3)	936 (50.1)	1961 (46.3)	936 (50.1)
Female	2275 (53.7)	931 (49.9)	2275 (53.7)	931 (49.9)	2275 (53.7)	931 (49.9)	2275 (53.7)	931 (49.9)
Education attainment								
No formal education	5 (≤1.0)	19 (≤1.0)	5 (≤1.0)	19 (≤1.0)	5 (≤1.0)	19 (≤1.0)	5 (≤1.0)	19 (≤1.0)
Some or all of primary school or secondary school	1830 (43.2)	717 (38.4)	1830 (43.2)	717 (38.4)	1830 (43.2)	717 (38.4)	1830 (43.2)	717 (38.4)
Non-tertiary study	1761 (41.6)	818 (43.8)	1761 (41.6)	818 (43.8)	1761 (41.6)	818 (43.8)	1761 (41.6)	818 (43.8)

Table 5.2 continued

	Wave 1		Wave 2		Wave 3		Wave 4	
	Born in Australia N (%)	**Migrants N (%)**	**Born in Australia N (%)**	**Migrants N (%)**	**Born in Australia N (%)**	**Migrants N (%)**	**Born in Australia N (%)**	**Migrants N (%)**
Tertiary study	529 (12.5)	283 (15.2)	529 (12.5)	283 (15.2)	529 (12.5)	283 (15.2)	529 (12.5)	283 (15.2)
Missing (no response)	111 (2.6)	30 (1.6)	111 (2.6)	30 (1.6)	111 (2.6)	30 (1.6)	111 (2.6)	30 (1.6)
Partner status								
Married	3003 (70.9)	1453 (77.8)	2641 (62.3)	1201 (64.3)	2458 (58.0)	1074 (57.5)	2271 (53.6)	977 (52.3)
Divorced or separated	496 (11.7)	193 (10.3)	478 (11.3)	188 (10.1)	465 (11.0)	179 (9.6)	449 (10.6)	171 (9.2)
Widowed	502 (11.9)	165 (8.8)	492 (11.6)	156 (8.4)	481 (11.4)	145 (7.8)	486 (11.5)	150 (8.0)
Never married	228 (5.4)	56 (3.0)	205 (4.8)	45 (2.4)	196 (4.6)	44 (2.4)	180 (4.2)	39 (2.1)
Missing (no response)	7 (≤1.0)	0 (≤1.0)	420 (9.9)	277 (14.8)	636 (15.0)	425 (22.8)	850 (20.1)	977 (28.4)
First preferred and native language								
English	4236 (100.0)	961 (51.6)	4236 (100.0)	961 (51.6)	4236 (100.0)	961 (51.6)	4236 (100.0)	961 (51.6)
Other	0 (≤1.0)	903 (48.4)	0 (≤1.0)	903 (48.4)	0 (≤1.0)	903 (48.4)	0 (≤1.0)	903 (48.4)
Years lived in Australia								
0-19 years	-	412 (22.1)	-	314 (19.4)	-	255 (17.3)	-	212 (15.4)

Table 5.2 continued

	Wave 1		Wave 2		Wave 3		Wave 4	
	Born in Australia N (%)	**Migrants N (%)**	**Born in Australia N (%)**	**Migrants N (%)**	**Born in Australia N (%)**	**Migrants N (%)**	**Born in Australia N (%)**	**Migrants N (%)**
20 years or more	-	1450 (77.9)	-	1301 (80.6)	-	1223 (82.7)	-	1165 (84.6)
Alcohol consumption								
Non-drinker	680 (16.1)	305 (16.3)	709 (16.7)	282 (15.1)	640 (15.1)	246 (13.2)	634 (15.0)	226 (12.1)
Low risk	3065 (72.4)	1285 (68.8)	2514 (59.3)	1017 (54.5)	2488 (58.7)	961 (51.5)	2294 (54.2)	900 (48.2)
Risky	274 (6.5)	87 (4.7)	290 (6.8)	83 (4.4)	273 (6.4)	72 (3.9)	245 (5.8)	65 (3.5)
Missing (no response)	217 (5.1)	190 (10.2)	723 (17.1)	485 (26.0)	835 (19.7)	588 (31.5)	1063 (25.1)	676 (36.2)
Smoking status								
Never smoker	2084 (49.2)	743 (39.8)	1746 (41.2)	591(31.7)	1716 (40.5)	535 (28.7)	1624 (38.3)	498 (26.7)
Former smoker	1317 (31.1)	681 (36.5)	1196 (28.2)	581 (31.1)	1145 (27.0)	548 (29.4)	1088 (25.7)	507 (27.2)
Current smoker	629 (14.8)	256 (13.7)	550 (13.0)	208 (11.1)	503 (11.9)	189 (10.1)	462 (10.9)	183 (9.8)
Missing (no response)	206 (4.9)	187 (10.0)	744 (17.6)	487 (26.1)	872 (20.6)	595 (31.9)	1062 (25.1)	679 6.4)

5.2.2 Univariable longitudinal analyses

Table 5.3 presents the unadjusted GEE regression health estimates for older migrants compared to the Australian-born population. There were no significant differences between the health of older migrants and the Australian-born as although the point estimate represented marginally lower odds of reporting good health, the confidence intervals for the point estimate crossed over the point of no difference; 1 (Model 1). Model 2 suggests variations in self-rated health by older migrants' specific region of birth. Older migrants from North-West Europe had higher odds for reporting better health compared to the Australian-born population, the point estimates maybe imprecise as indicated by the wide confidence intervals. Migrating from Southern and Eastern Europe was strongly associated with poor health but there were no significant differences in the health of older migrants born in Asia, other regions and the Australian-born population.

Table 5.3: Unadjusted older migrants' health estimates

	Model 1 (Unadjusted ORs)	**P values**	**Model 2 (Unadjusted ORs)**	**P values**
Country of birth				
Migrants	.942 (.843 to 1.053)	.295		
Reference is born in Australia				
Region of birth				
North-West Europe			1.243 (1.069 to 1.444)	.005
Southern and Eastern Europe			.428 (.352 to .520)	< 0.05
Asia			.951 (.729 to 1.239)	.708
Others			1.109 (.865 to 1.422)	.415
Reference is born in Australia				

Point estimates where $p < 0.05$ were said to be statistically significant, it also represents variables whose p values were .000

5.2.3 Multivariable longitudinal analyses

Table 5.4 presents the adjusted GEE estimates for country (model 3) and region of birth (model 4). After adjusting for the socio-demographic and risk factors older migrants had higher odds of reporting better health compared to the Australian-born population, the wide confidence intervals suggest imprecision of point estimates. There were variations in self-rated health by older migrants' specific region of birth. Older migrants from North-West Europe had higher odds of reporting better health compared to the Australian-born population while migrating from Southern and Eastern Europe was strongly associated with poor health. There were no significant differences in the health of older migrants from Asia, other regions and the Australian-born population.

Ageing, current and former smokers and preference of or a first language other than English were strongly associated with poor health. There was a dose response relationship between ageing and self-rated health, older age groups were associated with poor health compared to younger age groups. For partner status, being divorced or separated and never married were strongly associated to poor health, widowhood was not significantly associated to health.

Higher education attainment (other than primary education) and alcohol consumption (low risk and risky) were strongly associated with reporting better self-rated health. There was a dose response relationship between self-rated health and education, the higher the education attainment the greater the odds of reporting better health. Female sex was associated with reporting better health, the strength of association was weak as the point estimate was close to 1. The point estimates for first, native or preferred language (Model 4 only), higher education attainment and sex had wide confidence intervals indicating imprecision.

Point estimates in the region of birth model (age groups, sex, partner status, education, smoking status and alcohol consumption) were more precise compared to the country of birth model as they had narrow confidence intervals. However, for first, preferred or native language the strength of association was greater in the country of birth model, that is indicating languages other than English as your first, preferred or native language was strongly associated with poor health in model 3 compared to model 4.

Figure 5.2 indicated an interaction between sex, country of birth and self-rated health.

Table 5.4 Adjusted older migrants' health estimates

	Model 3a (Adjusted ORs)	P values	Model 4 (Adjusted ORs)	P values
Country of birth				
Migrants	1.305 (1.111 to 1.533)	.001		
Reference is born Australia				
Region of birth				
North-West Europe			1.410 (1.179 to 1.687)	< 0.05
Southern and Eastern Europe			.637 (.463 to .876)	.006
Asia			1.092 (.768 to 1.554)	.623
Others			1.073 (.816 to 1.412)	.614
Reference is born in Australia				
Age groups				
55-64 years	.717 (.629 to .818)	< 0.05	.710 (.622 to .811)	< 0.05
65-74 years	.582 (.502 to .676)	< 0.05	.569 (.489 to .661)	< 0.05
75-84 years	.329 (.275 to .394)	< 0.05	.326 (.272 to .391)	< 0.05
85 years or more	.203 (.143 to .290)	< 0.05	.200 (.140 to .284)	< 0.05
Reference is 45-54 years				
Sex				
Female	1.162 (1.035 to 1.305)	.011	1.157 (1.030 to 1.299)	.014
Reference is male				
Partner status				
Divorced or separated	.607 (.517 to .712)	< 0.05	.604 (.515 to .708)	< 0.05
Widowed	1.113 (.927 to 1.338)	.252	1.114 (.927 to 1.339)	.250
Never married	.641 (.497 to .825)	.001	.633 (.491 to .816)	< 0.05
Reference is married or de-facto				
Education attainment				
Primary or secondary education	2.309 (.776 to 6.865)	.132	2.081 (.729 to 5.944)	.171
Non-tertiary	3.366 (1.131 to 10.016)	029	2.979 (1.042 to 8.517)	.042
Tertiary	5.209 (1.733 to 15.657)	.003	4.643 (1.607 to 13.412)	.005

Table 5.4 continued				
	Model 3a (Adjusted ORs)	**P values**	**Model 4 (Adjusted ORs)**	**P values**
Reference is no formal education				
First, native or preferred language				
Other	.473 (.387 to .578)	< 0.05	.667 (.519 to .857)	.002
Reference is English				
Current smoking status				
Former smoker	.668 (.593 to .753)	< 0.05	.660 (.585 to .744)	< 0.05
Current smoker	.552 (.473 to .645)	< 0.05	.545 (.467 to .637)	< 0.05
Reference is never smoker				
Alcohol consumption				
Low risk	2.256 (1.997 to 2.550)	< 0.05	2.256 (1.995 to 2.552)	< 0.05
Risky	2.067 (1.679 to 2.546)	< 0.05	2.055 (1.668 to 2.532)	< 0.05
Reference is non- drinker				

Point estimates where p < 0.05 were said to be statistically significant

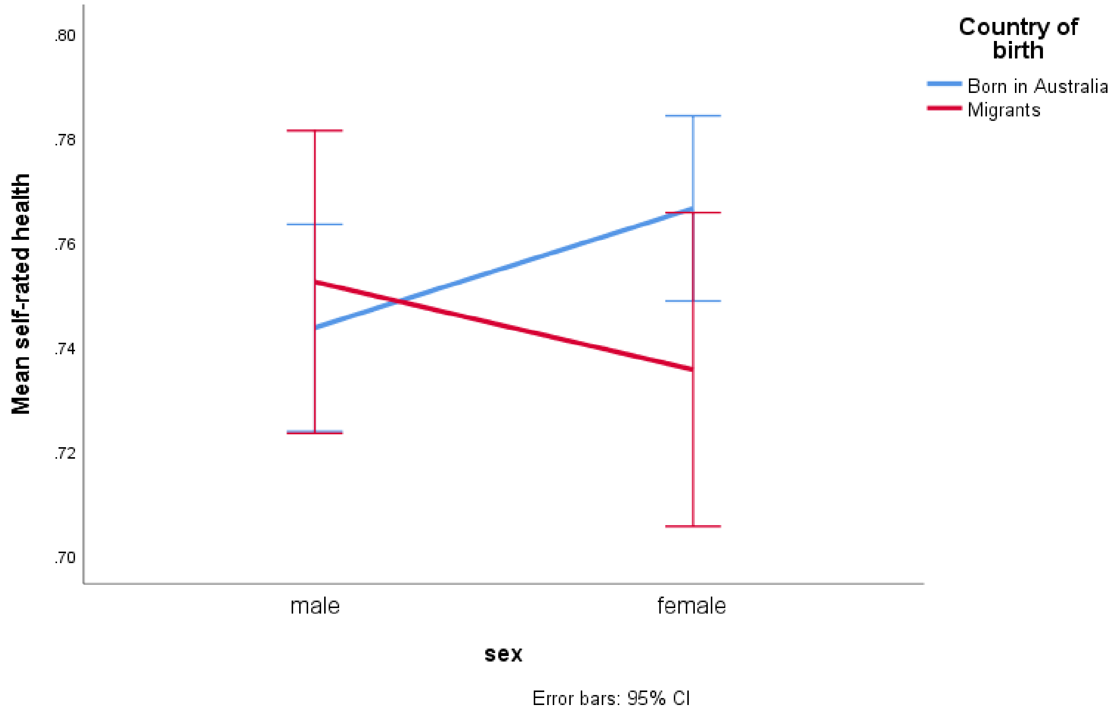

Figure 5.2: Interaction between sex and country of birth on self-rated health

Table 5.5 shows minimal variations in the point estimates of Model 3a and Model 3b; the latter included the interaction term “country of birth*sex”.

Table 5.5: Adjusted migrant health estimates over time including interaction effects

	Model 3b (Adjusted ORs with interaction terms)	**P values**
Country of birth		
Migrants	1.445 (1.177 to 1.774)	< 0.05
Reference is born in Australia		
Age groups		
55-64 years	.715 (.627 to .815)	< 0.05
65-74 years	.581 (.500 to .675)	< 0.05
75-84 years	.327 (.274 to .392)	< 0.05
85 years or more	.202 (.142 to .288)	< 0.05
Reference is 45-54 years		
Sex		
Female	1.229 (1.074 to 1.406)	.003
Reference is male		
Partner status		
Divorced or separated	.610 (.520 to .716)	< 0.05
Widowed	1.112 (.925 to 1.336)	.258
Never married	.642 (.499 to .827)	.001
Reference is married or de-facto		
Education attainment		
Primary or secondary education	2.210 (.741 to 6.595)	.155
Non-tertiary	3.217 (1.078 to 9.605)	.036
Tertiary	4.973 (1.649 to 14.998)	.004
Reference is no formal education		
First, native or preferred language		
Other	.472 (.386 to .577)	< 0.05
Reference is English		

Table 5.5 continued		
	Model 5 (Adjusted ORs with interaction terms)	**P values**
Current smoking status		
Former smoker	.666 (.591 to .751)	< 0.05
Current smoker	.550 (.471 to .642)	< 0.05
Reference is never smoker		
Alcohol consumption		
Low risk	2.250 (1.991 to 2.543)	< 0.05
Risky	2.065 (1.677 to 2.543)	< 0.05
Reference is non- drinker		
Country of birth*sex		
[Country of birth binary= Migrants] * [sex=Females]	.818 (.644 to 1.038)	.098
Reference is [Country of birth binary= Migrants] * [sex= Male]		
Reference is [Country of birth binary= Born in Australia] * [sex= Female]		
Reference is [Country of birth binary= Born in Australia] * [sex=Male]		

Point estimates where p < 0.05 were said to be statistically significant, it also represents variables whose p values were .000

5.2.4 Univariable and multivariable analyses for the years lived in Australia model

The unadjusted estimates indicate there were no significant differences in the health of older migrants by their duration of residence and the Australian-born population. The adjusted estimates suggest irrespective of the years lived in Australia older migrants had higher odds of reporting better health than the Australian-born population (Table 5.6).

Similar to the other adjusted models; being older, divorced or separated, never married, non-English speaking and current or former smokers were strongly associated with poor health. Female sex, higher education attainment (excluding primary education) and alcohol consumption (low risk and risky) were strongly associated with better health.

Widowhood was not associated with self-rated health. Some point estimates such as education attainment had wide confidence intervals indicating imprecision.

Table 5.6: Unadjusted and adjusted GEE estimates for years lived in Australia

	Model 5 (Unadjusted ORs)	P values	Model 6 *(Adjusted ORs)*	P values
Years lived in Australia				
0-19 years	1.068 (.859 to 1.327)	.554	1.337 (1.030 to 1.737)	.029
20 years or more	.922 (.817 to 1.039)	.181	1.313 (1.111 to 1.551)	.001
Reference is born in Australia				
Age groups				
55-64 years			.719 (.630 to .820)	<0.05
65-74 years			.582 (.500 to .676)	<0.05
75-84 years			.329 (.275 to .394)	<0.05
85 years or more			.205 (.144 to .292)	<0.05
Reference is 45-54 years				
Sex				
Female			1.164 (1.036 to 1.307)	.010
Reference is male				
Partner status				
Divorced or separated			.607 (.518 to .712)	<0.05
Widowed			1.113 (.926 to 1.338)	.252
Never married			.633 (.491 to .816)	<0.05
Reference is married or de-facto				
Education attainment				
Primary or secondary			2.306 (.775 to 6.862)	.133
Non-tertiary			3.376 (1.134 to 10.057)	.029
Tertiary			5.203 (1.729 to 15.655)	.003
Reference is no formal education				
First, native or preferred language				
Other			.470 (.384 to .575)	<0.05
Reference is English				
Current smoking status				
Former smoker			.669 (.594 to .755)	<0.05
Current smoker			.549 (.470 to .641)	<0.05

Table 5.6 continued				
	Model 5 (Unadjusted ORs)	**P values**	**Model 6 *(Adjusted ORs)***	**P values**
Reference is never smoker				
Alcohol consumption				
Low risk			2.253 (1.993 to 2.547)	<0.05
Risky			2.063 (1.675 to 2.541)	<0.05
Reference category 'non- drinker'				

Point estimates where $p < 0.05$ were said to be statistically significant, it also represents variables whose p values were .000

5.3 Discussion

5.3.1 Summary

Using one DYNOPTA dataset; HILDA, I longitudinally examined the health status of older migrants compared to the Australian-born population and investigated factors associated with the health of older migrants and the older Australian-born population over time. With respect to these research questions I found;

1. In the unadjusted findings there were no significant differences in the self-rated health of older migrants by their overall country of birth status and the Australian-born population. However, after adjusting for socio-demographic and risk factors older migrants had higher odds of reporting better health compared to the Australian-born population. In the univariable and multivariable analyses by region of birth subgroups, Southern and Eastern Europeans had higher odds of reporting poor health while North-West Europeans had higher odds of reporting better health than the Australian-born. However, there were no differences in the health of older Asians, other migrants compared to the Australian-born. After adjusting for factors, older migrants had higher odds of reporting better health than the Australian-born regardless of years lived in Australia.

2. In addition to region of birth, other measured socio-demographic and risk factors influenced older migrants' health status and when adjusted for in some of the models the health of older migrants shifted from "no

differences" to reporting better health compared to the Australian-born population. Accounting for an interaction between country of birth and sex did not largely affect the health estimates of older migrants.

3. Being older, smoking status (current and former smokers) and speaking/preference for a language other than English, partner status (being divorced or separated and never married) were strongly associated with higher odds of reporting poor health. Higher education attainment (other than primary education) and alcohol consumption (low risk and risky) were strongly associated with higher odds of reporting better self-rated health. Female sex was also associated with higher odds of reporting better health, but the strength of association was weaker. In all the models the magnitude of increase or reduction in the odds of reporting good health was greatest for education and age respectively. These variables demonstrated a "dose effect"; reduction in odds getting bigger with increasing age, and increasing odds with increasing levels of education fulfilling one of the Bradford-Hills criteria for causality. Although the confidence intervals for education were wide, those for age were precise.

4. The confidence intervals for point estimates in some variables were wide indicating imprecision, in all models this included sex and education attainment. For instance, in the country of birth model the confidence intervals suggest the odds of reporting better health for individuals with higher education could be as low as 1.733 or as high as 15.657. The point estimates for North-West Europe and Southern and Eastern Europe regions of birth and first, native or preferred language (region of birth model), migrant status (country of birth model) and years lived in Australia categories (years lived in Australia model) also had wide confidence intervals. The point estimates for variables in the region of birth model were more precise compared to the country of birth model as they had narrower confidence intervals.

5.3.2 Key longitudinal findings on older migrants' health

Assessing older migrants' health by overall nativity status and duration of residence subgroups may not have captured the variations in health status as regardless of years lived in Australia older migrants reported better health. A further analysis using categories commonly used in other migrant studies of health differences; <10 years, 10–19 years, and ≥ 20 years (20, 38, 41) largely produced similar findings[139] (Appendix O[140]).

Though overall nativity status and broadly defined duration of residence subgroups are commonly used in assessing older migrants' health they have several weaknesses. They often treat diverse migrants as a homogenous group facing comparable adaptation processes and they assume migrants interact with their host country factors in similar ways. These assumptions do not consider the different circumstances surrounding the migration of individuals such as economic, humanitarian and family reunification thereby masking variations in the health status of diverse migrant groups and their host population.

Longitudinal migrant health studies including the current chapter are important as they provide evidence highlighting variations in health status within various migrants' subgroups compared to their host population. Consistent with my findings, Jatrana, Richardson (84) found migrants from non-English speaking countries were more likely to report poor self-rated health relative to the Australian-born population even after 20 years of stay in Australia while their counterparts from English speaking countries had a health advantage relative to the Australian-born irrespective of their duration of residence. McCallum and Shadbolt (253) found non-British migrants were more likely to report poor health than British migrants and the Australian-born population with non-British migrants with poor English reporting the worst health. In Canada, older non-White migrants aged over 65 years were more likely to report poor health compared to Canadian-born Whites (27). My findings also provide interesting data on migrants from Asia, where there were no apparent differences in health: many countries in Asia were part of the British Empire and many years

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[139] Analysis carried out to indicate if my categorisations (0-9 years and 10 or more years in Australia) biased my findings by duration of residence.

[140] The appendix incudes results comparing the years lived in Australia (model 6) included to Model 6b which represents years lived in Australia using subgroups commonly applied in migrant health studies.

after independence English is still included as an official language (372), and is commonly spoken in their country of birth especially among those with tertiary education.

In the country of birth and years lived in Australia models when controlling for their effects the health of older migrants shifted from “lower” to “higher” odds of reporting better health compared to the Australian-born. In the region of birth model, after adjustment the strength of association between Southern and Eastern Europe and poor health was weakened while North-West Europe’s association with better health was strengthened.

Similar to Chapter (4) Repeated cross-sectional analysis this study findings are consistent with the “social determinants of health framework,” as the strong effects of education attainment on the self-rated health of older individuals remain over time. Though, robust evidence exists for this framework (1, 3, 97, 98, 309, 340), with the World Health Organization (WHO) establishing the Commission on Social Determinants of Health in 2005 to promote health equity around the world, an issue they describe as a matter of “life or death” (373). My findings are still important and relevant to policy makers as they highlight the role of social determinants like education attainment in the older population more so in older heterogenous migrant groups, who though vulnerable to poor health due to migrating circumstances, inadequate language skills among other factors, their health status and subsequent determinants remain understudied. Further, as discussed in Chapters 1, 3 and 4 social determinants of health frameworks in studies retain a relatively narrow focus on individual characteristics and behaviours, often neglecting broader social, economic and political factors which may result in health inequalities. They do not consider other factors such as knowledge of disease aetiology as some migrants may not be aware they are at an increased risk of latent or asymptomatic diseases endemic in their birth countries or changing their dietary patterns may increase their risk of diseases prevalent in their host countries. The subsequent sections explore mechanisms through which education attainment affects health, more so in older migrants including migration policies.

5.3.3 Reasons advanced for differential migrants' and the host population health status

5.3.3.1 Healthy migrant effect hypothesis

As discussed in Chapters 1 through 4 the healthy migrant effect hypothesis may not fully account for the health status of older migrants and have some conceptual and methodological limitations. Firstly, they make simplistic assumptions on complex migrant health changes and mainly focus on the negative effects of acculturation. The healthy migrant effect pays little attention to migrating circumstances, for example, it is difficult to apply to migrants escaping war and conflicts who are likely to report poor health at the time of arrival to their host country (374). The healthy migrant effect in some instances is inferred from studies comparing different migrant cohorts or migrants of different age groups and uses broad categories such as overall country of birth status which may limit their generalisability.

There is also evidence that the healthy migrant effect may not account for older migrants' health status or might exclude migrants returning home to convalesce or to possibly die. The health advantage under the healthy migrant effect mainly applies to recent migrants who are more likely to be non-European and migrated mainly under skilled based policies (13, 22, 39). Older HILDA migrants are likely North-West European and had lived in Australia for approximately 36 years by the 4th wave (Descriptive analysis; Table 5.2), given HILDA data were collected between 2001-2004 it is likely a significant proportion of these participants migrated under population-based policies. My longitudinal study findings further question the applicability of acculturation theories and the healthy migrant effect hypothesis to older migrants. My findings do not indicate convergence of migrants' health to their host population at <u>this</u> stage in their residence, rather, they show differential health status among diverse migrant populations compared to the Australian-born. If the healthy migrant effect is relevant at all, then perhaps any change had already occurred when the HILDA participants provided data – but the data still showed an overall health advantage in this group. However, the differences by region of birth persist over time, with North-West Europeans having a self-reported health advantage, possibly due to sharing some similar characteristics (culture, language etc.) with the Australian-born population. Though Southern and Eastern Europeans reported a self-rated health disadvantage, it is unlikely to be the result of waning selectivity effects, but rather, one of having characteristics associated with health disadvantage; as prior chapters have demonstrated these populations likely migrated with a poor socio-economic status and poor English proficiency.

5.3.3.2 Limitations in older migrants' health research

Though the few studies to date hinder understanding older migrants' health, it is an indicator of complex and contentious factors characterising migrant health studies in Australia. In her literature review on the health needs of older culturally and linguistically diverse (CALD) migrants in predominantly English-speaking host countries, Orb (43) highlights methodological limitations by various studies, the full text for some of these studies[141] were unavailable online and in library resources at my disposal[142]. Little attention has been given to the variation between different non-English speaking groups and it is unclear how language barriers in the research interviews themselves were addressed in the participants. They argued the older "ethnic" migrant health disadvantage is therefore poorly founded and findings from prior studies should be interpreted with caution. The central role of English language proficiency is highlighted as a profound influence on well-being of older migrants, with those with poor proficiency being at risk of social isolation, lack of awareness of support and health services and difficulties where institutions are English-speaking. Yet despite this, the attention to language and cultural diversity applied to the study methodology and data collection has been suboptimal.

Using singular terms to differentiate all other older migrants from the Anglo-Celtic majority is common in Australia. Though, in some instances it is useful in acknowledging Australia's cultural and ethnic diversity, in migrant health studies it has several disadvantages. Sawrikar and Katz (46) submits some terms such as migrants from non-English speaking backgrounds (NESB) can have the effect of "othering" individuals as not fully Australian. They also suggest terms like CALD may infer Anglo-Celtic migrants are either not considered to be a culturally and linguistically diverse group or their cultural or linguistic attributes are

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[141] These included studies Powles, J., & Gifford, S. (1990). 'How healthy are Australia's immigrants?' In J. Reid & P. Tromft (Eds). *The health of immigrant Australia. A social perspective Chapter 3*. Sydney: Harcourt Brace Jovanovich, Publishers <u>and</u> Galvin, J. (1985). 'The residential mobility and integration of the Lettesi Italian community in Newcastle, New South Wales'. In I. H. Burnley, S. Encel & G. McCall (Eds). *Immigration and ethnicity in the 1980s*. Chapter 12. Melbourne: Longman Cheshire

[142] Universities of Hull and York libraries & online resources (Google and Sci hub).

not "sufficient" to warrant being part of CALD. It may also falsely imply universal similarities in the health of Anglo-Celtic migrants and the Australian-born, more so in studies where the comparator includes both. For example, in a study by Menec, Shooshtari (375) examining differences in self-rated health the comparator group was British/Canadian, and Minas, Klimidis (376) included British migrants in the comparator group, while examining the rates of psychological morbidity in Australian-born elderly and three migrant elderly groups (Italian, Macedonian and Spanish-speaking elderly). This may mask the health differences of Anglo Celtic migrants and their host population, yet despite this, my thesis still demonstrates variations in self-reported health and that region of birth and language proficiency remain independent predictors. Consistent with other studies (253), I found North-West Europeans had a self-rated health advantage compared to the Australian-born. Further differences were also observed in Chapter (3) Systematic review as British migrants reported a lower risk of suicide as well as melanoma, circulatory disease and diabetes mortality relative to the Australian-born.

Rowland (377) argues use of singular terms in migrant health studies can create a misleading impression on the "plight" of the culturally and ethnically diverse older migrants and are therefore inappropriate in health studies. This includes portraying older ethnically diverse migrants as a "significant social problem" (378) or as "socially disadvantaged" (379), yet these categories group migrants who are relatively advantaged with those who are relatively disadvantaged but are considered culturally different to the Australian-born and Anglo Celtic migrants (46). The Australian government through the Ministerial Council of Immigration and Multicultural Affairs (MCMIA) acknowledged some of these limitations by dropping the use of the term and acronym non-English speaking background (NESB) in official communications in 1996 and replacing it with CALD. However, Sawrikar and Katz (46) argue CALD has also developed the same negative connotations and should only be used in a functional way to celebrate Australia's diversity, but not in a categorical way to refer to a sub-group of its population (46).

