ISSN 0970-0218

Jan-Mar 2017 / Vol 42 / Issue 1

Indian Journal *of* Community Medicine

Official Publication of Indian Association of Preventive and Social Medicine

www.ijcm.org.in

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Original Article

An Investigation to Identify Potential Risk Factors Associated with Common