These terms are still widely used in migrant health studies and their implications on the depiction of CALD migrants and the resulting societal attitudes towards ethnically diverse migrants remains understudied. As such, it remains uncertain if a "researcher bias" exists in terms of the negative portrayal of the health of <u>all</u> CALD migrants or indeed they have a greater health disadvantage. However, even with the uncertainty, such terms may yield false implications. For example stating that a significant proportion of the aged care work force is CALD negates the fact that there is a mismatch between CALD aged workers and older residents in aged care facilities from CALD backgrounds. Negin, Coffman (380) found CALD older migrants in such facilities were mainly Italian and Greek but aged care workers were more likely to originate from India and the Philippines.

There also lacks sufficient and appropriate data to investigate older migrants' health, more so those from culturally and linguistically diverse backgrounds (63, 189, 374). This is surprising, considering migration impacts on public health systems as migrants may present differential patterns of risk and protective health factors to their host population. Additionally, it is well-documented that the migrant population has and is increasing considerably, in terms of numbers and diversity, which will increase demands on the health and care systems – particularly for older migrants who are more likely to have medical conditions and social care needs.

There are several explanations for migrant health data constraints. To begin with, some databases were not designed with an explicit focus on the migrant population. For example, the DYNOPTA study core focus is on population ageing as opposed to older migrants as evidenced by a high proportion of participants with unknown nativity. Renzaho, Polonsky (374) indicates some migrant populations who by virtue of their ethnicity are at a greater risk of some diseases are excluded in some studies including HILDA and the Longitudinal Study of Australian Children (LSAC). Similarly, De Maio and Kemp (132) states databases such as the Canadian National Population Health Survey (NPHS) whose core focus is on the general Canadian population as opposed to the migrant population does not offer any data on actual migrants' experiences.

Secondly, compared to the general population, migrant health related research is considerably underfunded (189, 374). A series of systematic reviews on the coverage and representation of non-English speaking and multi-cultural factors published in three major Australian health care journals between 1996-2008 found that only 2.2% of the total studies primarily focused on multi-cultural issues (381). Migrants are also underrepresented in clinical trials especially those with poor English proficiency (374). Consequently, researchers cannot adequately answer questions on migrant health and neither can policy makers formulate appropriate policies and interventions addressing health and social inequalities. Therefore, my longitudinal research is a step in the right direction as it begins to differentiate older migrants' health by their region of birth.

5.3.4 Possible factors influencing the health of older migrants

5.3.4.1 Southern and Eastern Europeans

Several studies demonstrate the lack of positive selectivity factors: younger age, high education attainment, official language proficiency and economic skills in some older migrants at the time of migration (9, 10, 23-25, 38). Older Italian and Greek migrants report poor English language proficiency and lower socio-economic status decades after migration (59, 61-64). Though some studies like Kiropoulos, Klimidis (63) used a small convenience study population largely targeting Greek migrants with poor English proficiency other longitudinal studies provide sufficient evidence of poor English proficiency in a substantial proportion of older migrants (61) or summarised updated data extracted from the Australian Bureau of statistics (59, 64).

A lack of policies and programmes over time addressing socio-demographic and economic disadvantages (64) may have resulted in cumulative disadvantages which negatively affect the health of Southern European migrants, however more longitudinal evidence is needed to support this assertion. Given the strong association between poor health and non-English/non-preferred English speaking, language would seem to be a key issue thereby disadvantaging migrants from countries where English is not routinely spoken such as Southern and Eastern Europe. Although Australia's migration policy changed from previous racial exclusions, the implications of such a positive change does not appear to have led to relevant changes in the operation of helping migrants of all cultures and languages successfully integrate into Australian culture.

Other than poor self-rated health, Chapter (3) Systematic review found older South-European migrants also have a health disadvantage relating to depression and anxiety and self-reported physical health status (62, 63, 251). They also had some health advantages more so in terms of longevity and a lower risk of specific cancers and cardio-vascular disease, largely associated with either maintaining or returning to traditional Mediterranean dietary patterns in old age (294).

5.3.4.2 North-West Europeans

Older North-West Europeans reporting better health compared to their Australian-born counterparts is consistent with other literature. Older British migrants reported better health compared to non-British migrants and the older Australian-born population (253). This may be as a result of migrating with better education and skills compared to other migrants (59, 382). They are also likely to share greater similarities with the Australian-born population (84) as the majority of non-indigenous Australians are largely descended from the British Isles (59). There is a possibility the "health advantage" regardless of years lived in Australia and by nativity status may be representative of the large proportion of older migrants' from North-West Europe. However, as English language native speakers, and - at the time of migration in such a young country – sharing the predominant culture, they will have had an advantage with regards to acculturation and interacting with health care and other society supports.

5.3.4.3 Asian and other migrants

The findings on the health status of older Asians and other migrant groups are difficult to interpret as they were confounded by several factors. To begin with, Asian migrants were younger (mostly aged 45-54 years), had lived in Australia for fewer than 20 years and originated from around 20 South-East and North-East Asian countries, with varying English language and cultural understanding from very good to negligible, with each birthplace contributing relatively few numbers (Appendix P and Q). They are also likely to have migrated under different circumstances; such information was missing from the HILDA dataset. For instance, older Vietnamese migrants are likely to have arrived in Australia in the late 1970s and 1980s as refugees (59, 64). Humanitarian migrants are more likely to report poor health compared to economic migrants with the latter's health expected to decline with increased duration of residence (51). They are also likely to have poorer English language skills and levels of education.

Chapter (3) Systematic review found no studies investigating the self-rated health status of older Asians compared to the Australian-born population, however, by other health measures variations exists. Older Vietnamese migrants were more likely to be vitamin D deficient (265) had a higher risk for type 2 diabetes (264) and a greater burden for mental illness (248) compared to their Australian-born counterparts. Older North-East and South-East Asian migrants had a lower prevalence for cardiovascular disease (45) while older South-East Asian migrants were also less likely to die from circulatory disease and diabetes (49) compared to the Australian-born population. However, older migrants from the Indian subcontinent, East and South-East Asia had higher rates of treated end stage renal disease than their counterparts from the British Isles or the "rest of Europe" and the Australian-born population (254). However, despite their increased risk of some diseases, within this heterogeneous group, the proportion of migrants with good English, or even English as a preferred language – particularly those with higher education, is likely to be significant. This may well have helped them better access health care and ameliorate this risk. It would have been interesting to explore whether Asian migrants from previous English empire countries drove the apparent lack of difference in health status, "hiding" a disadvantage in those who did not. However, data (and numbers) were not available to do this.

5.3.5 Factors influencing older individuals' health

The observed relationships in my findings were largely consistent with other epidemiological studies, some variables however were notable for their lack of statistical significance and/or inconsistency with current literature.

5.3.5.1 First, preferred or native language

In the HILDA dataset, the question about language is of interest. Rather than asking about language spoken at home, this variable indicates three key aspects; first or native language and preferred language. An individual's preferred language may therefore not be their first or native language. This allows an assessment of proficiency. It is a reasonable assumption that most people, if English was not their first language would not prefer to use it unless they were fluent and comfortable in their ability to express themselves and engage with others in English. It is likely to give us a better indication of proficiency than "language spoken at home"; the variable used in Chapter (4) Repeated cross-sectional analysis although the latter can also be viewed as a proxy for poorer language proficiency. However, this does not account for the excellent language proficiency shown by many migrants where English is not their first language and who may still not speak English in the home.

Poor English proficiency in older Southern and Eastern Europeans is well established including in recent Census data, in 2016, 33% reported they either could not speak English well or they could not speak English at all (59). Poor English proficiency in older Southern and Eastern Europeans is attributed to their migrating circumstances; they migrated with poor proficiency. Even now, English is not routinely spoken proficiently in South or East Europe, even amongst those in tertiary education. Secondly, they may have maintained poor English proficiency across their life-course as a result of working in low-skilled jobs (although this may also represent a vicious cycle whereby skilled jobs are unattainable due to poor language skills) and living in communities where their native language was generally spoken (59, 64, 84). It is also common for older migrants to revert to their native language in old age especially if they have not acquired English proficiency prior to growing older (64).

Poor English skills also extend to other older migrants. The 2016 census data indicates a substantial proportion of older migrants from North Africa and the Middle East (39%), South-East Asia (44%), North-East Asia (69%), Southern and Central Asia (32%) and Americas (32%) had poor English proficiency (59). It is important to understand the context of English proficiency in older individuals, English proficiency in older migrants largely depend on their migrating circumstances. Older individuals migrating under population-based policies and family reunification programmes, whereby English proficiency may not be a requirement (Chapter (1) Introduction) may report poor proficiency. However, migrants, more so those from the British Commonwealth countries including Malaysia, Singapore, Hong Kong, India and Sri Lanka may be more proficient in English as English is widely spoken in those countries (376). Proficiency in the main host country language is also linked to other health determinants; age, socio-economic status and education attainment.

My findings, therefore complement other migrant health studies suggesting a strong association between poor English proficiency and reporting poor health (51, 84). They indicate language remains an independent predictor of health. This could be because within a group of migrants from a particular region (such as from Southern and Eastern Europe), there will be some who speak English well even if most do not.

English language proficiency appears therefore to be a source of considerable advantage in Australia as it is linked to all aspects of a migrant's life. Older migrants require English to access information in a predominantly English society, communicate with public sector providers (social, political, economic and health care systems) and participate and engage with the broader Australian society (253, 382). This includes participation in wider society, and gaining awareness of what and how to access relevant support including financial, practical, social and health service supports; all require a level of English language fluency both written and spoken.

To begin with, it denotes integration into the Australian society (377). Greater English fluency alongside high education attainment is associated with increased confidence which results in greater social and community participation (383). For example, poor English proficiency in migrants from Southern and Eastern Europe, Germany, North Africa, Middle East, China and South-East Asia with poor English proficiency was associated with a lower likelihood of volunteering in the community (382), these migrants were either older established migrants, humanitarian or family reunification migrants. Poor English proficiency also inhibits social connections and increases the risk of social isolation among older migrants as their social networks would be largely restricted to their families and ethnic community (59, 61, 64, 382, 383). In some cases even family and other members of their community may not be available to offer social support to older migrants. Petrov, Joyce (384) found there were a significant number of residents from non-English countries in residential aged care facilities (RACFs) who preferred to communicate in a language other than English but were the sole speaker of their preferred language in their facility. In addition to a reduction in quality of life and social networks, as stated in Chapter (4) Cross-sectional analysis social isolation is also associated with increased morbidity and mortality.

English language proficiency also aids in productive ageing and is highly beneficial for employment (59, 64). Older migrants from India, Sri Lanka, Malaysia, Singapore, Philippines, Hong Kong and Fiji who were proficient in English had higher employment rates comparable to the Australian-born and migrants from English-speaking countries (382). While some older Europeans and those from the Vietnam and the Middle East were less likely to be in paid employment. Australian government (382) suggests this may be as a result of early retirement from skilled work and poor English proficiency. As highlighted in Chapter (1) Introduction higher socio-economic status is positively correlated with health (3). This possibly indicates a key reason as to why language is strongly associated with health is due to its interrelatedness to other health determinants. More so in the context of migrants as those with a lower English proficiency are also more likely to report lower socio-economic status including some older established migrants, humanitarian and family reunification migrants.

English proficiency also provides linkages to health services and information (84). Engagement with health services is difficult without proficiency in the main language and undermines any confidence in engaging with services even if the person is aware of them. From understanding health screening programme information, to consulting with health care staff to presenting health symptoms and engaging with clinical decision making, to negotiating primary and secondary health care systems – easy use of the English language is important. As discussed in Chapter (3) Systematic review and Chapter (4) Repeated cross-sectional analysis, language proficiency is also linked to health literacy. Poor health literacy may be a major issue for older migrants with regard to being able to experience good health and provides a logic model for the observed poorer self-reported health in those migrants with these characteristics. Language barriers can result in miscommunication, misdiagnosis and lack of appropriate follow-up (306), resulting in poorer health compared to the host population. The systematic review found migrants were at a higher risk of hepatitis C, TB, *H. pylori,* diabetes and end-stage renal disease. Low health literacy at the individual and the health care systems levels may have resulted in missed opportunities to address their risk and offer early treatment due to current screening and treatment strategies as their risk factors may vary from the host population. As these migrants were generally from non-English speaking backgrounds, for some, possibly poor English proficiency negatively affected their knowledge of disease risk and health seeking behaviours. Health literacy is also independently associated with health, in Chinese migrants' low health literacy was associated with higher emergency department visits and poor self-rated health (304). Figure 5.3 illustrates the pathways through which poor English language proficiency results in poor health.

Though, higher levels of English proficiency are associated with better health and general well-being (305), current language programmes may not aid in the integration of migrants or in the acquisition of functional English skills. Australia has one of the oldest migrant language programmes; the adult migrant English program (AMEP), which began in 1948. AMEP is offered to all new residents who have less than functional English to help them settle and integrate into the Australian society (64, 385). However, AMEP is faced by several challenges. The main challenge is described by researchers as a "one-size-fit-all" teaching approach whereby participants are expected to acquire functional English in 510 hours only regardless of age and literacy levels (64, 385, 386). It is also difficult to provide teaching support in a language familiar to all migrants given the very large numbers of languages and dialects and written translated materials are unlikely to be as helpful as spoken support. Some individuals face additional challenges which may limit their ability or the rate at which they can acquire new language skills (64). This includes a decline in cognitive abilities in older individuals and low literacy in terms of education and their native language (386). As AMEP targets new migrants it excludes older migrants who have lived in Australia for a considerable period but still have poor English proficiency. AMEP is also under-funded and the uptake is poor.

The efficacy of AMEP has not been evaluated in recent times (64). The most recent evaluation, a qualitative longitudinal research spanning four years by Yates, Terraschke (386) provided useful information on migrants language experiences however, it did not quantify English proficiency over time and largely focused on young and recent migrants. As such we can only speculate on why some migrants retain poor English proficiency decades after migration. Although again, a vicious cycle of poorly paid employment with long hours and suboptimal living arrangements, often in cramped quarters, makes it particularly difficult for those without good English to learn a new skill. It is also difficult for those without employment, whose only social contact is within a home where English is not spoken, to practise English in order to become proficient. The efficacy of other language programmes also remains unknown. For instance, there are no available data on the utilisation of the government-subsidised translating and interpreting service for aged care by RACFS (384).

Similar language programmes exist in other countries. The Council of Europe (387) states language courses should have a more integrated approach designed to increase migrants' communication skills while also meeting their perceived needs in the host countries. Some European countries are said to have high quality migrant language programs (388) as they use more integrated approaches. The Swedish for immigrants (SFI) initiative has a wide coverage as it is available in every municipality and considers the specific needs of an individual. For example, study option one is designed for migrants who arrive with low levels of educational literacy from their country of birth (389), providing them with an opportunity to learn, read and write in Swedish (390). Sweden alongside Denmark have flexible but highly developed-language tailored programs for specific professions (389, 390). A key advantage of the SFI is that they teach children Swedish alongside other languages spoken at home regardless of the frequency of use in other languages at home or the number of children in a classroom (389). This approach is grounded in existing evidence that asserts migrants native languages aid in acquisition of other languages (391). Further, this approach recognises linguistic diversity a fundamental right protected by the European Union (392).

However, the Council of Europe also acknowledges that most language courses in their member states experience some challenges. In an attempt to address poor uptake, some European states impose conditions and sanctions as a strategy of language acquisition and integration. Half of the European member states had formal language and knowledge of society requirements when migrants apply for citizenship and these extended to vulnerable groups including minors, refugees and humanitarian migrants (393). For instance, though Denmark offers language courses tailored to meet the specific needs of individuals, they often exclude asylum seekers, some of whom remain in Denmark for decades as repatriation may not be possible even after their applications for asylum are denied (388). Similar to the Australian programme, the number of hours is insufficient as most migrants are only eligible for up to 250 hours free language classes and the effectiveness and impact of the tests on migrants is rarely investigated (393). Some of these limitations are observed in the Swedish language program. The quality of the SFI courses varied across municipalities in Sweden and according to OECD (390) they do not always suffice for low skilled migrants to acquire appropriate literacy skills. MacGregor (391) asserts some European states adopt an “either or” approach terms of language acquisition, as migrant native languages are often seen as problematic and a barrier to integration while emphasis is placed on European languages. In the UK, Mehmedbegovic (394) argues the classification of languages in the school systems devalues ethnic languages. Though schools are expected to teach at least one European language it is optional for languages spoken by large minority groups: Arabic, Bengali, Chinese, Gujarati, Hebrew, Punjabi, Russian, Turkish and Urdu. Such assumptions ignore the fact, skilled migrants’ who are highly proficient in their host country’s language likely acquired the high levels of proficiency in their country of birth alongside their native languages. Language initiatives in some countries depend on the political goodwill, for instance, discoversociety (388) reported the Danish government cut spending on hospitals’ interpretation and translation services, making it difficult for non-Danish speaking individuals to access health care services. Further, some government officials in Denmark some time back reportedly asked citizens to report non-Danish speaking migrants working in the hospitality sector as a way of detecting undocumented migrants (388). Such heavy-handedness approaches may not motivate migrants to acquire their host country’s language but it also may negatively affect their health as it hinders migrants from accessing, health care and health related information.

Lastly, it is interesting to observe, that the aim regarding integration focuses on economic rather than health. Given the relationship demonstrated in my thesis between language and self-reported health in this older population, many of whom have health and social care needs, then the impact on health should also provide a reason for the Australian government to review its policy and practice in this regard to address likely cost-ineffective health service utilisation by older migrants. Earlier engagement with public health messages/initiatives and primary care services is likely to be more cost-effective than reactive crisis interventions with late presentations with advanced, complex disease, provided by secondary health care services such as emergency department care and hospital admissions.

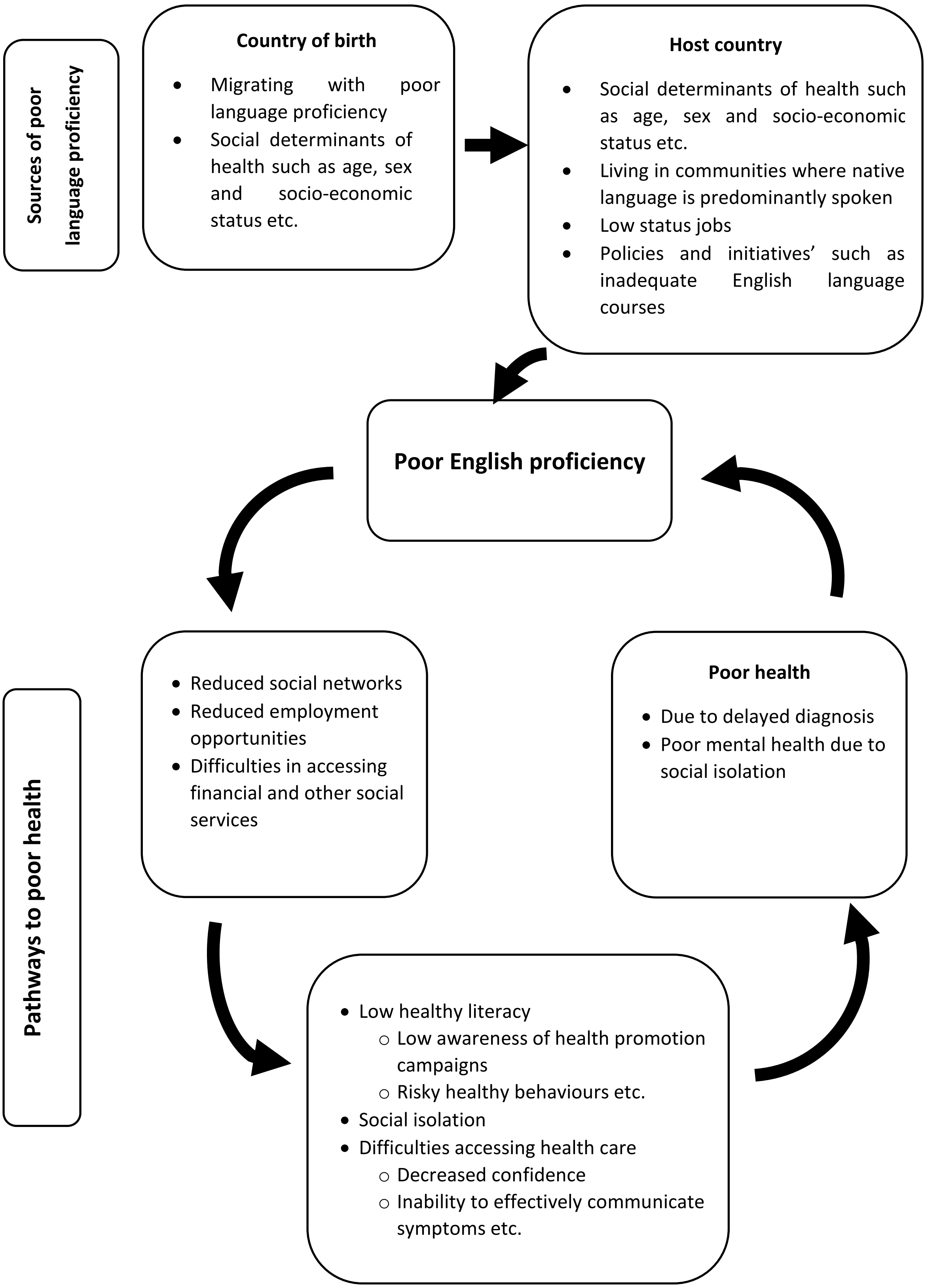


Figure 5.3: Mechanisms through which poor language proficiency influences health

5.3.5.2 The effects of ageing and sex on self-rated health

Being older was associated with poor health (5, 68, 134, 208). As stated in Chapter (4) Cross-sectional analysis getting older increases susceptibility to diseases (3, 9, 100, 119, 134) which increases the probability of reporting poor self-rated health (203, 342).

In Chapter (4) Cross-sectional analysis the effect of sex on self-rated health was marginal and mostly statistically insignificant, more so after adjusting for other socio-demographic, risk and health factors. However, my longitudinal findings indicate clear sex differences with females more likely to rate their health highly than males. This self-rated health advantage among older females is shown in other studies (67, 74, 134, 355, 364, 395, 396). Women's better self-rated health in old age may reflect changing social roles which may improve their health perception. For example, children transitioning into adulthood may allow older women more time to invest in their health (355). Additionally, health behaviours from a life course perspective may also influence the differences in the self-rated health of men and women, older men are more likely to have engaged in risky or poorer health behaviours such as smoking throughout their life course. Zajacova, Huzurbazar (355) found smoking and smoking-related health conditions figured more prominently in older men's self-assessments of their health than in women.

5.3.5.3 Education attainment

In line with other studies (1, 397), my findings imply high education attainment is strongly associated with better health longitudinally with a large magnitude. The wide confidence intervals may be due to small sample sizes within education attainment sub-categories (226). However, as discussed in Chapter (4) Repeated cross sectional analysis, it may also represent heterogeneity within the group as a whole in terms of educational ability, and a poor relationship in the older population (especially in women) between educational ability and educational opportunity. Culturally, women were much less likely to progress to tertiary education, and for both men and women, education opportunities may have been interrupted by war or economic depression. In addition to the poor relationship between educational ability and attainment in older people, cultural differences in the value of education exist, older Australians gained skills through apprenticeships as employers placed less value on tertiary education (398).

Though these findings are in relation to all older individuals, they may have important implications for specific older migrants' health status. Prior migrant studies often describe the education attainment of Southern European migrants as low, more so in comparison to their host population (59, 61-64), a status they have maintained throughout their life course (64). Appendix R indicates Southern and Eastern European migrants in my study were less likely to have higher education attainment compared to other migrants and the Australian-born population. Some researchers argue poor education attainment may result in cumulative disadvantages widening health inequalities in later life (399-401). For example, Oshio (366) used a longitudinal approach to investigate the association between age, self-rated health, functional limitations and psychological distress in Japan over a 9-year period for individuals aged 50–59 years at the baseline. They found education disparities widened with age for self-rated health, functional limitations and psychological distress. Another cross-national longitudinal study found the health gaps in chronic conditions and functional limitations across education levels increased by age, however this cumulative disadvantage was more pronounced in the United States, less pronounced in the United Kingdom and the Netherlands and least pronounced in Sweden (402), which may represent the relationship between education, employment, racial disparities and financial ability to access health care in countries without universal health care such as the United States. As such it would be reasonable to assume education attainment is an important factor for older migrants' health. Other studies however, assert health inequalities as a result of socio-economic status decline with age (403-405) as biological factors and mechanisms overshadow the potential effects caused by social processes (403).

In addition to the issues regarding health literacy above, lower educational attainment may also impact on an individual's view on their entitlement, or not, to health care, perhaps feeling intimidated by the tertiary-educated clinical staff. Education attainment may also be linked to higher English proficiency, which as discussed above influences the health and general well-being of individuals as it reduces the risk of social isolation. Migrants to Australia who are highly educated are also likely to have a greater fluency of English as it may be a requirement for visa approval, these migrants have generally been found to report better health compared to the Australian-born population and other migrants with lower education attainment and poor English proficiency. For such migrants' higher English proficiency increases their confidence easing their integration into the Australian society, while high education attainment increases migrant’s chances of finding appropriate jobs matching their skills.

How the prior context of education attainment affects older individuals’ health deserves further scrutiny to establish if it results in cumulative disadvantages which widen health disparities or the health disparities are as a result of a positive shift towards higher education.

5.3.5.4 Marital status

Being married was associated with better self-rated health (208, 367, 368, 406). As prior mentioned marriage is assumed to be a proxy for social support (208) which positively influences an individual’s disease coping mechanisms (105), improves their socio-economic status (367) and aids in health promoting behaviours (368).

There were no significant differences in the health of widowed and married participants implying the death of a spouse does not account for older individuals’ health perception. This is surprising as widowhood may result in social isolation, a key challenge in old age. Social isolation is associated with feelings of loneliness, helplessness and uncertainty more so in the case of unexpected accidents and illnesses, which may negatively affect health perceptions (63, 406). However, this observation is not uncommon, Ren (367) found widowhood was associated with a very small and insignificant positive relationship.

The relationship between widowhood and self-rated health remains unclear as many researchers in designing and interpreting their studies treat marital status as a dichotomy; married/not married. Kiropoulos, Klimidis (63) found “not married” which included widowed individuals was significantly associated with poor health. In other studies, such as Newbold and Danforth (5) individuals who were divorced, separated or widowed were included in one single group, there were no significant differences between them and the married in reporting poor health. My findings provide longitudinal evidence that health perceptions vary by different marital sub-categories.

5.3.5.5 Smoking status and alcohol consumption

Past and current smoking is associated with reporting poor health (67, 68, 208). The negative health perceptions of former smokers in older individuals may reflect smoking cessation due to poor health (67).

I found stronger evidence that alcohol consumption was associated with reporting better health in older participants. My findings are supported by other studies. Moderate, rather than heavy, alcohol consumption may have positive health effects on older persons (67, 365) and in older women aged 65 years or more was associated with better self-rated health (Balsa, Homer et al., 2008).

Reasons for my findings are discussed in Chapter (4) Cross sectional analysis, and supported by other researchers. Misclassification of older people with health problems both contributing to reduced alcohol intake and arising from previous heavy intake (407) may help explain this observation. In addition, the established causal link between unhealthy lifestyle patterns and poor health may not necessarily impact on an individual's perception of their health as they may lack sufficient knowledge on disease risk linked to specific lifestyle patterns.

5.4 Strengths and limitations

5.4.1 Strengths

This study has several advantages: -

1. It makes an important contribution to older migrants' health literature, an area with a paucity of literature despite Australia's long and rich migration history.

2. I used nationally representative longitudinal data containing a variety of health measures to examine older migrants' health status. I was therefore able to demonstrate a robust relationship between the health of older migrants and the Australian-born population when controlling for a number of factors, and identify some key independent predictors of self-reported health pertinent to migrants.

5.4.2 Limitations

My analysis however has several limitations.

1. I was unable to explore in any further detail the relationship with country of birth within the Asian region, and “other” (including individuals from North Africa and the Middle East, Americas and Sub-Saharan Africa) due to small numbers in the individual categories.

2. I lacked the data to categorise the Australian-born population by migrant generation status or ethnicity. Second generation migrants (i.e. those born in Australia and having at least one foreign-born parent) may have been included in the Australian-born group, this has the potential to bias my findings. However, my major research question focuses on the variations in health status of older foreign-born individuals compared to individuals born in the host country. In addition, host country language proficiency, education and employment opportunities usually improve in successive generations, redressing some of the main determinants of self-reported health identified in my data (408, 409). However, this phenomenon may vary by country and culture of origin of the migrated parents (409).

3. Due to time and data constraints I did not investigate migrant specific health determinants. However, some aspects of the Bradford Hill criterion such as “consistency” and “dose response” were used to derive some useful insights on factors possibly associated with older migrants’ health from the whole population models used in my analysis.

4. Other migrant specific characteristics that may be associated with health status were not available in the HILDA dataset. As older migrants’ migration patterns are diverse, general migrant health studies suggests differential health patterns exists by type or reason for migration. For example, economic migrants may report better health than those coming as family migrants or refugees (74, 84). However, my discussion focused on older established migrant groups (i.e. North-West Europeans and Southern and

Eastern Europeans) whose migration patterns are clearly described elsewhere, I found variations in health.

5. The HILDA dataset used in the current analysis was older and lacked data on objective health measures (chronic conditions) and types of migration (visa category) which were collected in the subsequent waves of the updated HILDA dataset. However, my findings are still applicable to the older Australian migrants as North-West and Southern Europeans consist a large proportion of the current older migrant population in Australia (59).

5.5 Implications

As Australia's population is ageing and the heterogenous older migrant population is increasing my findings highlight important considerations for research, policy and practice on their health.

5.5.1 Policy and practice

Health and well-being interventions in later life should seek to reverse or reduce the effects of socio-economic and demographic inequalities on health status. Policies and interventions should focus on education attainment, smoking status and first, preferred or native language as my findings indicate they were strongly associated with health. Further, education and first, preferred or native language also relate to health literacy; addressing education and language disparities in older individuals may aid in the reduction of health inequalities. Planning in health care should include an awareness of this persistent problem, recognising that written information, and provision of translation services having accessed services is unlikely to be sufficient. Prevention of this issue by reviewing the policy relating to new migrants should be better addressed with a review and revision of current practice, recognising the long-term cost-effectiveness of supporting language proficiency, not just in relation to economic integration, but also of health service utilisation.

5.5.1.1 Language-based care programs

Though researchers and policy makers agree poor English proficiency results in considerable social and health disadvantages, older migrants are generally excluded from interventions and policies geared at increasing English proficiency. For instance, McDonald, Moyle (64) suggested English language training would be largely ineffective for migrants in the oldest age groups (85 years or more), and recommended policies more so age care policy needed to focus on language-based care programs. Furthermore, despite identifying wide-ranging factors influencing English proficiency in Australia between 1981 to 2016 and subsequent recommendations aimed at improving English proficiency in new migrants, the authors only mention difficulties faced by older migrants in language acquisition but hardly offers ways of overcoming them.

Other Australian policies focusing on language-based programs includes the "translating and interpreting services" (410). Its key features include using a skilled multi-cultural workforce in old age related services including interpreters to help older CALD migrants interact with and navigate the health care system (411). Secondly, disseminating health information through easy to read materials printed in older migrants' native language and using ethnic community and social clubs for health promotion (412). However Hurley, Panagiotopoulos (413) suggests a disconnect exists between policy and implementation as there are few studies investigating their effectiveness in practice. They also found many formal health services assumed accessibility denoted providing translated materials (printed or online) which may not be useful to older migrants with low literacy in English and their native language, and only available to those already accessing health care where many may not be aware of them, or do not have the confidence to engage. Therefore, language-based care policies should address disparities in health and general literacy in older individuals and their focus should be on the specific needs of CALD groups.

5.5.1.2 Language acquisition programs

Some researchers assert that though age is an important factor in language acquisition it is not an overriding factor (414) and older individuals can learn a new language effectively (414-416). A qualitative study of older refugees in Germany aged between 45-64 years found though older individuals experienced greater learning difficulties, they remained highly motivated to learn German (415). Learning their host country's language is beneficial to older individuals as it increases their self-confidence, reduces the feelings of social isolation and is positively associated with health and well-being (416). As such, policies and interventions should also aim at improving English competency in older individuals. These programs should consider the needs of older migrants as opposed to adopting a "one size fits all" approach. Policy makers should consider adequate time, literacy levels and adequate funding (414, 415). Language acquisition programs should not attach legal conditions and sanctions such as access to benefits or citizenship as they can demotivate individuals and hamper integration (387). To aid older individuals in acquiring a new language, Donaghy (416) suggests language courses should include learning aids for older individuals with health and functional limitations such as using larger print type for printed text, integrating memory exercise classes and allowing adequate time to learn language.

5.5.1.3 Health literacy and public health initiatives

More health advocacy is needed to create awareness among older persons on individual characteristics such as smoking which predisposes them to poor health. Though Australia has comprehensive smoking cessation programs, their impact has been minimal in ethnically and diverse groups (417) as some still report higher smoking rates despite the well-known benefits of smoking cessation (418). For example, Greek-Australians have one of the highest smoking rates in Australia (419), while in some non-English speaking migrant groups their initial lower smoking prevalence rates have been found to converge towards the higher rates of the Australian-born population with increasing duration of residence (120).

Some aspects of the Australian smoking cessation policies target ethnically and diverse Australians. For example, Quitline (a telephone helpline offering treatment for addiction and behaviour issues) offers access to interpreters and printed resources translated into various languages (420). Similar to the language-based and acquisition programs, the challenges facing smoking cessation programs can be described as the use of a "one size fits all" approach. As a result such policies, though well intended may inevitably exclude some Australian groups such as individuals from non-English speaking backgrounds (417).

To formulate tailored and targeted smoking cessation programs, policy makers should consider psychosocial, cultural factors (420), attitude towards smoking in specific groups, health literacy (419), familial and community roles (421, 422) as aids or barriers to smoking cessation. A qualitative research on the smoking experiences in the Arabic speaking community in Sydney, Australia found male smoking was socially acceptable and family support often lacked in smoking cessation attempts (422). These participants were also unaware on the negative health impacts of second-hand smoke to adults closest to them including their wives. Low health literacy levels were also found in Greek-Australians who not only displayed a positive attitude towards smoking but also had minimal knowledge about the harmfulness of smoking and the benefits of smoking cessation (419). However, the study population was convenient and the bilingual translator was well known to the participants which may have biased the quality of the translations.

Attitudes also persist for other health preventative measures. Some ethnic groups are less likely to be vaccinated against covid-19 (423) despite their disproportionate risk of severe covid-19 (310, 311). The negative attitudes towards positive health preventative measures in some ethnic groups may result from mistrust of public health services due to historical injustices (423). Host countries must therefore ensure their health care systems and health preventative measures are culturally competent. Betancourt, Green (424) defines cultural competency as "the ability of health systems to provide care to patients with diverse values, beliefs, and behaviours by tailoring delivery to meet patients' social, cultural, and linguistic needs."

5.5.2 Research

5.5.2.1 Updated and reliable data

As research is critical to risk factors identification in diverse older migrant subgroups and informing service planning, use of reliable and updated data is important. Most of the explanations on older migrants' health are speculative due to a lack of reliable data linking health to migration status, past and prevailing circumstances of migrants. Low, Barcenilla-Wong (425) asserts culturally and linguistically older Australians are often excluded from research as information on their ethnicity, language and country of birth is not routinely collected or reported. Researchers and relevant authorities should consider collecting adequate information and updating past data on older migrants' characteristics that would fully inform on their health status. At the very least, data collected should include migrant specific information such as country of birth, years lived in Australia, migrating circumstances, proficiency in English, cultural factors in addition to their socio-demographic, risk and health factors.

5.5.2.2 Consider data linkages

Researchers should consider data linkages as they can enhance study datasets with additional data, otherwise not collected from study participants (426), allowing a detailed investigation of health status and associated determinants while reducing data collection costs (427). However, data linkage in countries such as Australia may be problematic as different legal jurisdictions with significant differences in access and approval processes are responsible for their data (427, 428). Applying to various jurisdictions, in addition to existing complex policies and practices on data linkages leads to lengthy wait times for researchers, and may fuel feelings of frustration and hopelessness among researchers (427). Various administrative bodies should consider harmonising their data linkage policies and practices, as they would result in robust evidence to inform research, policy and practice.

5.5.2.3 More longitudinal studies

As highlighted in Chapter (3) Systematic review and Chapter (4) Cross-sectional analysis more comprehensive and rigorously conducted nationally representative longitudinal studies taking into consideration the breadth of factors affecting heterogenous older Australians health status are needed as opposed to small-scale localised and cross-sectional studies. More so as the pathways by which health changes over time including the role of migration policies, ethnic and cultural diversity are poorly understood, limiting the ability to implement policies that will safeguard any health advantage while addressing possible health disadvantages.

5.5.2.4 More research on the social determinants of health in older adults

More research is needed to explain the role of socio-economic factors such as education in the widening or reduction of health inequalities in later life. For example, while Southern European migrants seem to have maintained a low socio-economic status throughout their life-course, there are few studies investigating the relationship of such inequalities and health status. Research is needed to clarify the effects of alcohol consumption on older persons health, and whether the apparent "alcohol consumption health advantage" is as a result of a misclassification or abstainers bias.

Further, more research is needed to examine English proficiency as a measure of health inequalities. From the current analysis, it was unclear if language is an indicator of "country of birth" or preferred language, more so in Asian migrants (depending on migrating circumstances) whose preferred language may or may not be a measure of English proficiency.

5.5.2.5 Population-based health determinants

More research is needed to identify population-based factors which influence health in addition to individual factors. Throughout my research, I have highlighted population factors identified from other studies which are often excluded in research. For migrants this would include health literacy policies in their country of birth and host countries. Though, minimal knowledge in disease aetiology can be linked to individual factors such as language and education disparities, it may also indicate a lack of or inadequate health literacy policies. If individuals originate from countries where they are at an increased risk to certain diseases with long latency periods and with no policies to educate them on adequate prevention measures and migrate to countries with a lower risk but with no or inadequate policies, their risk to such diseases persists.

A key advantage of including population-based factors is that it aids in the identification of population-based factors which largely influence individual characteristics. For instance; older established migrants may have lacked adequate opportunities to learn English or as earlier stated cohort differences in the value of education exist as employers and Australians in the past did not place a lot of value on tertiary education. This allows a shift from the individualisation of responsibility and risks and aids in addressing the broader social, economic and political forces which created or exacerbate such disparities (additional limitations to social determinants frameworks solely focused on individual factors are provided in Chapter (1) Introduction).

5.5.2.6 Migrant health categories in research

Studies should consider appropriate ways to categorise diverse older migrants' in their research given their data limitations. As evidenced by the country of birth and duration of residence variables in this analysis, some categories may mask substantial heterogeneity resulting in imprecise effect sizes leading to less effective migrant health policies and interventions.

5.5.2.7 Updated migrant health research

Research on older migrants' health status needs to be updated regularly to adequately inform on the health and health care needs of older migrants, whose diversity is constantly changing. For example, though Europeans comprise a significant proportion of the total older migrants' population in Australia, the proportion of older migrants from other regions is projected to substantially increase over time (59). The potential consequences of under-representation of such diverse older migrant populations and their socio-demographic characteristics in research is a paucity of evidence to adequately inform migrant health policies. An example of where such an understanding would be important is in cancer screening programs access, particularly among older adults with poor language skills will be affected by cultural issues. An older woman from a patriarchal society, who would only attend a health care facility with a male member of the family, or child with better English, may be reluctant to attend breast or cervical cancer screening programmes.

5.5.2.8 More research on acculturation theory and healthy migrant effect

More research is needed to understand the interplay between acculturation and the health of migrants, more so over time. Migrant health studies should adopt more complex approaches which may aid in understanding pathways through which aspects of acculturation are linked to health status (87, 429). Researchers should avoid the "one size fits all" approaches, which may lead to stereotyping and stigmatisation of specific migrant populations (429). Further, other than individual factors, structural health determinants including host country policies which may act as an aid or barrier to acculturation should be investigated.

5.5.2.9 Effectiveness of current policies and programs

In Chapter (3) Systematic review I recommended research into the effectiveness of pre-migration and post migration screening policies, to aid in identification of migrant groups that would benefit from early detection and treatment of diseases, more so for diseases with long latency periods such as tuberculosis, hepatitis C and *H. pylori*. Further, more research is needed to evaluate the effectiveness of current policies and programs addressing health disparities in older individuals. Such research should inform on the strengths and weaknesses of current programs and provide recommendations. For example, they should examine if current policies adequately deal with the effects of language and education disparities on health literacy and health service utilisation, or the impact of smoking cessation policies on older adults in Australia, more so those with poor English proficiency. Particularly, more research is needed to determine the effectiveness of English acquisition programs in older adults, identify barriers and aid in the development of language courses addressing the needs of older adults. It is important to examine the impact of interventions aimed at increasing the uptake of screening programmes by older migrants from culturally and linguistically diverse backgrounds. Lastly, it is also important to ascertain if policies are informed by research which differentiate migrants by their socio-demographic, risk and health characteristics as opposed to treating culturally and linguistically diverse migrants as a homogenous group.

5.6 Conclusion

I used data from a single longitudinal dataset to examine the older migrants' health status compared to that of the Australian-born. I found overall older migrants reported a health advantage to the Australian-born. However, substantial variations existed by region of birth. North-West Europe was associated with greater odds of reporting better health, while Southern and Eastern Europe was associated with reporting poor health compared to the Australian-born.

Factors associated with poor health included; ageing, first, preferred or native language other than English, current and former smoking. Factors associated with reporting better health included being female or married and having a high education attainment. Particularly, Southern and Eastern Europe, a first, preferred or native language other than English, current and former smokers were strongly associated with poor health while education attainment was strongly associated with reporting better health.

These findings imply policies must be based on the best available evidence, which should be representative of the population. The next chapter summarises thesis findings and highlights implications for research, practice and policy.

Chapter 6 Summary of findings

6.0 Introduction

My thesis examined the health status of older migrants compared with those born in the host country, firstly looking at the published literature with regard to Canada and Australia (two Commonwealth countries with a strong migrant history and similar initial approach [British/White European]), and then, using my own analysis from Australian data, to inform policy makers, service providers and researchers. Varied quantitative methods were used to investigate my stated objectives, other than in the systematic review where a narrative synthesis was used.

This chapter seeks to critically synthesize these findings to summarise i) my findings with regard to the thesis research questions, aims and objectives, ii) the strengths and weaknesses of my work, and iii) the implications of the research findings for research, practice and policy.

6.1 Summary of findings

In Table 6.1 I have brought together the findings from each of the studies presented in this thesis (systematic review, repeated cross-sectional and the longitudinal analysis) by tabulating summary findings against each thesis research question and synthesising them into overall findings for that question.

My findings demonstrate differences in the health of older migrants compared to their host population, with the clarity of the finding and strength of evidence increasing as I progressed from literature review, to repeated cross sectional analysis to longitudinal study.

These findings also strongly support my thesis hypotheses (outlined in Chapter (1) Introduction). Firstly, I hypothesised the health status of older migrants differs compared to their host population. Across the studies I found older migrants reported differential health status to their host population, more so when using various sub-groups. Secondly, I postulated diverse health determinants are related to the health of older individuals. I found age, language spoken at home, current/former smoking, education attainment, marital status and past chronic conditions were associated with the health of all older adults. Particularly, language spoken at home, past chronic conditions and current/former smoking were strongly associated with poor health. While education attainment was strongly associated with better health. The third hypothesis postulated the health status of older migrants differs compared to the host population over time. I found variations in the health of older migrants over time, however the strength and direction of association was linked to their region of birth. I found over time, North-West Europeans had higher odds of reporting better health, Southern and Eastern Europeans had lower odds with a greater magnitude while Asians and other migrants showed no differences. Lastly, I suggested diverse determinants of health are related to the health of older individuals over time. I found age, sex, first, preferred or native language, current/former smoking, education attainment, alcohol consumption, marital status and region of birth were associated with the health of all older adults over time. Particularly, Southern and Eastern Europeans, growing older, first, preferred or native language other than English and current/former smoking were strongly associated with poor health. While education attainment was strongly associated with better health. First, preferred or native language was a strong indicator of older migrants' health as they were more likely to have a first, preferred or native language other than English.

Table 6.1: Summary of thesis findings

	Summary of findings			
	Systematic review	**Repeated cross-sectional analysis**	**Longitudinal analysis**	**Summary**
Countries	Australia & Canada	Australia	Australia	All
1. What is the objective health status of older migrants relative to the host population? (objective measures).	• Migrants fared worse for: infectious diseases (tuberculosis, hepatitis C virus, H. Pylori); poor mental health (including suicide); diabetes, vitamin D deficiency, end stage renal disease and cognitive impairment. • Migrants fared better for: mortality, cardiovascular disease and some cancers. • Though there was only one longitudinal study (mortality), repeated cross sectional studies examining migrants health status suggested convergence to the host population health status over time.	• Not assessed	• Not assessed	• Migrants generally had a health advantage for non-communicable diseases and a health disadvantage for communicable diseases.

Table 6.1: Summary of thesis findings (continued)

	Summary of findings			
	Systematic review	**Repeated cross-sectional analysis**	**Longitudinal analysis**	**Summary**
2. What is the subjective health status of older migrants relative to the host population?	• Studies using overall nativity status found statistically non-significant differences in the SRH of migrants and their host population. • For migrant subgroups, self-rated health varied. Poor SRH was reported by: Non-British migrants, foreign-born non-whites aged 65 years or more and recent migrants (migrated ≤ 10 years ago, aged 65 years or more). • Higher odds of reporting better SRH were observed in British migrants and recent migrants (migrated ≤ 10 years ago and were aged 45-64 years).	Migrants self-rated health odds varied across the waves: - • Wave 1: they had marginal and non-statistically significant reduction in odds of reporting better health. • Wave 2: they had statistically significant but marginally higher odds of reporting better health. • Waves 3 and 4: they had statistically non-significant higher odds of poor health.	Migrants had statistically significant higher odds of reporting better health which varied by region of birth; • North-West Europeans had marginally higher odds • Southern and Eastern Europeans had lower odds with a greater magnitude • Asians and other migrants showed no difference	Using the most robust method (longitudinal analysis), overall, migrants had higher odds of reporting better health, but this “hid” variations by region of birth.

Table 6.1: Summary of thesis findings (continued)

	Summary of findings			
	Systematic review	**Repeated cross-sectional analysis**	**Longitudinal analysis**	**Summary**
	• There were no statistically significant differences for foreign-born Whites and non-Whites aged 55-64 years and migrants aged 45-64 years (who migrated ≥10 years ago). • There were no longitudinal studies investigating the self-rated health of migrants	For those of unknown nativity: - • Waves 1 and 2: they had a statistically significant health disadvantage of greater magnitude to the Australian-born population. • Waves 3 and 4: the health disadvantage was not statistically significant. • Sensitivity analyses regarding unknown nativity did not alter direction of findings.		

Table 6.1: Summary of thesis findings (continued)

	Summary of findings			
	Systematic review	**Repeated cross-sectional analysis**	**Longitudinal analysis**	**Summary**
3. What factors influence health?	• Differences in measured and unmeasured interrelated country of birth and host country factors influence the health of migrants.	• Associated with poor health: Being older, being divorced or never married, being a current or former smoker, not speaking English at home and a history of chronic conditions. • Associated with good health: having higher level education; not abstaining from alcohol • The strength of association was greater for speaking a language other than English at home, former/current smoking and a history of chronic conditions. • High education attainment was strongly associated with higher odds of reporting better self-rated health and by a larger magnitude.	• Associated with poor health: Being older, first, preferred or native language other than English, and current/former smoking. • Associated with good health: having higher level education; not abstaining from alcohol • First, preferred or native language other than English and current/former smoking were strongly associated with poor health. • Being female or being married, alcohol consumption and higher education attainment were associated with reporting better health. • The strength of association was greater for higher education attainment and by a greater magnitude.	Using the most robust method (longitudinal analysis) demonstrated factors associated with self-rated health. Particularly; language, education attainment and smoking status were strongly associated with self-rated health over time and with a greater magnitude.

Table 6.1: Summary of thesis findings (continued)

	Summary of findings			
	Systematic review	**Repeated cross-sectional analysis**	**Longitudinal analysis**	**Summary**
		• The relationship between sex (other than wave 1 where females reported statistically significant higher odds of reporting better health), alcohol consumption and self-rated health was unclear.		

The questions listed in Table 6.1 represent a summary of my thesis research questions: -

1. What is the health status of older migrants compared to the host population?
2. What is the relationship between potentially influential factors and the health of older migrants?
3. How does the health status of older migrants vary over time compared to the host population?
4. What are the factors associated with the health of older migrants' over time?
5. What are the gaps in knowledge identified from prior published literature regarding the health status of older migrants to Canada and Australia?

6.2 Major findings

6.2.1 Differences in objective health

The systematic review findings indicated differences in objective measures. They suggest an older migrants' non-communicable disease health advantage (except for diabetes, vitamin D deficiency, end stage renal disease, mental health, and cognitive impairment) but a health disadvantage regarding infectious diseases. However, the health advantage and disadvantages varied by region/country of birth and other migrant categories, age, sex and migrating circumstances. For example, though Asian migrants had lower rates of cardiovascular disease and mortality, they were at an increased risk of tuberculosis, hepatitis C, vitamin D deficiency, diabetes, end stage renal disease and poor mental health. Older Southern European migrants had a lower overall and cause specific mortality (circulatory diseases and diabetes), they also had a lower incidence of prostate, breast and colon cancer. However, they were at an increased risk of end stage renal disease.

The variations in the health of migrants and their host populations were as a result of several diverse and interrelated factors. Depending on specific diseases and other factors, these factors may result in health advantages or disadvantages. For example; changing migration policy goals from “population” to “skills” in Australia resulted in migrants who not only differ in their socio-demographic characteristics but also in their health. Different factors may result in similar health advantages in migrants (Figure 6.1); Southern Europeans and Asian migrants had a greater survival advantage compared to the Australian-born population. In Southern Europeans the advantage is thought to result from maintaining a traditional Mediterranean diet (296), however in Asian migrants the advantage results from selectivity effects (291, 292), that is, many are well-educated, highly proficient in English and likely to be in better health compared to their host population. These characteristics are a result of stringent selection criterion for skilled migrants in Australia and are associated with a health advantage at the time of migration in skilled migrants. Health disadvantages also result from inadequate policies in the host/birth country or both which may lead to low health literacy at the individual and population levels. More so in terms of knowledge of disease aetiology, particularly, in situations where some migrants have differential risk factors compared to their host population as observed for hepatitis C (257) or diabetes (277). Some migrant dietary patterns are positively associated with health; such as the earlier mentioned mortality advantage in Southern Europeans, in others it may result in health disadvantages. For example, in addition to religious and cultural factors, low calcium dietary patterns were associated with an increased risk of vitamin D deficiency in older Vietnamese and Middle Eastern migrants (265, 280-283).

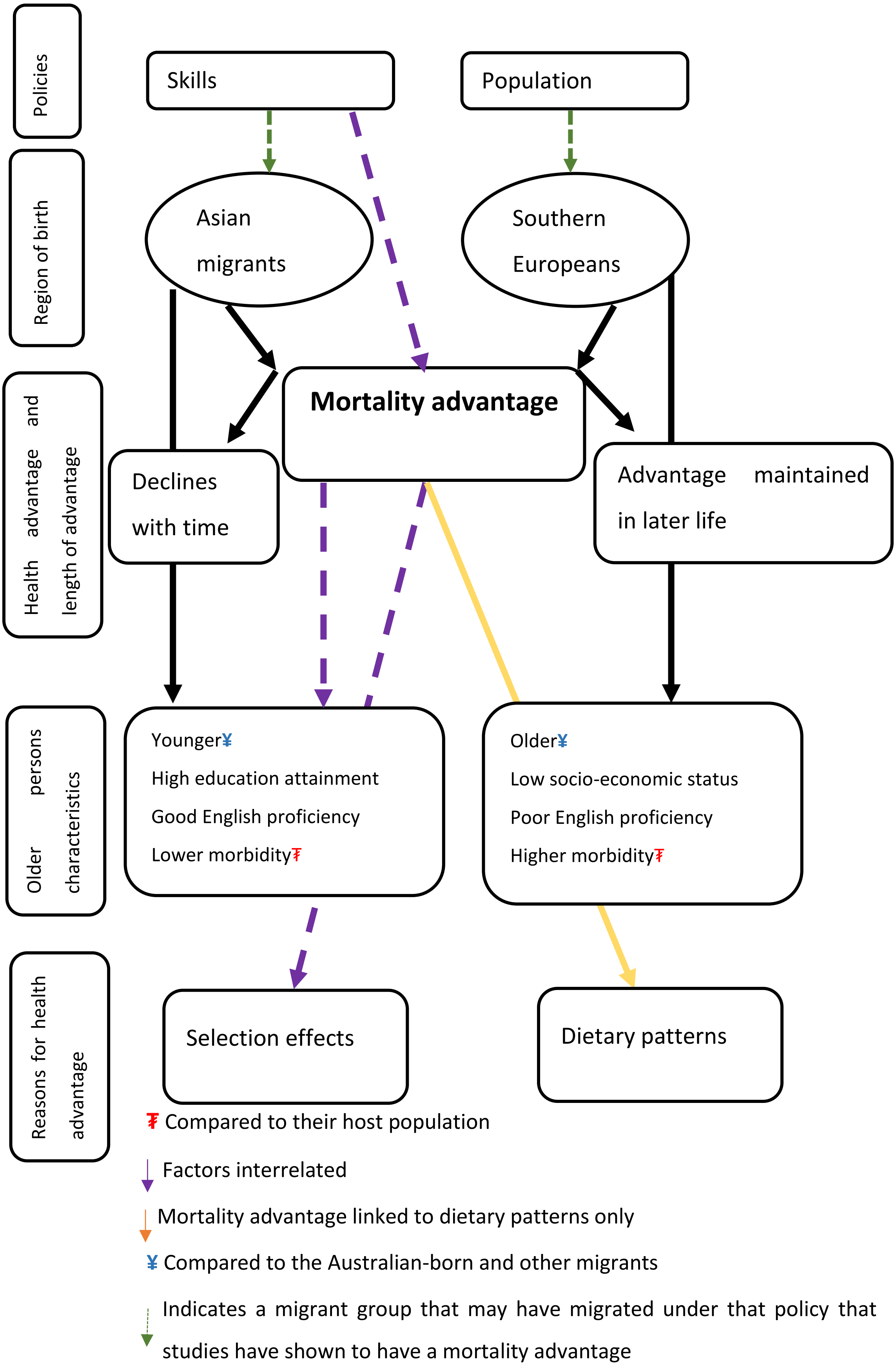


Figure 6.1: Differential patterns for mortality advantage in Southern Europeans and Asian migrants

6.2.2 Differences in subjective health

The systematic review found no differences in the self-rated health of older migrants and their host population using a binary nativity status only. My repeated cross-sectional analysis overall also found no convincing differences in self-rated health. However, using a single dataset with no missing data regarding nativity status, and using a longitudinal analysis of change in individual health status over time demonstrates clear differences in the health of North-West and Southern and Eastern Europeans compared to their host population.

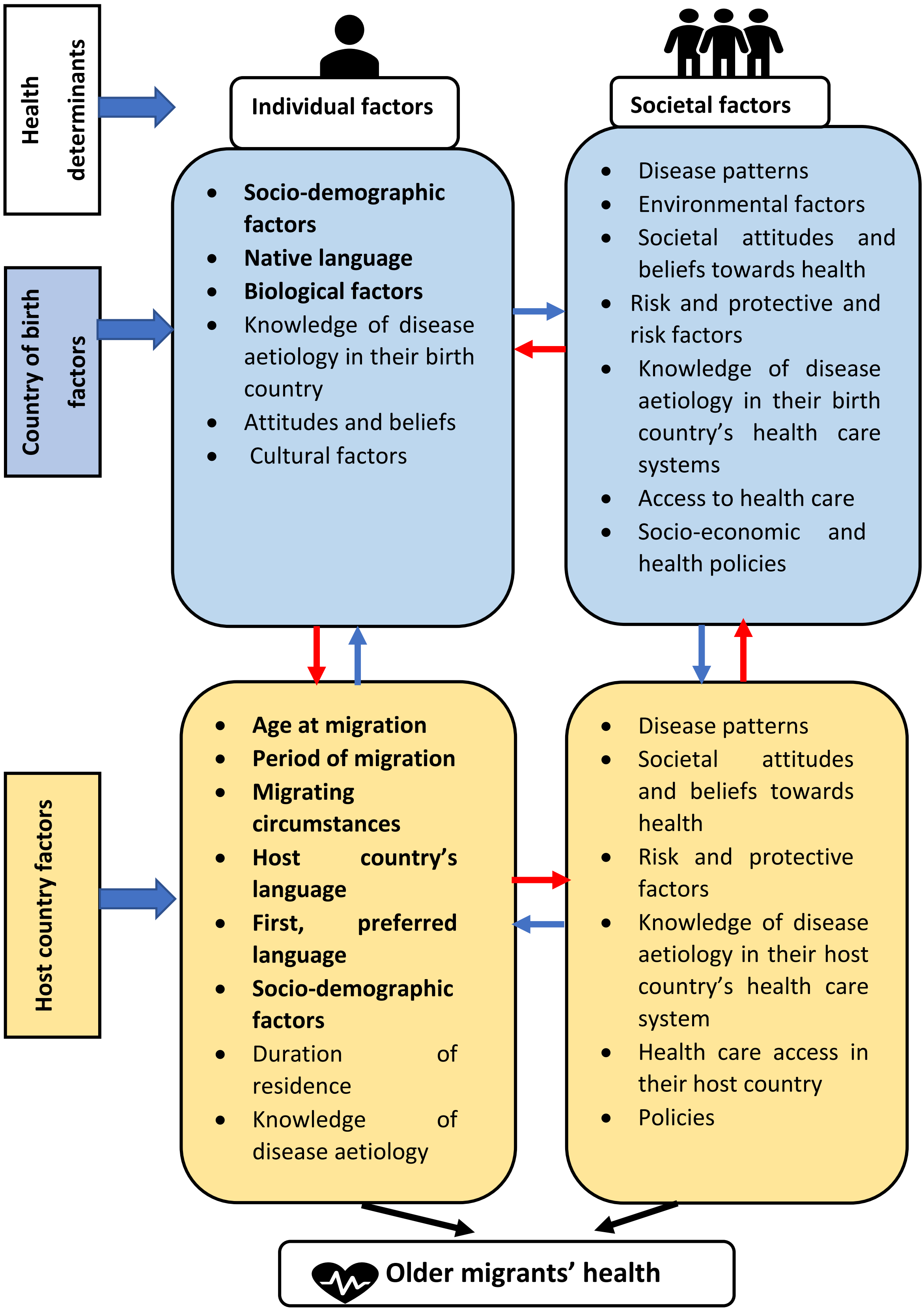
Failure to recognise that migrants are a heterogeneous group meant that differences compared to the host country-born were not seen. Where migrant sub-categories regarding country or region of birth showed a self-rated health advantage in some - particularly those from Britain/Ireland (systematic review) or Northern Europe – likely to be majority British/Irish- (longitudinal analysis). The magnitude of health advantage was to such an extent, that it "hid" the clinically relevant health disadvantage in those from South and East Europe. In the longitudinal analysis I was also able to provide findings pertinent to the health status of older migrants from other regions such as Asia, whose population is increasing and is projected to represent a larger proportion of the Australian older population in coming years (59).

6.2.3 Factors influencing health

I found socio-demographic and risk factors associated with older individuals' health and needed to be adjusted for in my final models. Being older, current or past smoking, never married, divorced or separated, not speaking English at home and a first, native or preferred language other than English were associated with lower odds of reporting better health while high education attainment was strongly associated with higher odds of reporting better self-rated health. Particularly, the repeated cross-sectional and longitudinal analysis indicate; age, non-English speaking (at home, generally or as an indicator of first or native language), past and current smoking and high education attainment are important indicators of self-rated health. Though history of chronic conditions was only assessed in the 1st wave of the repeated cross-sectional analysis due to data constraints, the findings indicate this characteristic is also likely to be an important determinant of older individuals' self-rated health over time.

Low education attainment and poor English proficiency may contribute to worse health, mediated through poorer health literacy in individuals. Higher education and English proficiency act as pathways to greater health literacy, resulting in easier and greater access to health information and health care services. They are also linked to greater migrant integration into their host society including access to social support, financial services and jobs matching their skills; all of which also support better health. English proficiency and high education attainment may also aid in earlier diagnosis, better management of medical conditions and increased adherence to treatment and medication. My thesis also provides additional evidence on education attainment in widening health inequalities over time, as it was strongly associated with poor health in the repeated cross-sectional and longitudinal analysis. In addition to language and education attainment, factors such as country of birth and smoking status were also associated with health. Country of birth, as well as directly affecting English language skills, may affect cultural attitudes towards smoking (419, 422) and health service utilisation including attitudes to joint (patient-clinician) clinical decision making and engagement with self-management treatment plans which negatively impact on the effectiveness of smoking cessation programs in specific populations.

Figure 6.2 further illustrates the interrelatedness of individual and population health determinants. For example, inadequate policies and initiatives in addressing some migrants' differential attitudes and beliefs towards health and well-being may increase their risk to certain diseases. Some examples included attitudes towards sunlight (preference for lighter skin) and dietary supplementation which may increase their risk of vitamin D deficiency or attitudes towards mental health problems which may hinder certain migrant populations from seeking appropriate care (Chapter (3) Systematic review). Other than an increased risk of diseases, inadequate policies lead to delayed diagnosis and poor prognosis, for example, infections such as hepatitis C may progress to liver cirrhosis (127) and liver cancer (319, 320, 322) if left untreated.



Factors highlighted in **"bold"** are commonly assessed health determinants in migrant studies

Figure 6.2 An outline of describing older migrants' characteristics

6.2.4 Evidence for existing theories, hypothesis and frameworks

6.2.4.1 Strong evidence for the social determinants of health framework

My findings provide additional longitudinal evidence for the social determinants of health framework as I found education attainment to be an important health determinant in older adults. Migrant health studies cite a key limitation of the social determinants of health framework as their "individualisation" of health risks as they do not consider how they are influenced by societal structures, political, economic and social forces (137, 340). However, I highlighted the pathways through which education affects health including a lack of appropriate policies and low health literacy. As prior mentioned higher education attainment and English proficiency are pathways to greater health literacy. Health literacy is associated with better health as it may result in greater access to health-related information and health care services. My findings importantly highlight socio-economic disparities in older migrants, their source and effect on health. Figure 6.3 summarises pathways through which education influences the health of older migrants. Education level in Australian migrants is largely influenced by their migrating circumstances and host country policies. For example, older established Southern Europeans likely migrated with low education attainment (59, 63, 64, 251), a status they have maintained due to low status, low skill, low paid jobs and inadequate policies addressing them. On the other hand, skilled migrants are highly educated due to stringent selection criterion at the time of migration (74).

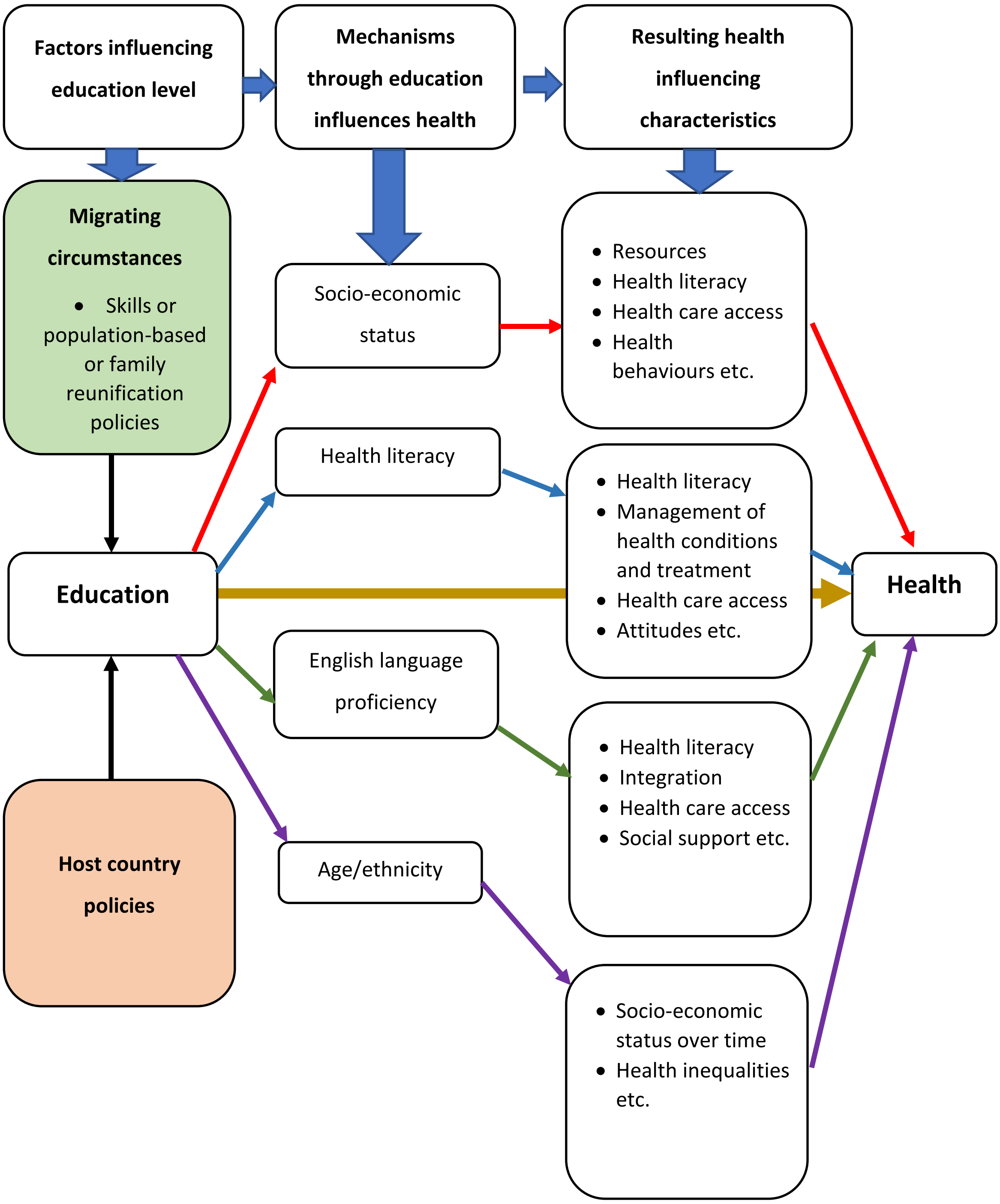


Figure 6.3: Mechanisms through which education influences health

6.2.4.2 Inadequate evidence for existing theories and hypothesis

Consistent with other studies highlighting the methodological and conceptual weaknesses of the healthy migrant effect hypothesis and acculturation theories (73, 85, 130, 208, 374), I found little evidence supporting their applicability to my thesis findings. The systematic review found weak cross-sectional evidence and I found no longitudinal evidence at all. In the included studies, convergence was inaccurately measured by assessing individuals in different age groups rather than following individuals over time, older migrants were generally treated as a homogenous group, some inferences were drawn from studies published more than 20 years ago and the findings were in reference to a specific migrant group and were not generalisable to all migrants.

The "marginal" or "no differences" observed in the repeated cross-sectional analysis may be indicative of convergence in health that had already occurred as my participants had lived in Australia for over three decades. However, this is unlikely to be the sole explanation as a significant proportion of my participants were British and may share similar socio-demographic characteristics to the older non-indigenous Australian-population which has relatively recent Anglo-Celtic origins. Also, to infer "convergence" from my repeated cross-sectional analysis study I needed to assume that the included diverse migrant populations; Southern and Eastern Europeans, North-West Europeans, Asian and other migrants share similar socio-demographic, health and risk factors. It is likely the "no differences" masks health variations in heterogenous migrant populations. Although my longitudinal study findings indicate differential health status among diverse migrant populations compared to the Australian-born, it is unlikely these differences indicate "convergence". As mentioned earlier some migrants share similar characteristics with the Australian-born population and may report similarities in health status, others may have migrated with and maintained characteristics associated with health disadvantages over time such as poor socio-economic status and poor English proficiency in Southern European migrants.

6.3 Strengths and limitations

6.3.1 Strengths

Table 6.2 summarises the strengths of my PhD thesis. Using three different and robust methods; systematic review, repeated cross-sectional and longitudinal analysis, my study findings make important contributions to older migrants' health literature. It begins by systematically summarising the health status of older migrants from existing studies and highlighting gaps in literature. The key gaps identified included: a paucity in older migrant's health literature including few longitudinal studies and the depiction of migrants as a homogenous group in research. These limitations hinder our understanding of older migrants' health status, that is, any health inequalities or health advantages and the subsequent determinants in diverse migrants are not yet well understood. This is concerning as Australia has a long and rich migration history and migrants represent a significant proportion of the Australian population (Chapter (1) Introduction).

Consequently, in the subsequent sections I addressed some of these limitations. Though, the repeated cross-sectional analysis investigated differences in self-rated health using binary nativity, it used a large sample size (n=44,415). This study also informed on the drawbacks of using binary nativity status including misinforming on health advantages or otherwise. Then, I longitudinally examined health status of older migrants relative to the Australian-born population using migrant's region of birth subgroups. This produced robust longitudinal evidence demonstrating variations in the health; North-West Europeans had marginally higher odds of reporting better self-rated health, Southern and Eastern Europeans had lower odds with a greater magnitude while Asians and other migrants showed no difference.

My study also identifies additional evidence on the limitations in the existing hypothesis, theories and frameworks on migrants' health which are highlighted in earlier sections. The methodological and conceptual limitations associated with the "healthy migrant effect" and the paucity of data on migrants health may misinform migrant health policies as such research findings do not accurately reflect where the opportunities for health improvement lie (374).

My research also identified factors associated with health, more so over time. Firstly, the repeated cross-sectional analysis identified factors associated with self-rated health at four DYNOPTA time points and how the strength and magnitude of the associations changed over time. The subsequent analysis further demonstrated strong longitudinal evidence for an association between some factors and self-rated health. I identified the importance of potentially remediable factors such as education attainment, first native or preferred language and past or current smoking as strong indicators of health. In the longitudinal analysis I was also able to show a "dose" effect in older age and level of education with change over time thereby giving an indication of causation as well as association (177, 220). My thesis also discussed likely associations with other unmeasured individual and population health determinants such as health literacy and access to health care systems by way of providing logic regarding to how such factors might affect any impact (Chapters 4 and 5). My findings provide useful insights for research, policy and practice which are discussed in subsequent sections.

Table 6.2: Summary of thesis strengths

Systematic review	Repeated cross-sectional analysis	Longitudinal analysis	Summary
• Systematically summarised the health status of older migrants compared to the Australian and Canadian-born population.	• Used a large sample size to investigate the association between self-rated health and various factors.	• Used a single nationally representative longitudinal dataset to investigate the self-rated health status of migrants compared to the Australian-born populations <u>over time.</u>	• My research makes important contributions to older migrants' research by using three robust methods to investigate the health of older migrants: • Systematic review • Repeated cross-sectional analysis • Longitudinal analysis
• It identified gaps in knowledge and the complexity of making inferences from older migrant health studies	• The chapter findings contribute to older migrants' health literature by addressing the limitations highlighted in the systematic review.	• The chapter findings contribute to older migrants' health literature by addressing the evidence gap and other limitations highlighted in the systematic review.	• I used robust quantitative analysis methods; repeated cross-sectional and longitudinal analyses to address some of the limitations observed in the systematic review chapter.
• I compared the health of various migrants' subgroups to their host population enabling a direct comparison.	• I used binary nativity status to compare older migrants' health to the Australian-born population.	• I used region of birth subgroups in comparing older migrants' health to the Australian-born population.	• I demonstrated variations in older migrants' health by using various migrants' subgroups to compare their health to their host populations.

Table 6.2 continued

Systematic review	Repeated cross-sectional analysis	Longitudinal analysis	Summary
• Provides useful insights on the health of older migrants and their host populations using objective and subjective health measures and highlighted potential health determinants for investigation in the subsequent chapters.	• This chapter provides additional evidence on differences in the self-rated health of older migrants and the Australian-born population and identifies factors associated with health of all older individuals. • The findings provided useful considerations for research, policy and practice.	• This chapter demonstrate variations in the self-rated health of older migrants and the Australian-born population <u>over time.</u> • It also identified some key independent predictors of self-reported health pertinent to migrants.	• My research demonstrates variations in the health of older migrants and their host populations using subjective and objective measures, cross-sectional and importantly, over time. It also identified factors associated with health, more so <u>over time.</u>

6.3.2 Limitations

Table 6.3 provides a summary of my thesis limitations. The systematic review and the repeated cross-sectional study findings were cross-sectional and no causality can be implied. However, my thesis also includes a longitudinal analysis which demonstrates variations in the health of older migrants by various region of birth subgroups, and provided some indication regarding causality as discussed above.

My study findings may not be generalisable to the general population. In the systematic review, only 14 of the 29 included Australian studies and eight of 14 included Canadian studies were nationally representative. The lack of generalisability extends to studies that were nationally representative as in most studies data for mortality, suicide and cancer incidence were derived from routinely collected data by Statistics Canada or the Australian Bureau of Statistics. Though readily available and provides useful insights on mortality and morbidity, these databases were limited in provision of diverse individual explanatory factors other than age and sex, further such studies were generally older. Similarly, data for the quantitative analyses were drawn from the DYNOPTA dataset, which consists of studies whose data were collected between 1990-2006. As the ethnic composition of the Australian and Canadian populations have changed over time, findings from such studies are hardly generalisable to the general populations. Similarly, some data from the repeated cross-sectional analysis were drawn from DYNOPTA contributory studies which were not nationally representative; ALSA and CLS (Chapter (2) Methodology). In this study, the high proportion of missing data across the waves, particularly for participants whose nativity was unknown, greatly affected the applicability of my findings. Though, the longitudinal analysis draws from a single longitudinal and nationally representative study; HILDA, migrants are underrepresented (374). Due to time constraints and using a relatively older dataset possibly lacking insufficient data to categorise migrants by their socio-demographic characteristics, my quantitative analyses models were not migrant specific. Though my analyses did not identify migrant specific health determinants, they provided a broad overview of determinants of health in the population many of which may be relevant to older migrants. Further, frameworks including the Bradford Hill criteria were used to infer causality and linkages between my research and other migrant health studies as appropriate.

I also, only included two Commonwealth countries in my systematic review and therefore cannot extrapolate findings more widely. However, given the diversity found even in migrants to these two countries with some similarities, adding to the diversity amongst host countries by including more would cause a major challenge in unpicking the complexities involved in such a task. This was beyond the scope of my thesis.

For my findings, inadequate categorisations of migrants and a lack of data on other factors associated with migrant health may result in poor understanding of older migrants' health. Some of the broad categorisations of older migrants in the systematic review included; visible and non-visible minorities (20), non-British migrants (253), foreign born Whites and non-Whites and Canadian-born Whites (27), while in the repeated cross-sectional analysis self-rated health was examined using the binary nativity status of the participants. However, my longitudinal analysis begins to disentangle the health of heterogenous older migrants by using their region of birth subgroups. Chapters 1 and 3 highlight the limitations of treating diverse migrants as a homogenous group in research including masking health differences which misinforms migrant health related policies. In my thesis, it was not possible to examine or include some commonly assessed health determinants. In the systematic review, as mentioned earlier this was a result of included studies that used routinely collected data, further most health measures were only included in single studies and for specific migrant groups. For example, the risk of diabetes was only measured in one study and for Vietnamese migrants only. In the repeated cross-sectional analysis, a high proportion of missing data limited the potential health determinants that could be included in this study. Though the longitudinal analysis study included some duration of residence measures such as "years lived in Australia," I still lacked data on objective health measures and migrating circumstances.

Lastly, my thesis lacked the data to categorise the host population by migrant generation status or ethnicity, consequently the comparator group may mask ethnic health variations within the comparator group, although this is likely to for a small number.

Table 6.3: Summary of thesis limitations

Systematic review	Repeated cross-sectional analysis	Longitudinal analysis	Summary
1. Factors related to cause and effect			
• Other than one, all included studies were cross-sectional	• All the analyses carried out were cross-sectional	N/A	• The systematic review and the repeated cross-sectional analysis chapters were largely cross-sectional and no causality can be implied.
2. Factors relating to the generalisability of my findings			
• Some included studies were not nationally representative • In some included studies data were derived from the same databases and mostly included routinely collected data by either Statistics Canada or the Australian Bureau of Statistics. • Some of the studies were migrant group specific • Included studies were generally older	• Data were derived from some DYNOPTA studies which were not nationally representative • High proportion of missing data due to variability in lengths of data collection in the DYNOPTA contributory studies • Participants whose nativity was unknown who appeared to have worse self-rated health • DYNOPTA dataset used in the current analysis was older	• Underrepresentation of migrants in the HILDA dataset • The HILDA dataset used in the current analysis was older • Lacked migrant specific models	• Including studies or data drawn from specific regions, deriving data from older datasets, high proportion of missing data, lack of migrant specific models and underrepresentation of migrants in datasets results in findings which are not generalisable to the general population

Table 6.3 continued			
Systematic review	**Repeated cross-sectional analysis**	**Longitudinal analysis**	**Summary**
2. Factors relating to the generalisability of my findings			
	• Lacked migrant specific models		
3. Factors resulting in poor understanding of older migrants' health			
• Some studies categorised migrants broadly • The healthy migrant effect hypothesis and acculturation theories were poorly measured in most of the included studies • Most health measures were measured singularly in studies	• Used binary nativity status to investigate the health of older migrants • Missing data limited the potential health determinants that could be assessed in this study, consequently some factors such as measures of duration of residence were excluded	• Lacked data on objective health measures (chronic conditions), types of migration (visa category)	• Inadequate categorisations of migrants, lack of data on other factors associated with migrant health may result in poor understanding of older migrants' health
4. Factors masking the effects of ethnicity on health			
• Broad categorisation of the comparator group	• Broad categorisation of the comparator group	• Broad categorisation of the comparator group	• The comparator group included all individuals born in their host country possibly masking the effects of ethnicity on health

6.4 Recommendations for research, policy and practice

6.4.1 Policy and Practice

Given that there are subgroups of older migrants who appear to experience poorer health than the Australian-born, policy makers should consider the following issues which are likely to be of the greatest impact.

6.4.1.1 Language proficiency and education attainment

English language confidence and education attainment appear to be of key importance:

1. Although there is Australian policy regarding language classes for migrants, uptake is poor, and poorer English proficiency appears to persist into older age – an age where the migrants are at risk of chronic medical conditions (another factor associated with poorer self-rated health). Therefore, this policy should be reviewed, and opportunities (with age- and culturally appropriate education styles) extended throughout the migrant's life and not just on arrival.
2. Information, access and ease of utilisation of health services given likely language challenges should be reviewed and health service policy revised to ensure adequate translation facilities, and public health messages to be culturally relevant to a range of cultures. Better health literacy would help to ensure earlier diagnosis, adherence to follow up of those at risk of e.g. TB, and accessing appropriate management (including self-management education) of chronic health conditions would be examples of beneficial outcomes of a policy focus on this issue. As well as provision of opportunities to improve English language proficiency, health service providers (including public health) need to ensure timely and accessible translation, and services which are culturally congruent(430).
3. Poor English language skills also impacts on the ability to gain employment which matches skills. Educational attainment in the country of birth may not lead to equivalent employment in Australia. A policy to support migrants undertake further study would improve employment prospects, with better income and other determinants of health; again, over time and not just on

arrival. The current focus on integration appears to be economic return for the country – a further focus on the health of migrants is important so that as they get older, they stay well. Preventing the need for expensive health care makes economic sense for the country as well as the health of the individual.

6.4.1.2 Health behaviours

My findings also indicate negative health behaviours such as smoking to be a considerable source of health disadvantages in older adults. Policies should consider attitudes, health literacy and language proficiency barriers in smoking cessation programs.

1. As discussed above, health services and public health initiatives need to address language barriers to uptake. Smoking cessation initiatives should consider using multi-lingual resources and ideally such programs should be disseminated through relevant community organisations. Use of community organisations may also be effective in increasing older migrants' awareness on modes of transmission, clinical progression, treatment, preventative measures and commonly known complications for diseases and untreated infections such as hepatitis C.
2. To address attitudes towards health behaviours, policies should consider increasing awareness on variations in risk factors in culturally diverse populations not only in individuals but also in health care systems as some primary health care providers lack enough understanding on differential risk factors. Increased awareness may aid in adopting health behaviours and seeking health care or health related information earlier in individuals, while at the health care systems it may aid in disease burden reduction in specific populations through early diagnosis and management.

6.4.2 Research

I recommend research should consider methodological and conceptual factors in older adults' health research.

6.4.2.1 Methodological issues

1. Migrant health studies should consider use of qualitative and quantitative methodologies in investigating older migrants' health. Qualitative studies would aid in understanding migrant experiences and attitudes towards their health, while the latter is useful in informing cause and effect.
2. As research is critical to informing effective policies, there is need to include more individuals from culturally, linguistically and diverse backgrounds as well as include more migrant specific variables including ethnicity and duration of residence measures. This would aid against speculative assumptions on older migrants' health, more so those from culturally and linguistically diverse backgrounds. Regularly updating such databases as the ethnic diversity of older migrants is not only increasing but also evolving would enable accurate examination of health status and identification of health determinants in specific older adult populations in Australia.
3. Researchers should use appropriate ethnicity, country of birth or region of birth categories so as to correctly interpret their findings. They should also consider the implications of combining individuals with substantial socio-cultural, demographic, economic, health, experiences and economic variations on public perceptions on specific migrant groups and for policy makers.

6.4.2.2 Research questions

Future research should consider the following questions: -

1. What is the health status of specific older migrant populations compared to their host population? This may increase our understanding on older migrants' health more so those from ethnically diverse backgrounds.
2. What are the key determinants of older migrants' health. My analyses inform on important factors which predisposes older adults to poor health including poor English proficiency and educational disparities, such factors limit health literacy and access to health services resulting in considerable health disadvantages. More research would either confirm, or identify other

important health determinants. This would result in considerable evidence to inform migrant health policies.

3. What are the pathways to poor health for older migrants in Australia, and how can they be ameliorated? Although education is an established social determinant of health, the mechanism whereby it influences health and health related factors such as health literacy in older Australian migrants is poorly understood. Some older migrants with low levels of education may have low health literacy, however highly educated migrants may also have low health literacy as they may lack knowledge on diseases in their host country or alternatively their skills may not be recognised in their host country. All these factors may affect health, however, how they influence health remains poorly understood.
4. What interventions best address migrants' disadvantages in language and educational attainment both on arrival and as they grow older? We need to better understand how to best provide culturally acceptable, and affordable opportunities to inform policy and practice. The strengths and weaknesses of various migrant health screening policies and policies addressing socio-economic inequalities and language proficiency in older migrants need to be identified to inform policy and practice.
5. What population-based health determinants mediate their effect and what is the role of health policies? For instance, it would be useful to consider the role policies or a lack of policies have played in addressing socio-economic inequalities in Southern Europeans.
6. What is the role of healthy migrant effect and the acculturation theory with regard to health advantage/disadvantage? There is need to better understand the source of any existing health advantages and disadvantages, more so if the aim is to retain the advantages and address the health disadvantages.
7. How does the categorisation of migrants influence public and structural perceptions of older migrants' health and how they influence policy making? Broad categories may "mask" the socio-demographic, risk and health factors in ethnically diverse populations. They also result in "othering" of individuals

who are categorised as visibly different from those perceived as “typical” which may negatively affect their health (430).

6.5 Conclusion

My analysis consisting of a systematic review, a repeated cross-sectional and a longitudinal analysis demonstrates differences in the objective and subjective health of older migrants compared to their host populations. Importantly, my thesis demonstrates varying differences in health over time using region of birth subgroups, whereby North-West Europeans were found to have a self-rated health advantage, but Southern and Eastern Europeans had a strong self-rated health disadvantage. I found no differences in the health of Asian and older migrants from other regions relative to the Australian-born population. Older age, educational attainment and language preference/use appeared to be important variables, showing a “dose dependent” relationship with poor health. Differences remain apparent despite the migrants having lived in Australia for decades, with the odds relating to health for key variables getting bigger over time. To effectively address health disparities among older migrants’, policies should consider variations in socio-demographic characteristics within migrant populations to identify pathways and culturally acceptable, accessible and affordable interventions which address these key issues which influence health; especially so in culturally and ethnically diverse countries like Australia.

My thesis establishes education attainment and language preference as important determinants of self-reported health in later life. These factors help with the successful integration of migrants into their host countries, they are associated with social support and health literacy. Policies should foster the availability of culturally accessible, available, and affordable opportunities regarding educational attainment, language proficiency and healthcare access and engagement, not just on arrival, but as the migrant grows older in their host country.

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Appendixes

Appendix A Systematic review protocol (PROSPERO registration)

Citation

Mary Kariuki, Liz Mitchel. How does the health status of older migrants in Australia and Canada change over time?. PROSPERO 2018 CRD42018103742 Available from:
https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42018103742

Review question

1. To compare and contrast the health of older migrants and the host population in Australia and Canada.

2. To highlight the applicability of the healthy migrant effect to older migrants.

Searches

This study will review articles identified using two approaches; that is searching electronic databases and manual and backward searching for potential studies. The electronic databases include Ovid MEDLINE, EMBASE, Academic Search Premier via EBSCO, PsycINFO via EBSCO, CINAHL Complete via EBSCO and Web of Science. While backward and manual searching will include reviewing the bibliography of various reviews and literature. Effort will be made to contact authors whose studies potentially meets the inclusion criteria but full text cannot be obtained without permission.

The applicability of dissertations and thesis' to this review is limited to if the work was published in for example a peer-reviewed journal, if not published, the rationale for non-publication will be sought before any decision is made on applicability of the literature to the review.

Search date: 1960-2018

Language restrictions: none

Types of study to be included

Longitudinal and cross-sectional observational studies, retrospective or prospective, Case control or cohort studies will be included in the review. Systematic reviews, opinion pieces, qualitative articles and randomised trials will be excluded from the review.

Condition or domain being studied

The aim of this review is to present an updated exhaustive summary of studies carried out from 1960 to 2018 focused on how the health status (physical and mental) of older migrants changes over time. A comparison of the health status of migrants and non-migrants in Australia and Canada similarly will be undertaken with an aim of reviewing and attempting to quantify and interpret the existing evidence in the two countries.

Participants/population

General older Australian population and migrants in Australia who are aged over 45 years. Indigenous Australians and persons aged less than 45 years will be excluded from the review.

Intervention(s), exposure(s)

Migration is the exposure, however this review limits exposure of migration to the 1st generation only.

Comparator(s)/control

The health outcomes of migrants will be compared to those of the Australian born older population.

Main outcome(s)

For a study to be included in this review, the outcome must be health. This review will include a wide scope of health conditions, including chronic conditions that affect migrants due to environmental, biological, socio-demographic and economic factors in their country of birth or host country.

Additional outcome(s)

None

Data extraction (selection and coding)

After a comprehensive search of the electronic databases outlined in the search strategy, the results will be transferred to Endnote where deduplication will be carried out. This will be followed by screening of the potential literature by their title and abstracts. Screening will be independently carried out by two reviewers and any discrepancies that arise from screening will be resolved by consensus. The data to be extracted includes; general information (name of study , year of publication and authors), study design and setting (study design , duration of observation/follow-up, country of study and funding source), study population (population size, mean age, gender distribution and study population), exposure (country of origin, language spoken, ethnicity, duration of stay, Australian state of residence and migration status), lifestyle factors (marital status, education status, employment status, pension status, smoking status, alcohol consumption status, type of accommodation, diet and physical activity) and health status (self-reported health (mental and physical health), mortality and morbidity i.e. reported illness (hypertension, high blood pressure, heart attack, thrombosis, eye conditions, respiratory conditions, stroke, cancers, parkinson's, dementia)

Risk of bias (quality) assessment

Full texts of all eligible studies will be assessed for risk of bias and quality by the Critical Appraisal Skills Programme (CASP) tool .

Strategy for data synthesis

The method of synthesis of data will depend on heterogeneity of data extracted.

Analysis of subgroups or subsets

Ethnicity, year of migration, migrant status and chronic conditions

Contact details for further information

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Organisational affiliation of the review

University of Hull
https://www.hull.ac.uk/Home.aspx

Review team members and their organisational affiliations

Miss Mary Kariuki. University of Hull
Dr Liz Mitchel. Hull York Medical School

Type and method of review

Systematic review

Anticipated or actual start date

01 March 2018

Anticipated completion date

31 October 2018

Funding sources/sponsors

None

Conflicts of interest

Language
English

Country
England

Stage of review
Review Ongoing

Subject index terms status
Subject indexing assigned by CRD

Subject index terms
Australia; Canada; Health Status; Humans; Transients and Migrants

Date of registration in PROSPERO
17 July 2018

Date of first submission
10 July 2018

Stage of review at time of this submission

Stage	**Started**	**Completed**
Preliminary searches	Yes	Yes
Piloting of the study selection process	Yes	No
Formal screening of search results against eligibility criteria	Yes	No
Data extraction	No	No
Risk of bias (quality) assessment	No	No
Data analysis	No	No

The record owner confirms that the information they have supplied for this submission is accurate and complete and they understand that deliberate provision of inaccurate information or omission of data may be construed as scientific misconduct.
The record owner confirms that they will update the status of the review when it is completed and will add publication details in due course.

Versions
17 July 2018

Appendix B Electronic databases search results

Appendix B.01 Ovid EMBASE

	Search terms	Results	Search strand
1.	exp "Emigrants and Immigrants"/	193	Migration
2.	(Migrant* or migrat* or Immig* or emigra* or "asylum seeker*" or Expat or "born abroad" or "Culturally and Linguistically Diverse" or "non-English speak*" or foreig*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	535693	
3.	1 or 2 368015	535693	
4.	4 exp Australia/	140108	
5.	(Australia* or Aussie).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	229478	
6.	4 or 5	229478	Australia
7.	exp Health/	215379	
8.	(Health* or Well* or Diseas* or ill* or Morbid* or mortal* or "Life expectancy").mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	13525579	
9.	7 or 8	13525580	Health

Appendix B.01 continued

	Search terms	Results	Search strand
10.	3 and 6 and 9	3830	Migration + Australia + Health
11.	exp Canada/	156449	
12.	canad*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	254419	
13.	11 or 12	254419	Canada
14.	3 and 9 and 13	4397	Migration +health + Canada
15.	6 or 13	475358	Australia or Canada
16.	3 and 9 and 15	8420	Migration + health + Canada or Australia

Appendix B.02 Academic Search Premier via EBSCO

	Search Terms	Results	Search strand
1.	Emigrants and Immigrants	5,283	
2.	Migrant* or Migrat* or Immig* or emigra* or "asylum seeker*" or Expat* or "Culturally and Linguistically Diverse" or "non-English speak*" or foreig*	53,923	
3.	S1 OR S2	53,923	Migration
4.	Australia	92,940	
5.	Australia* or Aussie	91,547	
6.	S4 OR S5	109,599	Australia
7.	Health* or Wellness or well-being or well-being or Diseas* or ill* or Mortal* or Morbid* or "Life expectancy"	2,337,488	
8.	Health	262,056	
9.	S7 OR S8	2,354,860	Health
10.	S3 AND S6 AND S9	1,369	Migration + Australia + Health
11.	Canada	48,487	
12.	canad*	75,068	
13.	S11 OR S12	75,068	Canada
14.	(S1 OR S2) AND (S4 OR S5) AND (S11 OR S12)	1,418	Migration +health + Canada
15.	S6 OR S13	182,581	Australia or Canada
16.	S3 AND S9 AND S15	2,738	Migration + health + Canada or Australia

Appendix B.03 CINAHL Complete via EBSCO

	Search Terms	Results	Search strand
1.	(MH "Emigration and Immigration")	5,336	
2.	Migrant* or Migrat* or Immig* or emigra* or "asylum seeker*" or Expat* or "Culturally and Linguistically Diverse" or "non-English speak*" or foreig*	54,655	
3.	S1 OR S2	54,655	Migration
4.	(MH "Australia+")	94,395	
5.	Australia* or Aussie		
6.	S4 OR S5		Australia
7.	Health		
8.	Health* or Wellness or well-being or wellbeing or Diseas* or ill* or Mortal* or Morbid* or "Life expectancy"		
9.	S7 OR S8		Health
10.	S3 AND S6 AND S9		Migration + Australia + Health
11.	Canada		
12.	canad*		
13.	S11 OR S12		Canada
14.	(S1 OR S2) AND (S4 OR S5) AND (S11 OR S12)		Migration +health + Canada
15.	S6 OR S13		Australia or Canada
16.	S3 AND S9 AND S15		Migration + health + Canada or Australia

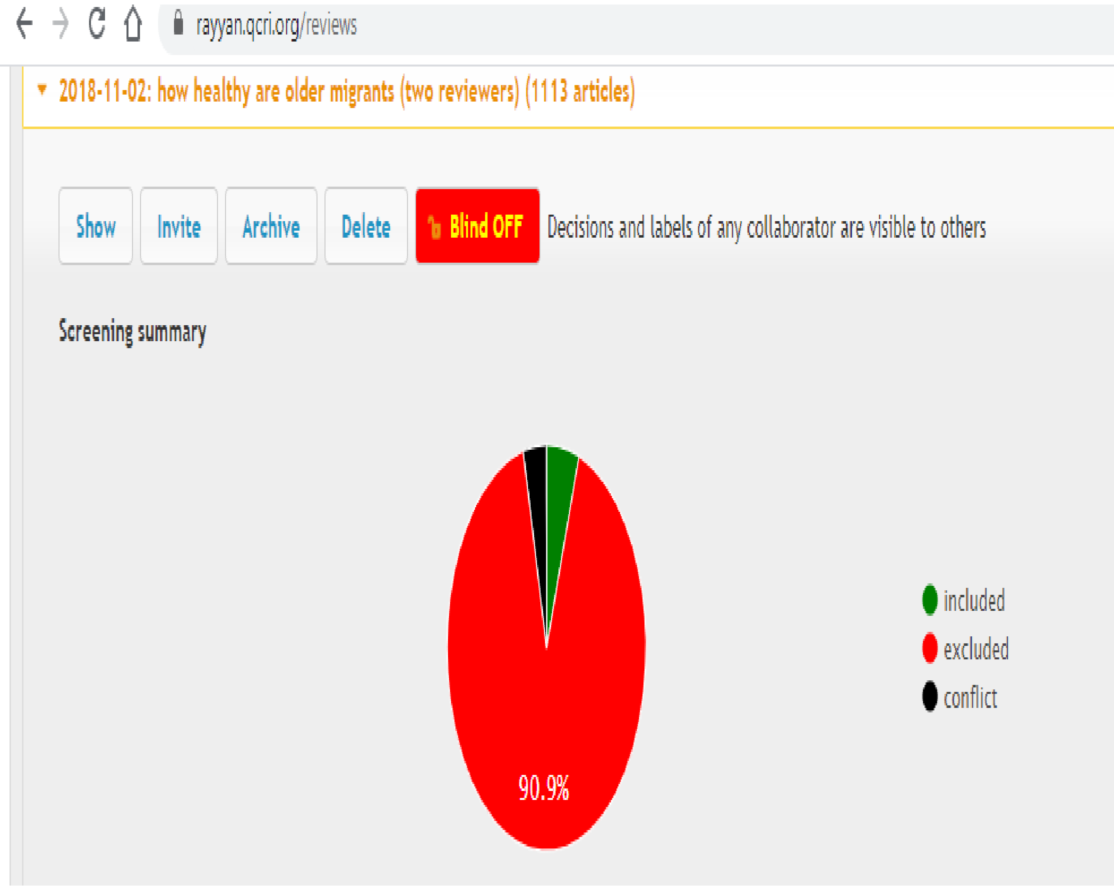
Appendix B.04 PsycINFO through EBSCO

	Search Terms	Results	Search Strand
1.	DE "Immigration"	19,753	
2.	Migrant* or Migrat* or Immig* or emigra* or "asylum seeker*" or Expat* or "Culturally and Linguistically Diverse" or "non-English speak*" or foreig*	95,254	
3.	S1 OR S2	95,254	Migration
4.	Australia	154,209	
5.	Australia* or Aussie	162,130	
6.	S4 OR S5	162,130	Australia
7.	DE "Health"	50,323	
8.	Health* or Wellness or well-being or wellbeing or Diseas* or ill* or Mortal* or Morbid* or "Life expectancy"	1,745,685	
9.	S7 OR S8	1,745,685	Health
10.	S3 AND S6 AND S9	1,866	Migration + Australia + Health
11.	Canada	248,337	
12.	canad*	256,436	
13.	S11 OR S12	256,436	Canada
14.	(S1 OR S2) AND (S4 OR S5) AND (S11 OR S12)	2,717	Migration +health + Canada
15.	S6 OR S13	411,053	Australia or Canada
16.	S3 AND S9 AND S15	4484	Migration + health + Canada or Australia

Appendix B.05 Web of Science

	Search Terms	Results	Search strand
1.	(TITLE-ABS-KEY (immigrants AND emmigrants) OR TITLE-ABS-KEY (migrant* OR migrat* OR immig* OR emigra* OR "asylum seeker*" OR expat* OR "Culturally and Linguistically Diverse" OR "non-English speak*" OR foreig*) AND TITLE-ABS-KEY (canada OR australia) AND TITLE-ABS-KEY (health* OR wellness OR well-being OR wellbeing OR diseas* OR ill* OR mortal* OR morbid* OR "Life expectancy"))	9410	Migration + health + Canada or Australia

Appendix C Rayyan (Summary of screening results)



Appendix D CASP (Longitudinal analysis)

		Study
		(Stanaway et al., 2019)
Section A: Are the results of the study valid?	**Did the study address a clearly focused issue?**	Yes
	Was the cohort recruited in an acceptable way?	Yes (although it included some individuals who heard about the study from study participants)
	Was the exposure accurately measured to minimise bias?	Yes (data were drawn from areas with high migrant population)
	Was the outcome accurately measured to minimise bias?	Yes (survival data were updated through 4 monthly phone calls or letters or through the NSW Registry of Births, Deaths and Marriages for men who withdrew from the study)
	Have the authors identified all important confounding factors?	Yes (though not possible to assess all confounders in migrant health, they identified age and country of birth as confounders of mortality)
	Have they taken account of the confounding factors in the design and/or analysis?	Yes (any important confounders were retained in the model regardless of statistical significance)
	Was the follow up of subjects complete enough?	Yes (The men were followed from their baseline visit for a mean of 7.5 years in Australian-born men and 8.0 years in Italian-born men)
Section B: What are the results?	**What are the results of this study?**	Italian-born men had lower mortality than expected considering their lower SES, higher rate of smoking and higher morbidity
	How precise are the results?	Moderately accurate, as the confidence intervals were wide. No of deaths was not mentioned, it is not possible to contextualise the findings
	Do you believe the results?	Yes
Section C: Will the results help locally?	**Can the results be applied to the local population?**	Yes
	Do the results of this study fit with other available evidence?	Yes, the results fit with other findings on the mortality morbidity paradox for Italian population
	What are the implications of this study for practice?	More studies are needed, as this was the only longitudinal study included in the review. Also, when accounting for age, the mortality advantage is lost.

Appendix E AXIS quality appraisal tool for cross-sectional studies

Appendix E.01 AXIS tables

	(Aglipay et al., 2013)	(Bareja et al 2014)	(Barry et al., 2009)
Were the aims/objectives of the study clear?	Yes	Yes	Yes
Was the study design (s) for the stated aim(s)	Yes	Yes	Yes
Was the sample size justified?	Yes	Yes	Yes
Was the target/reference population clearly defined? (is it clear who the research was about)	Yes	Yes	Yes
Was the sample frame taken from an appropriate base so that it closely represented the target/reference population under investigation	Yes	No (study data not weighted)	No (study data not weighted)
Was the selection process likely to select participants that were representative of the target/reference population under investigation	Yes (study data weighted)	No	No

Appendix E.01 continued			
	(Aglipay et al., 2013)	**(Bareja et al 2014)**	**(Barry et al., 2009)**
Were measures undertaken to address and categorise non-responders?	No	No (study data not weighted)	No (study data not weighted)
Were the risk factor and outcome variables measured appropriate to the aims of the study?	Yes	Yes	Yes
Were the risk factor and outcome variables measured correctly using instruments/ measurements that had been trialed, piloted or published previously?	Yes	Yes	Yes
Is it clear what was used to determined statistical significance and/or precision estimates? (eg, p values, CIs)	No	No	No
Were the methods (including statistical methods) sufficiently described to enable them to be repeated?	Yes	Yes	Yes
Were the basic data adequately described?	Yes	No	No
Does the response rate raise concerns about non-response bias?	No (potential biases not accounted for)	Yes	Yes

Appendix E.01 continued

	(Aglipay et al., 2013)	(Bareja et al 2014)	(Barry et al., 2009)
If appropriate, was information about non-responders described?	No	No	No
Were the results internally consistent?	Yes	Yes	Yes
Were the results for the analyses described in the methods, presented?	Yes	Yes	Yes
Were the authors' discussions and conclusions justified by the results?	No (their results are possibly biased by a cohort effect, as they are inferring to convergence from the results of individuals who differ by age and country of birth)	Yes	Yes
Were the limitations of the study discussed?	Yes	No	No
Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?	No	No	No
Was ethical approval or consent of participants attained?	Yes	No	No

Appendix E.01 continued			
	(Aglipay et al., 2013)	**(Bareja et al 2014)**	**(Barry et al., 2009)**
Grade	**Medium:** The study had several strengths, it was an older persons' study, it had a large sample size and was nationally representative. However, it used broad migrant categories to investigate health status.	**Low:** Though the study was nationally representative, it lacked basic data description, it lacked extractable data on older migrants by country of birth and only rates were derived for older individuals. Older adults sample size was not stated and it used registry data.	**Low:** Though the study was nationally representative, it lacked basic data description, it lacked extractable data on older migrants by country of birth and only rates were derived for older individuals. Older adults sample size was not stated and it used registry data.

Appendix E.02 AXIS tables

	(Brock et al 2004)	**(Burvill et al., 1973)**	**(Burvill, 1995)**
Were the aims/objectives of the study clear?	Yes	Yes	Yes
Was the study design (s) for the stated aim(s)	Yes	Yes	Yes
Was the sample size justified?	Yes	Yes	Yes
Was the target/reference population clearly defined? (is it clear who the research was about)	Yes	Yes	Yes
Was the sample frame taken from an appropriate base so that it closely represented the target/reference population under investigation	No (The study investigated the prevalence of vitamin D deficiency in elderly people in nursing homes, hostels and under self-care units as well aged free living Asian and Middle- Eastern migrants)	Yes	Yes (however some countries had few suicide rates)
Was the selection process likely to select participants that were representative of the target/reference population under investigation	No (As above)	Yes	Yes
Appendix E.02 continued			

	(Brock et al 2004)	(Burvill et al., 1973)	(Burvill, 1995)
Were measures undertaken to address and categorise non-responders?	No (study data not weighted)	Yes	Yes (data for countries with few suicide rates were combined based on geographical proximity)
Were the risk factor and outcome variables measured appropriate to the aims of the study?	Yes	Yes	Yes
Were the risk factor and outcome variables measured correctly using instruments/ measurements that had been trialed, piloted or published previously?	Yes	Yes	Yes
Is it clear what was used to determined statistical significance and/or precision estimates? (eg, p values, CIs)	Yes	Yes	Yes
Were the methods (including statistical methods) sufficiently described to enable them to be repeated?	Yes	Yes	Yes

Appendix E.02 continued

	(Brock et al 2004)	(Burvill et al., 1973)	(Burvill, 1995)

Were the basic data adequately described?	No	No (no description of participants is given apart from sex and country of birth)	No (participants were only described by sex and country of birth)
Does the response rate raise concerns about non-response bias?	Yes	No	No
If appropriate, was information about non-responders described?	No	No	No
Were the results internally consistent?	Yes	Yes	Yes
Were the results for the analyses described in the methods, presented?	Yes	Yes	Yes
Were the authors' discussions and conclusions justified by the results?	Yes	Yes	Yes
Were the limitations of the study discussed?	Yes	No (not discussed)	Yes
Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?	No	Not stated	Not stated
Was ethical approval or consent of participants attained?	No	Yes	Yes
Appendix E.02 continued			
	(Brock et al 2004)	**(Burvill et al., 1973)**	**(Burvill, 1995)**

Grade	**Low:** Though an older persons' study, it had a small sample size and was not nationally representative.	**Low:** Though nationally representative, the study lacked basic data description and had no extractable data on older migrants by country of birth and only rates were derived for older individuals.	**Medium:** The study had several strengths; it was older persons specific, findings were country of birth specific and were nationally representative. However, it was an old study that used registry data and lacked basic data description.

Appendix E.03 AXIS tables

	(Camie et al 2001)	(Chen et al 1996)	(Chen et al., 2013)
Were the aims/objectives of the study clear?	Yes	Yes	Yes
Was the study design (s) for the stated aim(s)	Yes	Yes	Yes
Was the sample size justified?	Yes	Yes	Yes
Was the target/reference population clearly defined? (is it clear who the research was about)	Yes	Yes	Yes
Was the sample frame taken from an appropriate base so that it closely represented the target/reference population under investigation	Yes	Yes	Yes
Was the selection process likely to select participants that were representative of the target/reference population under investigation	No	Yes	Yes

Appendix E.03 continued

	(Camie et al 2001)	(Chen et al 1996)	(Chen et al., 2013)
Were measures undertaken to address and categorise non-responders?	Yes	Yes (birth place was imputed using the regional distribution from birth records with a stated place of birth)	No
Were the risk factor and outcome variables measured appropriate to the aims of the study?	Yes	No (they used registry data, which may not provide all the relevant risk factors)	Yes
Were the risk factor and outcome variables measured correctly using instruments/ measurements that had been trialed, piloted or published previously?	Yes	Yes	Yes
Is it clear what was used to determined statistical significance and/or precision estimates? (eg, p values, CIs)	No	No	Yes
Were the methods (including statistical methods) sufficiently described to enable them to be repeated?	Yes	Yes	Yes
Were the basic data adequately described?	No	No	Yes
Appendix E.03 continued			

	(Camie et al 2001)	(Chen et al 1996)	(Chen et al., 2013)
Does the response rate raise concerns about non-response bias?	Yes	Yes	Yes
If appropriate, was information about non-responders described?	No	No	No
Were the results internally consistent?	Yes	Yes	Yes
Were the results for the analyses described in the methods, presented?	Yes	Yes	Yes
Were the authors' discussions and conclusions justified by the results?	Yes	Yes	Yes
Were the limitations of the study discussed?	No	No	Yes
Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?	No	No	No
Was ethical approval or consent of participants attained?	No	Yes (as appropriate)	Yes
Appendix E.03 continued			

	(Camie et al 2001)	(Chen et al 1996)	(Chen et al., 2013)
Grade	**Low:** though the study was nationally representative it lacked basic data description, it had no extractable data on older migrants by country of birth, only rates were derived for older individuals and the older adults sample size was not stated.	**Low:** though the study was nationally representative and used multiple health measures. It was an old study that used registry data, lacked basic data description and used broad migrant categories to investigate migrant health status.	**Medium:** Though a nationally representative recent study, it was not migrant group specific or an older persons' study.

Appendix E.04 AXIS tables

	(Dobson & Leeder, 1982)	(Gee et al., 2004)	(Gray et al., 2007)
Were the aims/objectives of the study clear?	Yes	Yes	Yes
Was the study design (s) for the stated aim(s)	Yes	Yes	Yes
Was the sample size justified?	Yes	Yes	Yes
Was the target/reference population clearly defined? (is it clear who the research was about)	No (data for study population were derived from different data sources (published in different years) alongside their own study data)	Yes	Yes
Was the sample frame taken from an appropriate base so that it closely represented the target/reference population under investigation	No	Yes	Yes
Was the selection process likely to select participants that were representative of the target/reference population under investigation	No	Yes	Yes

Appendix E.04 continued

	(Dobson & Leeder, 1982)	(Gee et al., 2004)	(Gray et al., 2007)
Were the risk factor and outcome variables measured appropriate to the aims of the study?	Yes	Yes (possibility of bias as they used a population health perspective (only included individual factors over medical care inputs and health behaviours)	Yes
Were the risk factor and outcome variables measured correctly using instruments/ measurements that had been trialed, piloted or published previously?	Yes	Yes	Yes
Is it clear what was used to determined statistical significance and/or precision estimates? (eg, p values, CIs)	No	Yes	Yes
Were the methods (including statistical methods) sufficiently described to enable them to be repeated?	Yes	Yes	Yes
Were the basic data adequately described?	No	Yes	Yes
Does the response rate raise concerns about non-response bias?	No	Not mentioned (potential biases not accounted for)	No

Appendix E.04 continued

	(Dobson & Leeder, 1982)	(Gee et al., 2004)	(Gray et al., 2007)
If appropriate, was information about non-responders described?	No	No	No
Were the results internally consistent?	Yes	Yes	Yes
Were the results for the analyses described in the methods, presented?	Yes	Yes	Yes
Were the authors' discussions and conclusions justified by the results?	Yes	No (their results are possibly biased by a cohort effect, as they are inferring to convergence from the results of individuals who differ by age and country of birth)	Yes
Were the limitations of the study discussed?	No (They should have mentioned study population data were derived from data sources published in different years)	Yes	Yes
Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?	No	No	Not stated

Appendix E.04 continued

	(Dobson & Leeder, 1982)	(Gee et al., 2004)	(Gray et al., 2007)
Was ethical approval or consent of participants attained?	Yes	Yes	Yes
Grade	**Low:** Though the study had a moderately high sample size. It was a relatively old non-nationally representative study whose data were drawn from different census dates and the sample size for older adults was unknown.	**Medium:** The study was a large nationally representative older persons study. However, it used broad migrant categories to investigate health status.	**Medium:** The study was a large nationally representative, country of birth specific older persons study. However, it used registry data and lacked basic data description of older migrants.

Appendix E.05 AXIS tables

	(Greenaway et al. 2017)	(Guo et al., 2015)	(Jensen et al., 2012)
Were the aims/objectives of the study clear?	Yes	Yes	Yes
Was the study design (s) for the stated aim(s)	Yes	Yes	Yes
Was the sample size justified?	Yes	Yes	Yes
Was the target/reference population clearly defined? (is it clear who the research was about)	Yes	Yes	Yes
Was the sample frame taken from an appropriate base so that it closely represented the target/reference population under investigation	Yes	Yes	Yes
Was the selection process likely to select participants that were representative of the target/reference population under investigation	Yes	No (The response rate was around 17.8%)	No
Were measures undertaken to address and categorise non-responders?	Yes	No	Yes
Were the risk factor and outcome variables measured appropriate to the aims of the study?	Yes	Yes	Yes

Appendix E.05 continued

	(Greenaway et al. 2017)	(Guo et al., 2015)	(Jensen et al., 2012)
Were the risk factor and outcome variables measured correctly using instruments/ measurements that had been trialed, piloted or published previously?	Yes	Yes	Yes
Is it clear what was used to determined statistical significance and/or precision estimates? (eg, p values, CIs)	Yes	Yes	No
Were the methods (including statistical methods) sufficiently described to enable them to be repeated?	Yes	Yes	Yes
Were the basic data adequately described?	Yes	Yes	No
Does the response rate raise concerns about non-response bias?	Yes	Yes	Yes
If appropriate, was information about non-responders described?	Yes	No	No
Were the results internally consistent?	Yes	Yes	Yes
Were the results for the analyses described in the methods, presented?	Yes	Yes	Yes
Appendix E.05 continued			

	(Greenaway et al. 2017)	(Guo et al., 2015)	(Jensen et al., 2012)
Were the authors' discussions and conclusions justified by the results?	Yes	Yes	Yes
Were the limitations of the study discussed?	Yes	Yes	No
Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?	No	No	No
Was ethical approval or consent of participants attained?	Yes	Yes	No
Grade	**Medium**: Though a relatively recent large study, it was not migrant group specific and nationally representative.	**Medium:** Ample sized migrant specific study which had a low response	**Low:** Though the study covered a wide period of time, it was a non-nationally representative study that lacked basic data description, had no extractable data on older migrants by country of birth, only rates were derived for older individuals and the **o**lder adults sample size was not stated

Appendix E.06 AXIS tables

	(Kiropoulos et al., 2004)	(Kiropoulos et al., 2012)	(Kliewer and Ward 1988)
Were the aims/objectives of the study clear?	Yes	Yes	Yes
Was the study design (s) for the stated aim(s)	Yes	Yes	Yes
Was the sample size justified?	No (sample size was too small)	No (sample size was too small)	Yes
Was the target/reference population clearly defined? (is it clear who the research was about)	Yes	Yes	Yes
Was the sample frame taken from an appropriate base so that it closely represented the target/reference population under investigation	No (Sixteen Greek community social clubs in the Melbourne metropolitan area were approached (i.e. elderly citizens clubs, activity clubs, women's clubs). Same criterion was used for elderly Australians	No	Yes
Was the selection process likely to select participants that were representative of the target/reference population under investigation	No	No	Yes
Were measures undertaken to address and categorise non-responders?	No	No	Yes
Were the risk factor and outcome variables measured appropriate to the aims of the study?	No (they did not assess migrants' English proficiency and mental health)	Yes	Yes

Appendix E.06 continued

	(Kiropoulos et al., 2004)	(Kiropoulos et al., 2012)	(Kliewer and Ward 1988)
Were the risk factor and outcome variables measured correctly using instruments/ measurements that had been trialed, piloted or published previously?	Yes (however the instruments used were translated from English to Greek and this could result in bias when assessing the two different groups; Australian born and Greek born)	Yes	Yes
Is it clear what was used to determined statistical significance and/or precision estimates? (eg, p values, CIs)	Yes	Yes	Yes
Were the methods (including statistical methods) sufficiently described to enable them to be repeated?	Yes	Yes	Yes
Were the basic data adequately described?	Yes	Yes	No
Does the response rate raise concerns about non-response bias?	Yes	Yes	No
If appropriate, was information about non-responders described?	No	No	No
Were the results internally consistent?	Yes	Yes	Yes
Were the results for the analyses described in the methods, presented?	Yes	Yes	Yes
Were the authors' discussions and conclusions justified by the results?	Yes	Yes	Yes
Were the limitations of the study discussed?	Yes	Yes	Yes
Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?	No	No	No

Appendix E.06 continued

	(Kiropoulos et al., 2004)	(Kiropoulos et al., 2012)	(Kliewer and Ward 1988)
Was ethical approval or consent of participants attained?	Yes	Yes	Yes
Grade	**Low:** though a migrant specific older persons' study, it had a small non-nationally representative convenient sample size.	**Low:** though a relatively recent migrant specific older persons study, it had a small non-nationally representative convenient sample size.	**Low:** though nationally representative, this was an old study that used registry data and lacked basic data, had no extractable data on older migrants by country of birth and only rates were derived for older individuals.

Appendix E.07 AXIS tables

	(Kliewer, 1991)	(Li et al., 2004)	(Lin et al., 2016)
Were the aims/objectives of the study clear?	Yes	Yes	Yes
Was the study design (s) for the stated aim(s)	Yes	Yes	Yes
Was the sample size justified?	Yes	Yes	Yes (It was a convenient sample, however there is limited data on psychological well-being among older Chinese migrants)
Was the target/reference population clearly defined? (is it clear who the research was about)	Yes	Yes	Yes
Was the sample frame taken from an appropriate base so that it closely represented the target/reference population under investigation	Yes	Yes	No (It was a convenience sample)
Was the selection process likely to select participants that were representative of the target/reference population under investigation	Yes	No	No (It was a convenience sample and participants were recruited from newspaper advertisement and distribution of flyers)
Appendix E.07 continued			

	(Kliewer, 1991)	(Li et al., 2004)	(Lin et al., 2016)
Were measures undertaken to address and categorise non-responders?	Yes	Yes	No
Were the risk factor and outcome variables measured appropriate to the aims of the study?	Yes	Yes	Yes
Were the risk factor and outcome variables measured correctly using instruments/ measurements that had been trialed, piloted or published previously?	Yes	Yes	Yes
Is it clear what was used to determined statistical significance and/or precision estimates? (eg, p values, CIs)	No	No	Yes
Were the methods (including statistical methods) sufficiently described to enable them to be repeated?	Yes	Yes	Yes
Were the basic data adequately described?	No	No	Yes
Does the response rate raise concerns about non-response bias?	No	Yes	No
If appropriate, was information about non-responders described?	No	No	Yes
Were the results internally consistent?	Yes	Yes	Yes

Appendix E.07 continued

	(Kliewer, 1991)	(Li et al., 2004)	(Lin et al., 2016)
Were the results for the analyses described in the methods, presented?	Yes	Yes	Yes
Were the authors' discussions and conclusions justified by the results?	Yes	Yes	Yes
Were the limitations of the study discussed?	Yes	No	Yes
Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?	Not stated	No	No
Was ethical approval or consent of participants attained?	Yes	No	Yes
Grade	**Low:** Though nationally representative, this was an old study that used registry data and lacked basic data description, had no extractable data on older migrants by country of birth and only rates were derived for older individuals	**Low:** This was a nationally representative older persons' study. However, it lacked basic data description, it had no extractable data on older migrants by country of birth and only rates were derived for older individuals	**Low:** This was a migrant specific older persons' study. However, it was not nationally representative and used a small convenient sample size

Appendix E.08 AXIS tables

	(Long et al., 2002)	(Malenfant, 2004)	(McCallum & Shadbolt, 1989)
Were the aims/objectives of the study clear?	Yes	Yes	Yes
Was the study design (s) for the stated aim(s)	Yes	Yes	Yes
Was the sample size justified?	yes	Yes (Sample size was too small)	Yes
Was the target/reference population clearly defined? (is it clear who the research was about)	yes	Yes	Yes
Was the sample frame taken from an appropriate base so that it closely represented the target/reference population under investigation	Yes	Yes	Yes (One of the surveys collected a high proportion of data from districts with high ethnic concentrations to maximise on the number of migrants)

Appendix E.08 continued

	(Long et al., 2002)	(Malenfant, 2004)	(McCallum & Shadbolt, 1989)
Was the selection process likely to select participants that were representative of the target/reference population under investigation	No	Yes	Yes (Both surveys used identical and similar questions and used a language from the target groups. The participants were grouped into mainstream Australians, British migrants including some English-speaking migrants not born in Britain, non-British migrants with good English, and non-British migrants with poor English)
Were measures undertaken to address and categorise non-responders?	Yes	Yes	Yes
Were the risk factor and outcome variables measured appropriate to the aims of the study?	Yes	Yes	No (excluded duration of residence, education and marital status)
Appendix E.08 continued			

	(Long et al., 2002)	(Malenfant, 2004)	(McCallum & Shadbolt, 1989)
Were the risk factor and outcome variables measured correctly using instruments/ measurements that had been trialed, piloted or published previously?	Yes	Yes	Yes
Is it clear what was used to determined statistical significance and/or precision estimates? (eg, p values, CIs)	No	Yes	Yes
Were the methods (including statistical methods) sufficiently described to enable them to be repeated?	Yes	Yes	Yes
Were the basic data adequately described?	No	Yes	No
Does the response rate raise concerns about non-response bias?	Yes	Yes	No
If appropriate, was information about non-responders described?	No	Yes	No
Were the results internally consistent?	Yes	Yes	Yes
Were the results for the analyses described in the methods, presented?	Yes	Yes	Yes
Were the authors' discussions and conclusions justified by the results?	Yes	Yes	Yes

Appendix E.08 continued

	(Long et al., 2002)	(Malenfant, 2004)	(McCallum & Shadbolt, 1989)
Were the limitations of the study discussed?	No	Yes	Yes
Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?	No	No	Yes
Was ethical approval or consent of participants attained?	No	Yes	Yes
Grade	**Low:** An old non-nationally representative older persons' study that lacked basic data description	**Low:** Though nationally representative, the study was not older persons' or migrant group specific it also lacked basic data description	**Medium:** This was a large study that included various health measures and used various categories to assess health status. However, it was an old non-nationally representative study whose data were derived from different datasets, used broad migrants' categories and lacked basic data descriptions

Appendix E.09 AXIS tables

	(Minami et al., 1993)	(Naja et al., 2007)	(Neutel et al., 1989)
Were the aims/objectives of the study clear?	Yes	Yes	Yes
Was the study design (s) for the stated aim(s)	Yes	Yes	Yes
Was the sample size justified?	Yes (All cancers cases, though the sample size for the Italian migrants were relatively small)	Yes	Yes
Was the target/reference population clearly defined? (is it clear who the research was about)	Yes	Yes	No (It would have been good to define what they met by Canadian-born)
Was the sample frame taken from an appropriate base so that it closely represented the target/reference population under investigation	Yes (Data for the Australians and migrants came from the same registry)	Yes	Yes
Was the selection process likely to select participants that were representative of the target/reference population under investigation	Yes	Yes (Population controls were identified using random selection and they were also weighted)	Yes
Were measures undertaken to address and categorise non-responders?	Yes	Yes	No (Not required as census data was used)

Appendix E.09 continued

	(Minami et al., 1993)	(Naja et al., 2007)	(Neutel et al., 1989)
Were the risk factor and outcome variables measured appropriate to the aims of the study?	Yes	Yes	No (Not a lot of variables included as registry data used)
Were the risk factor and outcome variables measured correctly using instruments/ measurements that had been trialed, piloted or published previously?	Yes	Yes	Yes
Is it clear what was used to determined statistical significance and/or precision estimates? (eg, p values, CIs)	Yes	Yes (however significance was measured at several levels)	No
Were the methods (including statistical methods) sufficiently described to enable them to be repeated?	Yes	Yes	Yes
Were the basic data adequately described?	Yes	No	No
Does the response rate raise concerns about non-response bias?	Yes	No	No
If appropriate, was information about non-responders described?	Yes	Yes	Yes
Were the results internally consistent?	Yes	Yes	Yes

Appendix E.09 continued

	(Minami et al., 1993)	(Naja et al., 2007)	(Neutel et al., 1989)
Were the results for the analyses described in the methods, presented?	Yes	Yes	Yes
Were the authors' discussions and conclusions justified by the results?	There is limited generalisability of the results because the population studied was age-matched to colon cancer patients	Yes	No (no confidence intervals were provided, data extracted from graphs, not very precise Rates for some countries used 20 years age groups while others used 10-year age groups. This might result in bias)
Were the limitations of the study discussed?	Yes	Yes	Yes
Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?	No	Not stated	No
Was ethical approval or consent of participants attained?	Yes	Yes	Yes

Appendix E.09 continued

	(Minami et al., 1993)	(Naja et al., 2007)	(Neutel et al., 1989)
Grade	**Low:** Though migrant group specific, this was an old non-nationally representative study that lacked basic data description	**Medium:** Though a large older persons' study, it was not migrant group specific and nationally representative	**Low:** Though nationally representative, this was an old study that used registry data and lacked basic data description, had no extractable data on older migrants by country of birth and only rates were derived for older individuals

Appendix E.10 AXIS tables

	(Newbold & Danforth, 2003)	(Newbold, K. B. & Filice, J. K. 2006)	(Prus et al., 2010)
Were the aims/objectives of the study clear?	Yes	Yes	Yes
Was the study design (s) for the stated aim(s)	Yes	Yes	Yes
Was the sample size justified?	Yes	Yes	Yes
Was the target/reference population clearly defined? (is it clear who the research was about)	Yes	Yes	Yes
Was the sample frame taken from an appropriate base so that it closely represented the target/reference population under investigation	Yes	Yes	Yes
Was the selection process likely to select participants that were representative of the target/reference population under investigation	Yes	Yes	Yes
Were measures undertaken to address and categorise non-responders?	Yes	Yes	Yes

Appendix E.10 continued

	(Newbold & Danforth, 2003)	(Newbold, K. B. & Filice, J. K. 2006)	(Prus et al., 2010)
Were the risk factor and outcome variables measured appropriate to the aims of the study?	Yes	Yes	Yes
Were the risk factor and outcome variables measured correctly using instruments/ measurements that had been trialed, piloted or published previously?	Yes	Yes	Yes
Is it clear what was used to determined statistical significance and/or precision estimates? (eg, p values, CIs)	Yes	Yes	Yes
Were the methods (including statistical methods) sufficiently described to enable them to be repeated?	Yes	Yes	Yes
Were the basic data adequately described?	Yes	Yes	Yes
Does the response rate raise concerns about non-response bias?	Yes	Yes	Yes
If appropriate, was information about non-responders described?	Yes	Yes	Yes
Appendix E.10 continued			

	(Newbold & Danforth, 2003)	(Newbold, K. B. & Filice, J. K. 2006)	(Prus et al., 2010)
Were the results for the analyses described in the methods, presented?	Yes	Yes	Yes
Were the authors' discussions and conclusions justified by the results?	Yes	Yes	Yes
Were the limitations of the study discussed?	Yes	Yes	Yes
Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?	No	No	No
Was ethical approval or consent of participants attained?	Yes	Yes	Yes
Grade	**Medium:** Though the study was nationally representative and used diverse health measures, it was not older persons or migrant group specific	**Medium:** This was a nationally representative older persons study that used diverse health measures, however it was not migrant group specific	**Medium:** This was a large nationally representative older persons study. However, it used broad migrant categories to assess health status

Appendix E.11 AXIS tables

	(Roche et al., 2006)	(Roche et al., 2007)	(Roche et al., 2008)
Were the aims/objectives of the study clear?	Yes	Yes	Yes
Was the study design (s) for the stated aim(s)	Yes	Yes	Yes
Was the sample size justified?	yes	yes	Yes
Was the target/reference population clearly defined? (is it clear who the research was about)	yes	yes	Yes
Was the sample frame taken from an appropriate base so that it closely represented the target/reference population under investigation	Yes	Yes	Yes
Was the selection process likely to select participants that were representative of the target/reference population under investigation	No	No	No
Were measures undertaken to address and categorise non-responders?	Yes	Yes	Yes

Appendix E.11 continued

	(Roche et al., 2006)	(Roche et al., 2007)	(Roche et al., 2008)
Were the risk factor and outcome variables measured appropriate to the aims of the study?	Yes	Yes	Yes
Were the risk factor and outcome variables measured correctly using instruments/ measurements that had been trialed, piloted or published previously?	yes	yes	Yes
Is it clear what was used to determined statistical significance and/or precision estimates? (eg, p values, CIs)	No	No	No
Were the methods (including statistical methods) sufficiently described to enable them to be repeated?	Yes	Yes	Yes
Were the basic data adequately described?	No	No	No
Does the response rate raise concerns about non-response bias?	Yes	Yes	Yes
If appropriate, was information about non-responders described?	No	No	No
Were the results internally consistent?	Yes	Yes	Yes

Appendix E.11 continued

	(Roche et al., 2006)	(Roche et al., 2007)	(Roche et al., 2008)
Were the results for the analyses described in the methods, presented?	Yes	Yes	Yes
Were the authors' discussions and conclusions justified by the results?	Yes	Yes	Yes
Were the limitations of the study discussed?	No	No	No
Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?	No	No	No
Was ethical approval or consent of participants attained?	No	No	No

Appendix E.11 continued

	(Roche et al., 2006)	(Roche et al., 2007)	(Roche et al., 2008)
Grade	**Low:** Though the study was	**Low:** Though the study was	**Low:** Though the study was

	nationally representative, it lacked basic data description, it lacked extractable data on older migrants by country of birth and only rates were derived for older individuals. Older adults sample size was not stated and it used registry data	nationally representative, it lacked basic data description, it lacked extractable data on older migrants by country of birth and only rates were derived for older individuals. Older adults sample size was not stated and it used registry data	nationally representative, it lacked basic data description, it lacked extractable data on older migrants by country of birth and only rates were derived for older individuals. Older adults sample size was not stated and it used registry data

Appendix E.12 AXIS tables

	(Samaan et al., 2003)	**(Silove et al., 2007)**	**(Stanaway et al., 2010**
Were the aims/objectives of the study clear?	Yes	Yes	Yes
Was the study design (s) for the stated aim(s)	Yes	Yes	Yes
Was the sample size justified?	Yes	No	No (sample size was too small)
Was the target/reference population clearly defined? (is it clear who the research was about)	Yes	Yes	Yes
Was the sample frame taken from an appropriate base so that it closely represented the target/reference population under investigation	Yes	Yes	Yes
Was the selection process likely to select participants that were representative of the target/reference population under investigation	No	Yes	No
Were measures undertaken to address and categorise non-responders?	Yes	No	No
Were the risk factor and outcome variables measured appropriate to the aims of the study?	Yes	Yes	Yes

Appendix E.12 continued			
	(Samaan et al., 2003)	**(Silove et al., 2007)**	**(Stanaway et al., 2010**
Were the risk factor and outcome variables measured correctly using instruments/ measurements that had been trialed, piloted or published previously?	Yes	Yes	Yes
Is it clear what was used to determined statistical significance and/or precision estimates? (eg, p values, CIs)	No	Yes	Yes
Were the methods (including statistical methods) sufficiently described to enable them to be repeated?	Yes	Yes	Yes
Were the basic data adequately described?	No	Yes	Yes
Does the response rate raise concerns about non-response bias?	Yes	No	Yes
If appropriate, was information about non-responders described?	No	No	Yes
Were the results internally consistent?	Yes	Yes	Yes
Were the results for the analyses described in the methods, presented?	Yes	Yes	Yes
Appendix E.12 continued			

	(Samaan et al., 2003)	(Silove et al., 2007)	(Stanaway et al., 2010
Were the authors' discussions and conclusions justified by the results?	Yes	Yes	Yes
Were the limitations of the study discussed?	No	No	Yes
Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?	No	No	No
Was ethical approval or consent of participants attained?	No	Yes	Yes
Grade	**Low:** Though the study was nationally representative, it lacked basic data description, it lacked extractable data on older migrants by country of birth and only rates were derived for older individuals. Older adults sample size was not stated and it used registry data	**Low:** Though the study was not nationally representative and had a small sample size, it was migrant group specific	**Medium:** This was a relatively recent large older persons' and migrant specific study. However, it was gender specific and was not nationally representative

Appendix E.13 AXIS tables

	(Stanaway et al., 2011)	(Stanaway et al., 2011)	(Stewart et al., 2004)
Were the aims/objectives of the study clear?	Yes	Yes	Yes
Was the study design (s) for the stated aim(s)	Yes	Yes	yes
Was the sample size justified?	No	No	No
Was the target/reference population clearly defined? (is it clear who the research was about)	Yes	Yes	Yes
Was the sample frame taken from an appropriate base so that it closely represented the target/reference population under investigation	Yes	Yes	No
Was the selection process likely to select participants that were representative of the target/reference population under investigation	No	No	No
Were measures undertaken to address and categorise non-responders?	Yes	Yes	Yes

Appendix E.13 continued

	(Stanaway et al., 2011)	(Stanaway et al., 2011)	(Stewart et al., 2004)
Were the risk factor and outcome variables measured appropriate to the aims of the study?	Yes	Yes	Yes
Were the risk factor and outcome variables measured correctly using instruments/ measurements that had been trialed, piloted or published previously?	Yes	Yes	Yes
Is it clear what was used to determined statistical significance and/or precision estimates? (eg, p values, CIs)	Yes	Yes	Yes
Were the methods (including statistical methods) sufficiently described to enable them to be repeated?	Yes	Yes	Yes
Were the basic data adequately described?	Yes	Yes	No
Does the response rate raise concerns about non-response bias?	Yes	Yes	No
If appropriate, was information about non-responders described?	Yes	Yes	Yes

Appendix E.13 continued			
	(Stanaway et al., 2011)	**(Stanaway et al., 2011)**	**(Stewart et al., 2004)**
Were the results internally consistent?	Yes	Yes	Yes
Were the results for the analyses described in the methods, presented?	Yes	Yes	Yes
Were the authors' discussions and conclusions justified by the results?	Yes	Yes	Yes
Were the limitations of the study discussed?	Yes	Yes	Yes
Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?	No	No	No
Was ethical approval or consent of participants attained?	Yes	Yes	Yes
Grade	**Medium:** This was a relatively recent large older persons' and migrant specific study. However, it was gender specific and was not nationally representative	**Medium:** This was a relatively recent large older persons' and migrant specific study. However, it was gender specific and was not nationally representative	**Medium:** Though the comparator possibly included indigenous Australians, it was a relatively recent, migrant specific nationally representative large study that covered a wide period

Appendix E.14 AXIS tables

	(Straiton et al., 2014)	**(Toms et al., 2015)**	**(Toms et al., 2017)**	**(Tran et al., 2014)**
Were the aims/objectives of the study clear?	Yes	Yes	Yes	Yes
Was the study design (s) for the stated aim(s)	Yes	Yes	Yes	Yes
Was the sample size justified?	No	yes	Yes	No
Was the target/reference population clearly defined? (is it clear who the research was about)	Yes	yes	Yes	Yes
Was the sample frame taken from an appropriate base so that it closely represented the target/reference population under investigation	Yes (mainly established migrant groups)	Yes	Yes	No
Was the selection process likely to select participants that were representative of the target/reference population under investigation	No (conducted in English, could have excluded migrants with poor English)	No	No	No

Appendix E.14 continued

	(Straiton et al., 2014)	(Toms et al., 2015)	(Toms et al., 2017)	(Tran et al., 2014)
Were measures undertaken to address and categorise non-responders?	Yes	Yes	Yes	No
Were the risk factor and outcome variables measured appropriate to the aims of the study?	Yes	Yes	Yes	Yes
Were the risk factor and outcome variables measured correctly using instruments/ measurements that had been trialed, piloted or published previously?	Yes	Yes	Yes	Yes
Is it clear what was used to determined statistical significance and/or precision estimates? (eg, p values, CIs)	Yes	No	No	Yes
Were the methods (including statistical methods) sufficiently described to enable them to be repeated?	Yes	Yes	Yes	Yes

Appendix E.14 continued

	(Straiton et al., 2014)	(Toms et al., 2015)	(Toms et al., 2017)	(Tran et al., 2014)
Were the basic data adequately described?	No	No	No	Yes
Does the response rate raise concerns about non-response bias?	Yes	Yes	Yes	Yes
If appropriate, was information about non-responders described?	Yes	No	No	Yes
Were the results internally consistent?	Yes	Yes	Yes	Yes
Were the results for the analyses described in the methods, presented?	Yes	Yes	Yes	Yes
Were the authors' discussions and conclusions justified by the results?	Yes	Yes	Yes	Yes
Were the limitations of the study discussed?	Yes	No	No	Yes
Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?	No	No	No	No

Appendix E.14 continued

	(Straiton et al., 2014)	(Toms et al., 2015)	(Toms et al., 2017)	(Tran et al., 2014)
Was ethical approval or consent of participants attained?	Yes	No	No	Yes
Grade	**Medium:** Though a relatively recent large older persons' study, it used broad duration of residence categories to assess health status	**Low:** Though the study was nationally representative, it lacked basic data description, it lacked extractable data on older migrants by country of birth and only rates were derived for older individuals. Older adults sample size was not stated and it used registry data	**Low:** Though the study was nationally representative, it lacked basic data description, it lacked extractable data on older migrants by country of birth and only rates were derived for older individuals. Older adults sample size was not stated and it used registry data	**Medium:** Though not nationally representative and with a low response rate, this was a migrant group specific older persons study

Appendix F Standardised data extraction table

Factors	Additional details
Study ID	Name of study
Year of study	Year study was published
Publication Type	Journal, report etc
Funding source	Organisation funding the study
Study design	i.e. cross-sectional, longitudinal etc
Data source	i.e. own research or from secondary source
Was the study nationally representative	Yes or no question
Migrants	How were migrants categorised
Migrant composition	Where did they originate from
Comparator definition	Definition of migrants in the study
No of participants	Sample size
Female	Proportion of females in study
Mean age	Average age of participants
Migrant population	Proportion of migrants in study
Proportion of older participants	Proportion of older participants in study
Age covered	i.e. 45-64 years or 60 years or older
Aims	Study aims
Study duration	Data collection period
Response rate	Proportion of individuals who took part in a particular study
Statistical methods	i.e. logistic regression
Statistical outcomes calculated	i.e. odds ratio
Study outcomes	Unadjusted and adjusted odd ratios, rate ratios, crude rates, relative ratios, incidence rates, point prevalence, life expectancy, mortality rate, survival probabilities, healthy expectancy and mean scores
independent variables	Factors adjusted for in a study to observe their effect on a dependent variable
Study findings	Study main findings
Health measures	Were the health measures collected in the study self-reported? Yes or no question

Appendix G Additional information on Australian studies included in the review

Appendix G.01 Additional information on Australian studies included in the review

Study ID	Funding source	Female (%)	Study duration (years)	Response rate (%)
(Bareja et al 2014)	Unknown	Not stated	2011	Not stated
(Barry et al., 2009)	Not stated	Not stated	2007	97.9
(Brock et al 2004)	USyd Small Grants Scheme 1995–1997, 1998–2000	Not stated	Not stated	Not stated
(Burvill et al., 1973)	Not stated	Not stated	1962-1966	Not stated
(Burvill, 1995)	Not stated	27.6	1979-1990	Not stated
(Camie et al 2001)	Not stated	Not stated	1998	Not stated
(Dobson & Leeder, 1982)	Australian Department of Health.	Not stated	1968-77	Not stated
(Gray et al., 2007)	Medical Research Council (UK)	Not stated	1998–2002	Not stated
(Guo et al 2015)	National Heart Foundation, NSW Cardiovascular Research Network	Australia (55.0), North-East Asia (55.0), South-East Asia) (57.0), Europe (49.0)	2006–2008	Not stated
(Kiropoulos et al., 2004)	Not stated	Greek-born (52.1) & Australian-born (50.1)	Not stated	Not stated
(Kiropoulos et al., 2012)	Beyond blue: the national depression initiative	32.5	2009 and 2011	Greek-born migrants (68.5) and Anglo-Australians (51.2).
(Li et al 2004)	Not stated	Not stated	2002	Not stated
(Lin et al., 2016)	Not stated	Chinese-born (64) and Australian-born (72)	One-time interview	Not stated
(McCallum & Shadbolt, 1989)	Not stated	Ageing and the Family Project survey (66) & Ethnic Aged survey (38)	1981 & 1984	Not stated

Appendix G.01 continued				
Study ID	**Funding source**	**Female (%)**	**Study duration**	**Response rate**
(Minami et al., 1993)	Not stated	58.0	1982-1987	Not stated
(Roche et al., 2006)	Not stated	Not stated	2004	Not stated
(Roche et al., 2007)	Not stated	Not stated	2005	Not stated
(Roche et al., 2008)	Not stated	Not stated	2006	Not stated
(Samaan et al., 2003)	Not stated	Not stated	2002	Not stated
(Silove et al., 2007)	National Health and Medical Research Council of Australia	Vietnamese (50.3) & Australian (48.2)	1999	Australian (78.0) & Vietnamese (82.0)
(Stanaway et al., 2010)	National Health and Medical Research Council (NHMRC Project Grant No. 301916), the Ageing and Alzheimer's Research Foundation and NHMRC Postgraduate Research Scholarship in Public Health (Scholarship No. 402956)	Not stated	January 2005 to 4 June 2007	54.0
(Stanaway et al., 2011)	National Health and Medical Research Council (NHMRC Project Grant No. 301916), the Ageing and Alzheimer's Research Foundation and NHMRC Postgraduate Research Scholarship in Public Health (Scholarship No. 402956)	Not stated	January 2005 to 4 June 2007	54.0
(Stanaway et al., 2011)	As above	Not stated	January 2005 to 4 June 2008	54.0

Appendix G.01 continued				
Study ID	**Funding source**	**Female (%)**	**Study duration**	**Response rate**
(Stanaway et al., 2019)	Australian National Health and Medical Research Council (NHMRC Project Grant No. 301916) and the Ageing and Alzheimer's Research Foundation	Not stated	Baseline data were collected between January 2005 and June 2007. The men were followed by phone calls every 4 months and at 2-year, 5 year and 8 year follow up visits	50.0
(Stewart et al., 2004)	Ingster Ross Memorial Fund, University of Otago, and an unconditional grant to ANZDATA by AMGEN Australia	Not stated	1993–2001	Not stated
(Straiton et al., 2014)	Not stated	Australian born (50.6) Foreign-born (English speaking background 48.5) Foreign-born (non-English speaking background 43.6)	2004 and 2006 (wave 2)	49.4
(Toms et al., 2015)	Not stated	Not stated	2012 & 2013	Not stated
(Toms et al., 2017)	Not stated	Not stated	2014	Not stated
(Tran et al., 2014)	Not stated	Vietnamese (50.7), Australian (54.6)	2006	18.0

Appendix G.02 Extracted study findings (Australian studies)

Study ID	Statistical methods	Independent variables	Findings
(Bareja et al 2014)	Not stated	Household or other close contact with TB, ever resided in a correctional facility, ever resided in an aged care facility, ever employed in an institution, currently or previously employed in health industry in Australia or overseas, ever homeless, past travel to or residence in a high-risk country, chest x-ray suggestive of old untreated TB, currently receiving immunosuppressive therapy, Australian-born child with one or more parent born in a high-risk country, age and sex, country of origin and HIV status	**Crude TB rates** **For overseas born**; 10% (45-54 years), 12% (55-64 years), 23% (65+ years) **For Australian born;** 1% (45-54 year), 1.5% (55-64 years), 3% (65+ years)
(Barry et al., 2009)	Not stated	Age, sex, duration of residence, country of birth	**Crude TB rates** **Non-indigenous Australian crude TB rates** (%) 45- 54 years (0.9), 55-64 years (0.9) and 65+ years (2.4), **Overseas born 45- 54 years** (12.4), 55-64 years (9.2) and 65+ years (15.0)
(Brock et al 2004)	Descriptive statistics, Student's t-test and logistic analyses	Residential status age, gender, mobility, muscle strength and sun exposure, vitamin D status, HDL, dietary vitamin D intake, dietary calcium, dairy intake, sun exposure, body mass index, body fat, exercise	**Odds ratio** Middle Eastern elderly were 3.5 (1.4–9.0) times and Vietnamese 2.6 (1.1–6.9) times more likely to have marginal Vitamin D status (<37 nmol/L) than their Australian counterparts. Vitamin D status was lower in Middle Eastern and Vietnamese free-living elderly than North European migrants and Australian-born elderly persons.

Appendix G.02 continued			
Study ID	**Statistical methods**	**Independent variables**	**Findings**
(Burvill et al., 1973)	Standardisation	Age, sex and country of birth	**Age standardized rates** Female and male migrants had higher age specific suicide rates compared to the Australian born. 50-59 years Australian-born males 37.1/100,000 migrant males 42.6/100,000, 60-69 years Australian-born males 35.5/100,000, migrant males 48.4/100,000, 70-79 Australian-born males 35.9/100,000 and migrant males 41.8/100,000. 50-59 years Australian-born females 20.8/100,000, migrant females 26.9/100,000, 60-69 Australian-born females 17.5/100,000, migrant females 23.8/100,000 and 70-79 Australian-born females 12.3/100,000, migrant females 22.1/100,000. Female and male migrants had higher age specific motor vehicles mortality rates compared to the Australian born. 50-59 years Australian-born males 43.8/100,000 migrant males 50.8/100,000, 60-69 years Australian-born males 53.3/100,000, migrant males 60.5/100,000, 70-79 Australian-born males 80.0/100,000 and migrant males 84.0/100,000. 50-59 years Australian-born females 16.1/100,000, migrant females 17.5/100,000, 60-69 Australian-born females 21.8/100,000, migrant females 25.5/100,000 and 70-79 Australian-born females 37.2/100,000, migrant females 46.6/100,000. Male and female migrants had higher violent age specific suicide rates compared to the Australian born. Among the males the migrant age-specific rates were higher than, or almost equal to, those of the Australian-born in all age groups. The female migrant age-specific rates were all higher with the. Exception of the age group 50-59 years (data not extracted).

Appendix G.02			
Study ID	**Statistical methods**	**Independent variables**	**Findings**
(Burvill, 1995)	direct standardisation	Country of birth and sex	**Standardised mortality ratio** SMR, Compared to Australian born males, New Zealand (1.13), England and Wales (0.96), Scotland (0.78), Northern Ireland (1.86), Ireland (1.68) and the United States (1.1). Females New Zealand (1.02), England and Wales (1.04), Scotland (0.83), Northern Ireland (1.33), Ireland (1.82) and the United States (3.32). Europe males, Austria (1.56), Czechoslovakia (1.64), Germany (1.68), Greece (0.72), Hungary (2.86), Italy (1.24), Malta (0.89), Poland (1.81), Scandinavia (1.32), USSR (2.08) and Yugoslavia (2.19). European females. Austria (5.0), Czechoslovakia (2.87), Germany (2.46), Greece (1.55), Hungary (7.27), Italy (1.19), Malta (1.02), Poland (3.27), Scandinavia (2.98), USSR (3.56) and Yugoslavia (2.48). Asia males China (2.03) India (0.51), other countries males Turkey (2.58) and S. Africa (1.4). Asia females China (3.66) India (0.71), other countries males Turkey (1.22) and S. Africa (1.22)
(Camie et al 2001)	**Not stated**	Household or other close contact with TB, ever resided in a correctional facility, ever employed in an institution, currently or previously employed in health industry in Australia or overseas, ever homeless, past travel to or residence in a high-risk country, chest x-ray suggestive of old untreated TB, Australian-born child with one or more parent born in a high-risk country, age and sex, country of origin and HIV status	**Crude rates** Migrants had a higher rate of TB compared to the Australian-born population

Appendix G.02			
Study ID	**Statistical methods**	**Independent variables**	**Findings**
(Dobson & Leeder, 1982)	Not stated	Age, sex, place of usual residence, country of birth, period of residence in Australia and for males aged 15-64 years, occupation	**Mortality rate** **For Australian-born;** 13.57 men aged 60 + years and 8.59 for women aged 60+ years **United Kingdom and Eire migrants who had lived in Australia for less than 24 years** men 6.19, women 1.13. **Migrants for those who had lived for ≥24 years,** males had a mortality rate of 10.32 for females 4.20
(Gray et al., 2007)	Multivariable Poisson regression	Sex, age group, year of death, occupational class and marital status	**Relative risk** New Zealand 45–54 years 0.79 (0.68–0.93), 55–64 years 0.74 (0.65–0.85), UK and Ireland 45–54 years 0.70 (0.64–0.76), 55–64 years 0.71 (0.67–0.75) Germany 45–54 years 1.21 (1.01–1.45) 55–64 years 0.77 (0.66–0.88) Greece 45–54 years 0.84 (0.66–1.08) 55–64 years 0.70 (0.62–0.79), Italy 45–54 years 0.72 (0.59–0.87) and 55–64, 0.69 (0.62–0.76), East Asia 45–54 years 0.37 (0.30–0.46) and 55–64 years 0.41 (0.34–0.48) South Asia 45–54 years 0.41 (0.29–0.57) 55–64 years 0.72 (0.60–0.87)
(Guo et al 2015)	modified Poisson regression	Age, marital status, education, location of residence, household annual pre-tax income, health insurance, duration of residence and age migrated to Australia, current smoking, diabetes, current treatment for hypertension, current treatment for hypercholesterolaemia, BMI_25 kg/m2 and physical inactivity	**Prevalence ratio** Relative to the Australian born, North-East Asia (0.61(0.54-0.68)), South-East Asia (0.76(0.69-0.83)), Europe (0.92(0.90-0.94)). Relative to the Australian born males, North-East Asia (0.54(0.47-0.62)), South-East Asia (0.79(0.70-0.89)), Europe (0.89(0.87-0.90)). Relative to the Australian born females, North-East Asia (0.69(0.58-0.82)), South-East Asia (0.72(0.62-0.84)), Europe (0.90(0.87-0.94)).

Appendix G.02 continued			
Study ID	**Statistical methods**	**Independent variables**	**Findings**
(Kiropoulos et al., 2004)	Multivariable analysis & Univariable descriptions	Age, gender, marital status, household composition, level of education, occupational status, employment status, financial comfort, memory functioning, physical health and experience of recent stressors	**Depression and anxiety scores** Greek-born, moderate to severe depression score (17.1%), Australian-born, moderate to severe depression score (4.1%). Greek-born, moderate to severe anxiety score (43.1%), Australian-born, moderate to severe anxiety score (15.8%)
(Kiropoulos et al., 2012)	χ2 test, Pearson correlations, ANOVA and regression analyses	Age, sex, country of birth, ethnic background, marital status, living situation, number of children, highest level of education, occupational level during working life, current work status, currently smoking, taking medication and whether they had attended cardiac rehabilitation, English proficiency and duration of residence	**Depression and anxiety scores** Greek-born, depression mean score 13.93(9.62), Australian-born, depression mean score 8.25 (9.11). Greek-born, anxiety mean score 45.08 (12.25), Australian-born, anxiety mean score 33.85(11.81). Greek-born, physical health mean score 31.08 (10.21), Australian-born, physical health mean score 34.83(8.92).
(Li et al 2004)	Not stated	Country of birth, extrapulmonary site, new or relapse case, TB outcomes, age, indigenous status, selected risk factors and sex	**Crude TB rates** Non-Indigenous Australian-born 45-54 years (0.9), overseas-born (13.7), for Non-Indigenous Australian-born 55-64 years (1.5), Overseas-born (9.9) and for Non-Indigenous Australian-born 65+ years (4.1), Overseas-born (18.8)

Appendix G.02 continued			
Study ID	**Statistical methods**	**Independent variables**	**Findings**
(Lin et al., 2016)	Mann–Whitney and the χ2	Age, gender, marital status, highest education level, self-perceived financial situation, and self-perceived, physical health. For Chinese migrants, migration history, duration of residence, satisfaction with life in Australia, reason for migration and English language proficiency	**Median (IQR) for depression and anxiety** Median (IQR) for depression in Chinese migrants 1.00 (2.00), p> 0.05, For Australian born 0 (2.00), p>0.05. Median (IQR) for anxiety in Chinese migrants 0 (2.00), p> 0.05, for Australian born 1.00 (3.00), p>0.05
(McCallum & Shadbolt, 1989)	Ordinary least squares regression	Age, gender, household composition, family, income, education and employment status	**Self-rated health and depression scores** Self-rated health for mainstream Australians (8.97 ± 2.16), British migrants (9.20 ± 1.92, Non-British migrants with good English (8.04±2.43) and Non-British migrants with poor English (6.74±2.38). Psychological health for mainstream Australians (5.32 ±1.46), British migrants (5.34 ± 1.49), Non-British migrants with good English (5.68±1.69) and Non-British migrants with poor English (6.52±2.00).
(Minami et al., 1993)	Poisson regression	Age, sex and country of birth	Female and male migrants in the age groups 45-54 and 55-64 and 65-74 had lower rates for colon cancer. Male Migrants in the age groups 45-54 and 55-64 and 65-74 had lower rates for prostate cancer compared to the Australian born population. Female migrants in the age groups 45-54 and 55-64 and 65-74 had lower rates for breast cancer compared to the Australian born population.

Appendix G.02 continued			
Study ID	**Statistical methods**	**Independent variables**	**Findings**
(Roche et al., 2006)	Not stated	Age, sex, country of birth, HIV/Aids and other risk factors, state, disease site, disease outcomes,	**Crude TB rates** Non-Indigenous Australian-born 45-54 years (0.8), overseas-born (10.8), for non-Indigenous Australian-born 55-64 years (11.0), overseas-born (0.9) and for non-Indigenous Australian-born 65+ years (1.3), overseas-born (20.6)
(Roche et al., 2007)	Not stated	Age, sex, country of birth, HIV/Aids and other risk factors, state, disease site, disease outcomes,	**Crude TB rates** Non-Indigenous Australian-born 45-54 years (0.4), overseas-born (11.9), for non-Indigenous Australian-born 55-64 years (0.6), overseas-born (9.8) and for non-Indigenous Australian-born 65+ years (3.0), overseas-born (18.1)
(Roche et al., 2008)	Not stated	Age, sex, country of birth, HIV/Aids and other risk factors, state, disease site, disease outcomes,	**Crude TB rates** Non-Indigenous Australian-born 45-54 years (0.3), Overseas-born (15.3), for Non-Indigenous Australian-born 55-64 years (1), Overseas-born (9.6) and for Non-Indigenous Australian-born 65+ years (3.5), Overseas-born (65.7)
(Samaan et al., 2003)	Not stated	Country of birth, Extrapulmonary site, New or relapse case, TB outcomes, Age, Indigenous status, Selected risk factors and Sex	**Crude TB rates** Non-Indigenous Australian-born 45-54 years (0.9), Overseas-born (13.7), for Non-Indigenous Australian-born 55-64 years (1.5), Overseas-born (9.9) and for Non-Indigenous Australian-born 65+ years (4.1), Overseas-born (18.8)

Appendix G.02 continued			
Study ID	**Statistical methods**	**Independent variables**	**Findings**
(Silove et al., 2007)	Chi square and Multivariable logistic regression	Gender, age, marital status, employment status, main source of income, household tenure, education, additional vocational or tertiary and time in Australia	**Prevalence rate** All ICD-10 mental illness Australians ≥ 55 years 8.4%, ICD-10 PTSD 1.3%, total mental illness 15.2%., trauma count (mi), mean (SD) 1.8 (1.6), trauma count (PTSD), mean (SD) 3.0 (1.5). All ICD-10 mental illness ≥ 55 years Vietnamese 9.0%, ICD-10 PTSD 5.7%, total mental illness 62.1%, trauma count (MI), mean (SD) 4.1 (1.6), trauma count (PTSD), mean (SD) 3.9 (1.5).
(Stanaway et al., 2010)	logistic regression	Age group (years), number of comorbid conditions, self-rated health, level of education, occupation, source of income, marital status, disability (IADL), years in Australia, living arrangements, satisfaction with social support and language spoken at home	**Odds ratios and relative risks** Italian men compared to the Australian born, 1.9 (1.2–3.0), adjusted country of birth plus age 2.2 (1.4–3.5), adjusted for country of birth plus source of income 1.4 (0.9–2.3), adjusted for country of birth plus satisfaction with social support 1.6 (1.0–2.6) and the full model 1.7 (0.9–3.0)

Appendix G.02 continued			
Study ID	**Statistical methods**	**Independent variables**	**Findings**
(Stanaway et al., 2011a)	Chi squared statistics & multivariable logistic regression analysis	Age group (years), number of comorbid conditions, self-rated health, level of education, occupation, source of income, marital status, disability (IADL), years in Australia, living arrangements, satisfaction with social support and language spoken at home	**Odds ratios and relative risks** Being born in Italy had a highly statistically significant association with increased reported frequency of back pain in the univariable analysis (unadjusted OR = 1.81, $p = 0.002$) & (adjusted OR = 1.53, $p = 0.149$). Being born in Italy had a highly statistically significant association with increased reported severity of back pain in the univariable analysis (unadjusted OR = 1.93, $p < 0.001$) & (adjusted OR = 1.51, $p = 0.103$). In the univariable analysis there was a statistically significant association between being born in Italy and reporting chronic back (unadjusted OR = 1.59, $p = 0.023$) & (adjusted OR = 1.41, $p = 0.145$). There was a borderline significant association between having additional sites of pain and being born in Italy in the univariable analysis (unadjusted OR = 1.41, $p = 0.061$) & (adjusted OR = 1.16, $p = 0.580$). Being born in Italy had a highly statistically significant association with reported limitations due to back pain in the univariable analysis (unadjusted OR = 1.78, $p = 0.001$). In the multivariable analysis, there was a statistically significant interaction between country of birth and walking speed for reported limitations ($p = 0.008$). The association between slow walking speed and limitations in activities due to back pain was much stronger in Italian-born men compared to Australian-born men (OR = 3.32, $p = 0.002$ vs. OR = 1.41, $p = 0.136$).

Appendix G.02 continued			
Study ID	**Statistical methods**	**Independent variables**	**Findings**
(Stanaway et al., 2011)	Negative binomial regression	age group (years), marital status, living arrangements, social support satisfaction, years of education, occupation history, number of comorbidities, depressive symptoms, cognitive impairment, dementia, ADL disability, drink alcohol, medications, psychotropic medications, vision, dizziness, history of falls in past year, PASE score, timed chair stands, walking speed (metres/second), years in Australia (years) and language spoken at home	**Odds ratios and relative risks** Men born in Italy had half the risk of having two or more falls and half the incidence rate of falls compared with Australian-born men, Relative risk (95% CI) 0.52 (0.37, 0.71), Incidence rate ratio (95% CI) 0.51 (0.38, 0.67). In the multivariable analysis with fall history excluded, being born in Italy remained significantly associated with a reduced rate of falls (P = 0.006) with Italian-born men demonstrating a 43% lower incidence rate of falls (IRR =0.57, 95% CI: 0.39–0.85)
(Stanaway et al., 2019)	Cox regression	Age at baseline, social support satisfaction, occupation history, source of income, myocardial infarction history, stroke history, cancer history, diabetes diagnosis, depressive symptoms, cognitive status, dementia, ADL disability, IADL disability, walking speed, smoking never smoker, drinking, physical activity	**Hazard ratios** (Adjusted HR) of 0.67 [95% confidence interval (CI) 0.53–0.84]

Appendix G.02 continued			
Study ID	**Statistical methods**	**Independent variables**	**Findings**
(Stewart et al., 2004)	Indirect method	Not derived	Standardized incidence ratios of treated end-stage renal disease (ESRD) in overseas-born Australians (relative to the Australian-born, non-indigenous population) for renal disease (Hypertensive renal disease), age group and place of birth age group 45-64 years British Isles (0.7 (0.4–1.0)), Southern Europe (0.9 (0.6–1.2)), Rest of Europe (0.9 (0.5–1.4)), Middle East (3.3 (1.9–5.2)) and East and South Asia (1.1 (0.6–2.0)). ≥65 years British Isles (0.9 (0.7–1.1)), Southern Europe (0.9 (0.8–1.2)), Rest of Europe (1.0 (0.8–1.2)), Middle East (1.6 (1.0–2.5)), Indian sub-continent (2.0 (1.2–3.2)), East and South Asia (1.5 (1.0–2.0)) and Pacific Island nations (1.5 (1.0–2.0)). Compared with Australian-born, the incidence of ESRD due to hypertensive disease was higher in migrants from, the Middle East (45-64 years) and Indian sub-continent (>65 years). Standardized incidence ratios of treated end-stage renal disease (ESRD) in overseas-born Australians (relative to the Australian-born, non-indigenous population) for renal disease (All other known diagnoses), age group and place of birth age group 45-64 years British Isles (0.6 (0.5–0.7)), Southern Europe (0.7 (0.6–0.8)), Rest of Europe (0.6 (0.5–0.8)), Middle East (0.9 (0.6–1.3)), Indian sub-continent (0.8 (0.5–1.3)) East and South Asia(0.7 (0.5–0.9)). ≥65 years British Isles (0.5 (0.4–0.6)), Southern Europe (0.8 (0.6–0.9)), Rest of Europe (0.7 (0.6–0.9)), Middle East (1.2 (0.7–1.9)), Indian sub-continent (1.0 (0.5–1.7)), East and South Asia (0.6 (0.4–0.9))

Appendix G.02 continued			
Study ID	**Statistical methods**	**Independent variables**	**Findings**
(Straiton et al., 2014)	Chi-square analyses, one-way ANOVAs and Logistic regression	Age group, marital status, education, income, employment, living situation, general health & length of stay	**Odds ratio** Current depression Australian born men 45-54 years (reference ≥ 55 years) 1.27 (0.60-2.68) Foreign-born (0.77 (0.32-1.85)). Diagnosis Australian born men 45-54 years (reference ≥ 55 years) 0.64 (0.34-1.21) Foreign-born 0.53 (0.24-1.19). Current depression Australian born women 45-54 years (reference ≥ 55 years) 1.19 (0.65-2.18) Foreign-born 1.71 (0.76-3.89). Diagnosis Australian born women 45-54 years (reference ≥ 55 years) 1.53 (0.83-2.78), Foreign-born 2.43 (1.18-5.00)
(Toms et al., 2015)	Point-in-time analysis	Age, sex, state, country of birth,	**Crude rates** **(2012)** Non-indigenous Australian-born 45-54 years (0.4), overseas-born (12.0). For non-Indigenous Australian-born 55-64 years (0.7), overseas-born (10.6) and for non-indigenous Australian-born 65+ years (1.4), overseas-born (16.1). (**2013)** Non-Indigenous Australian-born 45-54 years (0.8), overseas-born (9.7), for non-Indigenous Australian-born 55-64 years (0.7), overseas-born (11.4) and for non-indigenous Australian-born 65+ years (1.8), overseas-born (12.7)
(Toms et al., 2017)	Not stated	Age, sex, duration of residence, country of birth	**Crude TB rates** Non-indigenous Australian-born 45-54 years (0.9), overseas-born (11.2), for non-Indigenous Australian-born 55-64 years (1.2), overseas-born (12.2) and for non-indigenous Australian-born 65+ years (3.8), Overseas-born (16.8)

Appendix G.02 continued			
Study ID	**Statistical methods**	**Independent variables**	**Findings**
(Tran et al., 2014)	Logistic regression	Gender (female), age (years), living with a partner, education, household income ($AUD), health insurance, family history of diabetes, BMI (kg/m2), vegetable intake, fruit intake, physical activity ≥5 sessions/week, diabetes type 2, high blood pressure, self-rated general health, self-rated quality of life and physical limitation SF36-PF	**Crude and age-adjusted prevalence** A total of 103 (13.1 %) Vietnam-born and 15,221 (7.7 %) Australia-born participants were classified as having T2D. The respective age-standardised prevalence of T2D was 14.7 % (95 % CI 12.0–17.4) and 7.4 % (95 % CI 7.3–7.5); SRR was 1.99 (95 % CI 1.66–2.39, p \ 0.001). The Vietnam-born group had lower rate of overweight and obesity (BMI ≥25.0, SRR 0.34, p \ 0.001), however, they were more likely to have limitations of physical functioning (e.g. severe limitation, SRR 1.92, p \ 0.001), psychological distress (e.g. high level of distress, SRR 2.41, p\0.001) and to rate their general health status and quality of life as poor or fair.

Appendix G.03 Additional information on Canadian studies included in the review

Study ID	Funding source	Female (%)	Study duration (years)	Response rate (%)
Aglipay et al 2013	Unknown	55.1	2007-2008	84.6
Chen et al 1996	Health Canada	not stated	1986 and 1991	For the death records in Quebec 9% in 1986 and 13% in 1991 were missing country of birth, while for the rest of Canada in 1986 less than 1% and 1% in 1991 were missing data for country of birth
(Chen et al., 2013)	Consumer Product Safety and Injury Prevention in Canada" Program	Non-migrants (52.8) and migrants (49.9)	2007–2008	74.20
(Gee et al., 2004)	Health Canada	Canadian-born females aged 45-64 years (50.6), migrant females aged 45-64 years who had lived in Australia for 0-9 years (47.9) and 10+ years (50.4). Canadian-born females aged +65 years (57.0). Migrant females aged +65 years who had lived in Australia for 0-9 years (55.5), 10+ years (53.9)	2000–2001	Not stated
(Greenaway et al. 2017)	Fonds de recherche du Québec-Santé	46.4 (migrants) and 31.7 (non-migrants)	January 1, 1998 and June 30, 2008	Not stated

Appendix G.03 continued				
Study ID	**Funding source**	**Female**	**Study ID**	**Funding source**
(Jensen et al., 2012)	Canadian Institute of Health Research and First Nations and Inuit Health Branch, Alberta Region. M Jensen and A Lau received Summer Studentship Awards from Alberta Innovates-Health Solutions	Not stated	(1989–1998 and 1999–2008)	Not stated
(Kliewer and Ward 1988)	Unknown	Not stated	1969-1973	Not stated
(Long et al., 2002)	Not stated	Not stated	1989-1998	Not stated
(Malenfant, 2004)	Unknown	Not stated	1991 and 1996	Not stated
(Naja et al., 2007)	National Cancer Institute and the National Institutes of Health	43.9	2007	Not stated
(Neutel et al., 1989)	Not stated	Not stated	1970-1973	Not stated
(Newbold & Danforth, 2003)	Canadian Institutes of Health Research	Not stated	1998/99	Not stated
(Newbold, K. B. & Filice, J. K. 2006)	Health Canada	48.1(migrants) and 46.4 (native-born)	2000/01	Not stated
(Prus et al., 2010)	Not stated	Not stated	2002–2003	Not stated

Appendix G.04 Extracted study findings (Canadian studies)

Study ID	Statistical outcomes calculated	Independent variables	Findings
(Aglipay et al 2013)	Odds ratios	Sex, race, total household income, education, marital status, and conversational ability and perceived life stress	**Odds ratio** Odds ratio for recent migrants compared to the Canadian-born population (0–9 years since migration) were 1.2 (0.52 -2.80). For longer-term migrants 10 or more years since migration 0.86 (0.70- 1.04). They were adjusted for sex, race, total household income, education, marital status and conversational ability and perceived life stress
(Chen et al 1996a)	Life expectancy	Age, sex and migrant status	**Mortality and life expectancy rates** Canadian-born males 14.6 for 1986 and 15.3 in 1991 for females 19.0 in 1986 and 19.7 in 1991, for European migrant males the life expectancy was 15.7 in 1986 and 16.2 in 1991, for females 19.7 (1986) and 19.9 in 1991 for Non-European migrant males the life expectancy was 17.3 in 1986 and 19.5 in 1991 for females 21.5 in 1986 and 23.8 in 1992. Migrants, particularly those from non-European countries, had higher age-specific survival probabilities than did the Canadian-born in 1991. For example, 41% of male and 57% of female non-European migrants could be expected to live to age 85; the corresponding proportions for the Canadian-born were 23% and 45%. While the overall patterns were similar, in 1991, migrants had lower mortality rates than did the Canadian-born population. Before age 70, mortality rates for the three birthplace groups generally ran parallel. However, at older ages, rates for the Canadian-born and European migrants converged. Disability-based health expectancy reveals that not only did migrants, on average, live longer than the Canadian-born, but also that a greater proportion of their life was without moderate or severe disability

Appendix G.04 continued			
Study ID	**Statistical outcomes calculated**	**Independent variables**	**Findings**
(Chen et al., 2013)	Cumulative incidence and odds ratio	Sex, age (years), education, income, smoking status, body mass index (kg/m2), alcohol drinking, physical activity, self-perceived health, mood disorder, anxiety disorder	**Adjusted odds ratio** Adjusted odds ratio for full injury associated with mood disorder for migrants 5.52 (2.13, 14.31) for non-migrants 1.33 (0.53, 3.35). Adjusted odds ratio for full injury associated with anxiety disorder for migrants 7.49 (2.30, 24.43) for non-migrants 0.48 (0.09, 2.63). Adjusted odds ratio for full injury associated with SHR (good) for migrants 1.39 (0.57, 3.41) for non-migrants 1.42 (0.75, 2.70). Adjusted odds ratio for full injury associated with SHR (fair) for migrants 1.11 (0.40, 3.08) for non-migrants 1.45 (0.69, 3.02).
(Gee et al., 2004)	odds ratio	Sex, age, marriage status, race, language, education, income, alcohol, smoke, fruit-vegetables	**Odds ratio** AR 45-64 years who had lived 0–9 years 0.489*(0.389, 0.615) odds for SHR 1.323*(1.077, 1.626) and mean HUI 0.891(0.878, 0.903. AR odds ratio for migrants who had lived 10+ 1.001 (0.921, 1.088). Odds for SHR 0.778* (0.717, 0.845), mean HUI 0.854 (0.850, 0.859), the comparison group was the Canadian-born, the mean HUI for the Canadian-born was 0.867 (0.865, 0.870). AR odds ratio for migrants aged 65 years or more who had lived 0–9 years 1.251 (0.946-1.656), odds for SHR 0.759 (0.575-1.001) and mean HUI 0.799 (0.766-0.831). AR odds ratio for migrants who had lived 10+ 1.084(1.001-1.175), odds for SHR 0.819 (0.755-0.899), mean HUI 0.765 (0.757-0.773), the comparison group was the Canadian-born, the mean HUI for the Canadian-born was 0.790 (0.786-0.795)

Appendix G.04 continued			
Study ID	**Statistical outcomes calculated**	**independent variables**	**Findings**
(Greenaway et al. 2017)	Rate ratios	Age, sex, residence area by public health region, immigration category, region of origin, mean time to diagnosis after arrival, co-morbidities prior to diagnosis	**Relative risk (RR)** Reported rate for migrants 50–59 age group 24.2 (21.5–26.8), non-migrants 28.5 (27.5–29.6), overall RR for migrants compared to non-migrants 0.85 (0.75–0.95). Reported rate for migrants 60–69 age group 19.6 (16.8–22.4), non-migrants 16.5 (15.5–17.5), overall RR for migrants compared to non-migrants 1.19 (1.02–1.38). Reported rate for migrants ≥ 70 age group 20.5 (17.7–23.4), non-migrants 17.1 (16.1–18.2), overall RR for migrants compared to non-migrants 1.20 (1.03–1.39)
(Kliewer and Ward 1988)	Suicide rates	Sex, age at death, birthplace, and cause of death	The relations between the age-specific rates for foreign-born and native-born were distinct for each sex. For younger males (ages 45-64 years), the suicide rates were higher in the native-born than in the foreign-born, whereas the reverse was true at older ages (65 years and older). After age 55 years the rates declined for native-born males while they continued to increase for migrant males. The crossover occurred at ages 65-69 years. Although the differences in rates were relatively large for elderly males, these were not significant because of the small number of deaths involved. rates in the foreign-born females were significantly different from the rates for native-born females, foreign-born females had higher rates than those of the native-born females. For male at age 60 the rate for suicide was 28/100000 for foreign born and 29/100000 for the Canadian-born. For Canadian and foreign born at 80 the rate was 20/100,000 for the Canadian-born while for the foreign born the rate was 30/100,000. For females at age 60 the rate for suicide was 12/100000 for Canadian and 14/100,000 foreign born at 80 the rate was 5/100,000 for the Canadian-born while for the foreign born the rate was 8/100,000

Appendix G.04 continued			
Study ID	**Statistical outcomes calculated**	**Independent variables**	**Findings**
(Jensen et al., 2012)	Incidence rates	Age, sex, year of study	**Crude TB rates** Older migrants had a greater rate for TB compared to the Canadian-born population. 10/100,000 for Canadian-born other1989-1998 and 2/100,000 for Canadian-born Other for foreign born 60/100,000 for FB 1989-1998 and 1999-2008, 50/100,000
(Long et al., 2002)	Age adjusted rates	Age, sex, year of study	**Crude TB rates** The foreign-born are at increased risk of TB compared to the Canadian-born population
(Naja et al., 2007)	prevalence, age-adjusted odds ratio	Age, marital status, place of birth, ethnicity, age of immigration, education, income, number of siblings, regular use of antacids, regular use of multivitamins, regular use of aspirin, regular use of acetaminophen, fruit intake, vegetable intake, red meat intake, smoking, number of cigarettes, alcohol intake, drinks/week & inflammatory bowel disease	**Odds ratios** H pylori odds for male migrants compared to the Canadian-born 2.2 (1.6–3.0) and female migrants 0.8 (0.5–1.3). Odds for males who migrated when they were <20 years, 1.6 (1.0–2.5) and ≥ 20 years 2.9 (1.9–4.2, compared to the Canadian-born
(Newbold, K. B. & Filice, J. K. 2006)	Odds ratio and mean HU13 scores	Age, sex, marital status, ethnicity, education, working status, income adequacy, smoking in the house, smoking status, drinking status, physical activity, immigrant model minus residency effects and home tenure	**Odds ratio** Odd for reporting self-rated health for migrants compared to the native-born population (0.022), odds for reporting chronic conditions for migrants compared to the native-born population (0.806). For HUI3 immigrants had a significantly lower HUI3 score than the native-born (0.626 (0.019=0.607)).

Appendix G.04 continued			
Study ID	**Statistical outcomes calculated**	**Independent variables**	**Findings**
(Malenfant, 2004)	Suicide rates	Age, sex and country of birth	**Suicide rates** Suicide rates per 100000 for migrants aged 45-54 in 1995-1997 (11.7*), Canadian-born (21.0). Suicide rates per 100000 for migrant males aged 45-54 (18.0*) and Canadian-born males (31.5), female migrants (5.3*) and for female Canadians (10.5). Suicide rates per 100000 for migrants aged 55-64 (11.7*), Canadian-born (15.7). Suicide rates per 100000 for migrant males aged 55-64 (15.6*) and Canadian-born males (25.5), female migrants (7.7) and for female Canadians (6.3). Suicide rates per 100000 for migrants aged 65-74 (12.7), Canadian-born (13.1). Suicide rates per 100000 for migrant males aged 65-74 (18.8*) and Canadian-born males (23.4), female migrants (7.3*) and for female Canadians (4.6). Suicide rates per 100000 for migrants aged 75+ (17.9), Canadian-born (14.0). Suicide rates per 100000 for migrant males aged 65-74 (32.9) and Canadian-born males (30.6), female migrants (7.7*) and for female Canadians (3.7). Suicide rates per 100000 for migrants aged 45-54 in 1990-1992 Crude (10.8), Canadian-born (18.2). Suicide rates per 100000 for migrant males aged 45-54 (14.8) and Canadian-born males (28.1), female migrants (6.7) and for female Canadians (8.3). Suicide rates per 100000 for migrants aged 55-64 (12.3), Canadian-born (16.1). Suicide rates per 100000 for migrant males aged 55-64 (19.2) and Canadian-born males (26.1), female migrants (5.1) and for female Canadians (6.6). Suicide rates per 100000 for migrants aged 65-74 (12.5), Canadian-born (13.7). Suicide rates per 100000 for migrant males aged 65-74 (17.1) and Canadian-born males (23.6), female migrants (8.5) and for female Canadians (5.6). Suicide rates per 100000 for migrants aged 75+ (20.9), Canadian-born (13.9). Suicide rates per 100000 for migrant males aged 65-74 (39.4) and Canadian-born males (30.1), female migrants (8.1) and for female Canadians (3.7).

Appendix G.04 continued			
Study ID	**Statistical outcomes calculated**	**Independent variables**	**Findings**
(Neutel et al., 1989)	Mortality rates	Age, sex and country of birth	Full finding indicated in Chapter (3) Systematic review
(Newbold & Danforth, 2003)	Odds ratios and mean	Age, sex, marital status, ethnicity, education, working status, income adequacy, smoking in house, smoking status, drinking status, physical activity, immigrant model minus residency effects and home tenure	**Odds ratios** HU13 means for participants in the age groups 50–64 years migrants (0.866 *) and non-migrants (0.873 *). HU13 means for participants in the age groups 65+ years migrants (0.762 *) and non-migrants (0.794 *). Logit of reporting poor/fair health for migrants (age groups) 50–64 year (0.390) and non-migrants (0.405*) compared to migrants and non-migrants aged 65 years. The two were not significantly different. Also, the differences in logit for HU13 were not significant for 50-64 years for migrants compared to non-migrants

Appendix G.04 continued			
Study ID	**Statistical outcomes calculated**	**Independent variables**	**Findings**
(Prus et al., 2010)	Odds ratio	Age in years, gender, marital status, educational level, income, smoking status, physical activity and health insurance	**Odds ratio** Compared to native-born whites, foreign-born Whites aged 45-64 years were more likely to report unfavourable health (1.23), while Foreign-born Non-Whites were less likely to report unfavourable health (0.72). Compared to Native-born whites, foreign-born Whites aged >65 years were less likely report unfavourable health (0.99), while Foreign-born Non-Whites were more likely to be report being unfavourable healthy (2.51*). The odds for reporting cognitive impairment were not significant and no differences existed between (=1) for native-born whites, foreign-born whites and foreign-born non-whites aged 45-64 years (not strongly associated). Compared to Native-born whites, foreign-born Whites aged >65 years were less likely report cognitive impairment (0.87), while Foreign-born Non-Whites had greater odds of cognitive impairment (2.12† at p<0.1).

Appendix H Regression model when including all variables (missing data)

	Wave 2 (n=18675) Unadjusted OR (CI)	Wave 3 Unadjusted OR (CI)	Wave 4 (n=10256) Unadjusted OR (CI)
Country of birth		All variables automatically excluded in model	
Migrants	1.111 (.996 to 1.240)		1.023 (.878 to 1.193)
Unknown nativity	.681 (.449 to 1.034)		.932 (.366 to 2.375)
Reference group (born in Australia)			
Age at the time of observation	.974 (.970 to .977*)		.952 (.914 to .991*)
Sex			
Female	Automatically deleted from model		Automatically deleted from model
Reference is males			
Partner status			
Divorced or separated	.676 (.590 to .775*)		.594 (.508 to .695*)
Widowed	.948 (.853 to 1.054)		.699 (.527 to .925*)
Never married	.689 (.554 to .856*)		.466 (.342 to .635*)
Reference group is married or de-facto			

Appendix H continued

	Wave 2 (n=18675) Unadjusted OR (CI)	Wave 3 Unadjusted OR (CI)	Wave 4 (n=10256) Unadjusted OR (CI)
Education attainment highest educational attainment 4 categories			
Primary or secondary education	1.936 (.806 to 4.651)		.000 (.000)
Non-tertiary	2.470 (1.022 to 5.965*)		.000 (.000)
Tertiary	2.976 (1.223 to 7.243*)		.000 (.000)
Reference is no formal education			
Language spoken at home			
Other	.475 (.398 to .567*)		.613 (.463 to .812*)
Reference is English			
Past chronic conditions			
1-5 Past chronic conditions	.359 (.326 to .396*)		.343 (.300 to .392*)
+ 6 chronic conditions	.110 (.091 to .131*)		.081 (.061 to .108*)
Reference is no past chronic conditions			

Appendix H continued

	Wave 2 (n=18675) Unadjusted OR (CI)	Wave 3 Unadjusted OR (CI)	Wave 4 (n=10256) Unadjusted OR (CI)
Current smoking status			
Former smoker	.749 (.684 to .820*)		.808 (.703 to .928*)
Current smoker	.576 (.506 to .655*)		.484 (.412 to .568*)
Reference is 'never smoker'			
Alcohol consumption: long-term risk factor group (NHMRC guidelines 2001)			
Low risk	1.602 (1.462 to 1.756*)		1.837 (1.589 to 2.124*)
Risky	1.840 (1.479 to 2.290*)		2.358 (1.746 to 3.185*)
High risk	1.519 (.888 to 2.596)		1.631 (.915 to 2.905)
Reference category 'non- drinker'			

N represents the sample included in analysis

* represents statistical significance

Appendix I Sensitivity analysis findings

Appendix I.01 Multivariable sensitivity analysis (all Australians)

	Wave 1 **Adjusted OR (CI)**	**Wave 2** **Adjusted OR (CI)**	**Wave 3** **Adjusted OR (CI)**	**Wave 4** **Adjusted OR (CI)**
Country of birth				
Migrants	1.002 (.924 to 1.088)	1.148 (1.048 to 1.257*)	1.096 (.964 to 1.247)	1.094 (.993 to 1.206)
Reference group (born in Australia)				
Age	.975 (.973 to .978*)	.961 (.958 to .964*)	.959 (.953 to .965*)	.962 (.959 to .966*)
Sex				
Female	1.247 (1.127 to 1.380*)	.871 (.761 to .997*)	.924 (.733 to 1.166)	.959 (.805 to 1.143)
Reference is males				
Partner status				
Divorced or separated	.734 (.658 to .819*)	.651 (.580 to .732*)	.586 (.506 to .679*)	.633 (.557 to .720*)
Widowed	.945 (.867 to 1.030)	.948 (.865 to 1.039)	1.024 (.838 to 1.253)	.874 (.795 to .962*)
Never married	.718 (.607 to .850*	.710 (.590 to .853*)	.568 (.439 to .735*)	.651 (.526 to .806*)
Reference group is married or de-facto				

Appendix I.01 continued				
	Wave 1 **Adjusted OR (CI)**	**Wave 2** **Adjusted OR (CI)**	**Wave 3** **Adjusted OR (CI)**	**Wave 4** **Adjusted OR (CI)**
Education attainment				
Primary or secondary education	1.353 (.843 to 2.172)	2.353 (1.267 to 4.368*)	2.613 (.864 to 7.900)	2.786 (1.356 to 5.722*)
Non-tertiary	1.792 (1.112 to 2.889*)	3.052 (1.637 to 5.690*)	3.279 (1.082 to 9.938*)	3.546 (1.719 to 7.313*)
Tertiary	2.454 (1.505 to 4.002*)	3.753 (1.997 to 7.054*)	4.275 (1.399 to 13.065*)	5.001 (2.404 to 10.405*)
Reference is no formal education				
Language spoken at home				
Other	.467 (.410 to .531*)	.476 (.409 to .553*)	.524 (.423 to .650*)	.543 (.460 to .640*)
Reference is English				
Past chronic conditions				
1-5 Past chronic conditions	.394 (.363 to .427*)	Not possible to include in the model	Not possible to include in the model	Not possible to include in the model
+ 6 chronic conditions	.137 (.121 to .154*)			
Reference is no past chronic conditions				

Appendix I.01 continued				
	Wave 1 **Adjusted OR (CI)**	**Wave 2** **Adjusted OR (CI)**	**Wave 3** **Adjusted OR (CI)**	**Wave 4** **Adjusted OR (CI)**
Current smoking status				
Former smoker	.793 (.738 to .853*)	.791 (.734 to .854*)	.885 (.790 to .992*)	Not possible to include in the model
Current smoker	.522 (.474 to .574*)	.597 (.533 to .668*)	.567 (.492 to .654*)	
Reference is 'never smoker'				
Alcohol consumption				
Low risk	1.597 (1.483 to 1.719*)	Not possible to include in the model	Not possible to include in the model	Not possible to include in the model
Risky	1.756 (1.461 to 2.111*)			
High risk	1.230 (.959 to 1.578)			
Reference category 'non- drinker'				

Appendix I 02 Multivariable sensitivity analysis (all migrants)

	Wave 1 Adjusted OR (CI)	Wave 2 Adjusted OR (CI)	Wave 3 Adjusted OR (CI)	Wave 4 Adjusted OR (CI)
Country of birth				
Migrants	.984 (.907 to 1.066)	1.115 (1.019 to 1.219*)	1.085 (.955 to 1.232)	1.079 (.981 to 1.188)
Reference group (born in Australia)				
Age	.975 (.973 to .978*)	.961 (.958 to .964*)	.959 (.953 to .966*)	.962 (.959 to .966*)
Sex				
Female	1.246 (1.126 to 1.379*)	.870 (.760 to .995)	.925 (.733 to 1.166)	.958 (.804 to 1.141)
Reference is males				
Partner status				
Divorced or separated	.734 (.658 to .819*)	.652 (.580 to .733*)	.586 (.506 to .679*)	.634 (.558 to .720*)
Widowed	.945 (.867 to 1.030)	.947 (.864 to 1.038)	1.024 (.837 to 1.252)	.874 (.795 to .961*)
Never married	.718 (.607 to .849*)	.709 (.589 to .852*)	.568 (.438 to .735*)	.651 (.525 to .806*)
Reference group is married or de-facto				

Appendix I.02 continued				
	Wave 1 **Adjusted OR (CI)**	**Wave 2** **Adjusted OR (CI)**	**Wave 3** **Adjusted OR (CI)**	**Wave 4** **Adjusted OR (CI)**
Education attainment				
Primary or secondary education	1.351 (.841 to 2.169)	2.348 (1.265 to 4.358*)	2.614 (.865 to 7.904)	2.784 (1.355 to 5.718*)
Non-tertiary	1.792 (1.112 to 2.888*)	3.055 (1.639 to 5.691*)	3.283 (1.083 to 9.951*)	3.547 (1.720 to 7.316*)
Tertiary	2.454 (1.505 to 4.001*)	3.756 (2.000 to 7.055*)	4.280 (1.400 to 13.079*)	5.003 (2.404 to 10.410*)
Reference is no formal education				
Language spoken at home				
Other	.473 (.416 to .538*)	.486 (.418 to .565*)	.528 (.426 to .655*)	.548 (.465 to .646*)
Reference is English				
Past chronic conditions				
1-5 Past chronic conditions	.394 (.363 to .427*)	Not possible to include in the model	Not possible to include in the model	Not possible to include in the model
+ 6 chronic conditions	.137 (.121 to .154*)			
Reference is no past chronic conditions				

Appendix I.02 continued				
	Wave 1 **Adjusted OR (CI)**	**Wave 2** **Adjusted OR (CI)**	**Wave 3** **Adjusted OR (CI)**	**Wave 4** **Adjusted OR (CI)**
Current smoking status				
Former smoker	.795 (.739 to .855*)	.793 (.736 to .856*)	.886 (.790 to .993*)	Not possible to include in the model
Current smoker	.523 (.475 to .575*)	.598 (.534 to .669*)	.568 (.493 to .654*)	
Reference is 'never smoker'				
Alcohol consumption				
Low risk	1.597 (1.483 to 1.720*)	Not possible to include in the model	Not possible to include in the model	Not possible to include in the model
Risky	1.755 (1.460 to 2.109*)			
High risk	1.229 (.958 to 1.576)			
Reference category 'non- drinker'				

Appendix J Years lived in Australia

	Inadequately described N (%)	Oceania and Antarctica N (%)	North-West Europe N (%)	Southern and Eastern Europe N (%)	North Africa and the Middle East N (%)	South-East Asia N (%)	North-East Asia N (%)	Southern and Central Asia N (%)	Americas N (%)	Sub-Saharan Africa (N%
Years lived in Australia (Mean (SD)	**39.2 (8.0)**	**30.6 (20.2)**	**37.8 (16.1)**	**38.2 (12.0)**	**30.9 (14.9)**	**20.5 (12.4)**	**20.3 (15.8)**	**26.1 (14.3)**	**31.2 (16.8)**	**27.0 (20.5)**
Decades lived in Australia										
0-9 years	0 (0.0)	22 (11.7%)	70 (3.2)	16 (2.6)	8 (12.5)	25 (16.3)	20 (33.9)	7 (8.0)	4 (5.6)	8 (11.8)
10-19 years	1 (0.6)	42 (22.3%)	200 (9.1)	45 (7.4)	6 (9.4)	58 (37.9)	18 (30.5)	28 (32.2)	13 (18.1)	22 (32.4)
20-29 years	19 (12.3)	47 (25.0%)	418 (19.0)	66 (10.9)	15 (23.4)	42 (27.5)	10 (16.9)	22 (25.3)	26 (36.1)	16 (23.5)
30-39 years	43 (27.9)	39 (20.7%)	645 (29.3)	183 (30.1)	21 (32.8)	14 (9.2)	4 (6.8)	15 (17.2)	17 (23.6)	15 (22.1)
40-49 years	88 (57.1)	15 (8.0%)	568 (25.8)	265 (43.7)	11 (17.2)	11 (7.2)	6 (10.2)	14 (16.1)	5 (6.9)	0 (0.0)

Appendix J continued

	Inadequately described N (%)	Oceania and Antarctica N (%)	North-West Europe N (%)	Southern and Eastern Europe N (%)	North Africa and the Middle East N (%)	South-East Asia N (%)	North-East Asia N (%)	Southern and Central Asia N (%)	Americas N (%)	Sub-Saharan Africa (N%
Decades lived in Australia										
50-59 years	0 (0.0)	0 (0.0%)	31 (1.4)	10 (1.6)	1 (1.6)	0 (0.0)	1 (1.7)	0 (0.0)	0 (0.0)	0 (0.0)
60-69 years	2 (1.3)	7 (3.7)	148 (6.7)	19 (3.1)	1 (1.6)	1 (0.7)	0 (0.0)	0 (0.0)	4 (5.6)	1 (1.5)
70-79 years	1 (0.6)	14 (7.4)	83 (3.8)	3 (0.5)	1 (1.6)	2 (1.3)	0 (0.0)	1 (1.1)	2 (2.8)	4 (5.9)
80-89 years	0 (0.0)	2 (1.1)	36 (1.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.4)	1 (1.5)
90-99 years	0 (0.0)	0 (0.0)	1 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0%)	1 (1.5)

Appendix K Complete cases included in the regression analysis

Number of complete cases included in the logistic regression analysis (when all variables are included)

	Wave 1 N (%)	Wave 2 N (%)	Wave 3 N (%)	Wave 4 N (%)
Included in analysis	-	18675 (51.3)	-	10256 (42.6)
Missing cases	-	17757 (48.7)	-	13843 (57.4)
Total	44415	36432	26321	24099

Appendix L Complete cases included in the regression analysis

Number of complete cases included in the logistic regression analysis (when some variables are excluded)

	Wave 1 N (%)	**Wave 2 (N%)**	**Wave (N%)**	**Wave 4 (N%)**
Multivariable analysis				
Included in analysis	29913 (67.7)	23995 (65.9)	12253 (46.6)	18176 (75.4)
Missing cases	14302 (32.3)	12437 (34.1)	14068 (53.4)	5923 (24.6)
Study population selected for analysis	44215	36432	26321	24099
Sensitivity analysis (all Australians)				
Included in analysis	29913 (67.7)			
Missing cases	14302 (32.3)			

Appendix M Mean age of Australian-born participants by language spoken at home

Language spoken at home	Country of birth	
	Born in Australia	Migrants
	age at time of observation Mean (SD)	age at time of observation Mean (SD)
English	60.5 (12.7)	60.5 (12.6)
Other	56.2 (12.7)	61.9 (12.3)

Appendix N Longitudinal analysis SPSS syntax

1. Univariate longitudinal analysis country of birth model

DATASET ACTIVATE DataSet1.

* Generalized Estimating Equations.

GENLIN srh_binary (REFERENCE=FIRST) BY COB_bin (ORDER=DESCENDING)

/MODEL COB_bin INTERCEPT=YES

DISTRIBUTION=BINOMIAL LINK=LOGIT

/CRITERIA METHOD=FISHER(1) SCALE=1 MAXITERATIONS=100 MAXSTEPHALVING=5 PCONVERGE=1E-006(ABSOLUTE)

SINGULAR=1E-012 ANALYSISTYPE=3(WALD) CILEVEL=95 LIKELIHOOD=FULL

/REPEATED SUBJECT=Did WITHINSUBJECT=wave SORT=YES CORRTYPE=INDEPENDENT ADJUSTCORR=YES COVB=ROBUST

MAXITERATIONS=100 PCONVERGE=1e-006(ABSOLUTE) UPDATECORR=1

/MISSING CLASSMISSING=EXCLUDE

/PRINT CPS DESCRIPTIVES MODELINFO FIT SUMMARY SOLUTION (EXPONENTIATED).

2. Univariate longitudinal analysis; duration of residence model

* Generalized Estimating Equations.

GENLIN srh_binary (REFERENCE=FIRST) BY Durationofresidence3 (ORDER=DESCENDING)

/MODEL Durationofresidence3 INTERCEPT=YES

DISTRIBUTION=BINOMIAL LINK=LOGIT

/CRITERIA METHOD=FISHER(1) SCALE=1 MAXITERATIONS=100 MAXSTEPHALVING=5 PCONVERGE=1E-006(ABSOLUTE)

SINGULAR=1E-012 ANALYSISTYPE=3(WALD) CILEVEL=95 LIKELIHOOD=FULL

/REPEATED SUBJECT=Did WITHINSUBJECT=wave SORT=YES CORRTYPE=INDEPENDENT ADJUSTCORR=YES COVB=ROBUST

MAXITERATIONS=100 PCONVERGE=1e-006(ABSOLUTE) UPDATECORR=1

/MISSING CLASSMISSING=EXCLUDE

/PRINT CPS DESCRIPTIVES MODELINFO FIT SUMMARY SOLUTION (EXPONENTIATED).

3. Multivariate analysis; region of birth model

DATASET ACTIVATE DataSet1.

* Generalized Estimating Equations.

```
GENLIN srh_binary (REFERENCE=FIRST) BY regionofbirth5 Agegroup sex partner_cat
edu_attain_cat4 language_first_bin smoking_status Alcohollong2 (ORDER=DESCENDING)
 /MODEL regionofbirth5 Agegroup sex partner_cat edu_attain_cat4 language_first_bin
smoking_status Alcohollong2 INTERCEPT=YES
 DISTRIBUTION=BINOMIAL LINK=LOGIT
 /CRITERIA METHOD=FISHER(1) SCALE=1 MAXITERATIONS=100 MAXSTEPHALVING=5
PCONVERGE=1E-006(ABSOLUTE)
   SINGULAR=1E-012 ANALYSISTYPE=3(WALD) CILEVEL=95 LIKELIHOOD=FULL
 /REPEATED SUBJECT=Did WITHINSUBJECT=wave SORT=YES CORRTYPE=INDEPENDENT
ADJUSTCORR=YES COVB=ROBUST
   MAXITERATIONS=100 PCONVERGE=1e-006(ABSOLUTE) UPDATECORR=1
 /MISSING CLASSMISSING=EXCLUDE
 /PRINT CPS DESCRIPTIVES MODELINFO FIT SUMMARY SOLUTION (EXPONENTIATED).
```

4. **Multivariate analysis: country of birth model**

```
* Generalized Estimating Equations.
GENLIN srh_binary (REFERENCE=FIRST) BY COB_bin Agegroup sex partner_cat edu_attain_cat4
   language_first_bin smoking_status Alcohollong2 (ORDER=DESCENDING)
 /MODEL COB_bin Agegroup sex partner_cat edu_attain_cat4 language_first_bin smoking_status
   Alcohollong2 INTERCEPT=YES
 DISTRIBUTION=BINOMIAL LINK=LOGIT
 /CRITERIA METHOD=FISHER(1) SCALE=1 MAXITERATIONS=100 MAXSTEPHALVING=5
PCONVERGE=1E-006(ABSOLUTE)
   SINGULAR=1E-012 ANALYSISTYPE=3(WALD) CILEVEL=95 LIKELIHOOD=FULL
 /REPEATED SUBJECT=Did WITHINSUBJECT=wave SORT=YES CORRTYPE=INDEPENDENT
ADJUSTCORR=YES COVB=ROBUST
   MAXITERATIONS=100 PCONVERGE=1e-006(ABSOLUTE) UPDATECORR=1
 /MISSING CLASSMISSING=EXCLUDE
 /PRINT CPS DESCRIPTIVES MODELINFO FIT SUMMARY SOLUTION (EXPONENTIATED).
```

5. **Multivariate analysis**; **country of birth*sex model**

```
* Generalized Estimating Equations.
GENLIN srh_binary (REFERENCE=FIRST) BY COB_bin Agegroup sex partner_cat edu_attain_cat4
    language_first_bin smoking_status Alcohollong2 (ORDER=DESCENDING)
  /MODEL COB_bin Agegroup sex partner_cat edu_attain_cat4 language_first_bin smoking_status
    Alcohollong2 COB_bin*sex INTERCEPT=YES
 DISTRIBUTION=BINOMIAL LINK=LOGIT
  /CRITERIA METHOD=FISHER(1) SCALE=1 MAXITERATIONS=100 MAXSTEPHALVING=5
PCONVERGE=1E-006(ABSOLUTE)
    SINGULAR=1E-012 ANALYSISTYPE=3(WALD) CILEVEL=95 LIKELIHOOD=FULL
  /REPEATED SUBJECT=Did WITHINSUBJECT=wave SORT=YES CORRTYPE=INDEPENDENT
ADJUSTCORR=YES COVB=ROBUST
    MAXITERATIONS=100 PCONVERGE=1e-006(ABSOLUTE) UPDATECORR=1
  /MISSING CLASSMISSING=EXCLUDE
  /PRINT CPS DESCRIPTIVES MODELINFO FIT SUMMARY SOLUTION (EXPONENTIATED).
```

Multivariate analysis; duration of residence model

```
* Generalized Estimating Equations.
GENLIN srh_binary (REFERENCE=FIRST) BY COB_dOR2 Agegroup sex partner_cat edu_attain_cat4
    language_first_bin smoking_status Alcohollong2 (ORDER=DESCENDING)
  /MODEL COB_dOR2 Agegroup sex partner_cat edu_attain_cat4 language_first_bin
smoking_status
    Alcohollong2 INTERCEPT=YES
 DISTRIBUTION=BINOMIAL LINK=LOGIT
  /CRITERIA METHOD=FISHER(1) SCALE=1 MAXITERATIONS=100 MAXSTEPHALVING=5
PCONVERGE=1E-006(ABSOLUTE)
    SINGULAR=1E-012 ANALYSISTYPE=3(WALD) CILEVEL=95 LIKELIHOOD=FULL
  /REPEATED SUBJECT=Did WITHINSUBJECT=wave SORT=YES CORRTYPE=INDEPENDENT
ADJUSTCORR=YES COVB=ROBUST
    MAXITERATIONS=100 PCONVERGE=1e-006(ABSOLUTE) UPDATECORR=1
  /MISSING CLASSMISSING=EXCLUDE
  /PRINT CPS DESCRIPTIVES MODELINFO FIT SUMMARY SOLUTION (EXPONENTIATED).
```

Appendix O Years lived in Australia sensitivity analyses

	Model 6a (Adjusted ORs)	P values	Model 6b (Adjusted ORs)	P values
Years lived in Australia				
0-9 years	n/a	n/a	1.315 (1.113 to 1.554)	.001
10-19 years	1.337 (1.030 to 1.737)	.029	1.156 (.868 to 1.540)	.322
20 years or more	1.313 (1.111 to 1.551)	.001	1.979 (1.280 to 3.059)	.002
Reference is born in Australia				
Age groups				
55-64 years	.719 (.630 to .820)	<0.05	.714 (.625 to .815)	<0.05
65-74 years	.582 (.500 to .676)	<0.05	.577 (.496 to .672)	<0.05
75-84 years	.329 (.275 to .394)	<0.05	.327 (.273 to .391)	<0.05
85 years or more	.205 (.144 to .292)	<0.05	.204 (.143 to .291)	<0.05
Reference is 45-54 years				
Sex				
Female	1.164 (1.036 to 1.307)	.010	1.164 (1.036 to 1.307)	.010
Reference is male				
Partner status				
Divorced or separated	.607 (.518 to .712)	<0.05	.608 (.518 to .713)	<0.05
Widowed	1.113 (.926 to 1.338)	.252	1.116 (.929 to 1.342)	.240
Never married	.633 (.491 to .816)	<0.05	.633 (.491 to .816)	<0.05
Reference is married or de-facto				
Education attainment				
Primary or secondary	2.306 (.775 to 6.862)	.133	2.380 (.797 to 7.108)	.120
Non-tertiary	3.376 (1.134 to 10.057)	.029	3.495 (1.169 to 10.446)	.025
Tertiary	5.203 (1.729 to 15.655)	.003	5.340 (1.769 to 16.124)	.003
Reference is no formal education				
First, native or preferred language				
Other	.470 (.384 to .575)	<0.05	.468 (.383 to .573)	<0.05
Reference is English				

Appendix N continued

	Model 6a (Adjusted ORs)	P values	Model 6b (Adjusted ORs)	P values
Current smoking status				
Former smoker	.669 (.594 to .755)	<0.05	.670 (.594 to .756)	<0.05
Current smoker	.549 (.470 to .641)	<0.05	.549 (.470 to .641)	<0.05
Reference is never smoker				
Alcohol consumption				
Low risk	2.253 (1.993 to 2.547)	<0.05	2.258 (1.997 to 2.552)	<0.05
Risky	2.063 (1.675 to 2.541)	<0.05	2.064 (1.675 to 2.542)	<0.05
Reference category 'non- drinker'				

Appendix P: Older migrants' distribution by years lived in Australia

	Region of birth				
	Born in Australia (N)	North West Europe (N)	Southern and Eastern Europe (N)	Asia (N)	Others (N)
Duration of residence					
Born in Australia	16944	0	0	0	0
20 or more years	0	2937	1153	375	674
19 or less years	0	327	172	403	291

Appendix Q: Older Asian migrants' specific country of birth

Older Asian migrants sample size by their age groups

	Age groups				
	45-54 years (N)	**55-64 years (N)**	**65-74 years (N)**	**75-84 years (N)**	**85 or more years (N)**
South-East Asia					
Burma (Myanmar)	2	0	1	0	0
Cambodia	3	1	1	0	0
Thailand	1	0	0	0	0
Vietnam	28	9	4	0	0
Indonesia	9	1	2	1	0
Malaysia	13	9	4	2	0
Philippines	19	6	2	1	0
Singapore	3	1	1	0	0
East Timor	2	2	2	1	0
North East Asia					
China (excludes SARs and Taiwan Province)	10	11	5	2	0
Hong Kong (SAR of China)	8	6	0	0	0
Taiwan	3	0	0	0	0
Japan	1	1	0	0	0
South Korea	0	0	2	0	0
Bangladesh	1	0	0	0	0
India	15	7	4	6	0
Pakistan	2	0	2	0	0
Sri Lanka	12	8	5	2	1
Afghanistan	1	0	1	0	0
Azerbaijan	1	0	0	0	0

Appendix R Education attainment by migrant's region of birth

	Region of birth				
	Born in Australia N %	North West Europe N %	Southern and Eastern Europe N %	Asia N %	Others N %
No formal education	5 (≤ 1)	0 (≤ 1)	10 (2.4)	6 (2.4)	3 (1.1)
Some or all of primary school	218 (5.1%)	29 (3.1)	107 (26.0)	13 (5.2)	12 (4.3)
Some or all of secondary school	1612 (38.1)	293 (31.6)	117 (28.4)	70 (28.2)	76 (27.0)
Non-tertiary study	1761 (41.6)	479 (51.7)	137 (33.3)	90 (36.3)	112 (39.9)
Tertiary study	529 (12.5)	111 (12.0)	39 (9.5)	63 (25.4)	70 (24.9)
No response	111 (2.6)	14 (1.5)	2 (≤ 1)	6 (2.4)	8 (2.8)

Abbreviations and acronyms

A

ABS Australian Bureau of Statistics

AIHW Australian Institute of Health and Welfare

ALSA Australian Longitudinal Study of Ageing

ALSWH Australian Longitudinal Study of Women's Health

AusDiab Australian Diabetes, Obesity and Lifestyle Study

B

BMES Blue Mountains Eye Study

BMI Body mass index

C

CALD Culturally and linguistically diverse

CASP Critical Appraisal Skills Programme tool

CES-D Centre for Epidemiological Studies- Depression

CHD Coronary heart disease

CI Confidence interval

CINAHL Cumulative Index to Nursing and Allied Health Literature

CLS Canberra Longitudinal Study

CSDH Conceptual social determinants of health framework

CVD Cardio-vascular diseases

D

DYNOPTA Dynamic analyses to optimise ageing

E

EMBASE Excerpta Medica database

ESB English speaking background

ESRC Economic and Social Research Council

ESRD End stage renal disease

G

GADS Goldberg Anxiety and Depression Scale
GEE Generalized estimating equations

H

HIE Healthy immigrant effect

HILDA Household, Income and Labour Dynamics in Australia

HR Hazard ratio

M

MCMIA Ministerial Council of Immigration and Multicultural Affairs

MEDLINE Medical Literature Analysis and Retrieval System Online

MELSHA Melbourne Longitudinal Study of Healthy Ageing

MER Mixed effects regression

MMSE Mini-Mental State Exam

N

NESB non-English speaking backgrounds

NNDSS National Notifiable Disease Surveillance System

NHMRC National Health and Medical Research Council

O

ORs odds ratios

P

PATH PATH Through Life Study

PTSD Post traumatic stress disorder

PROSPERO International Prospective Register of Systematic Reviews

R

RR relative risk

S

SAR of China Special administrative regions of China

SHR self-rated health

SOPS Sydney Older Person’s Study

T

TB Tuberculosis

T2D Type 2 Diabetes

U

UK United Kingdom

US United States

UN United Nations

USSR Union of Soviet Socialist Republics

V

VDD Vitamin D deficiency

W

WOS Web of Science
WHO World Health Organisation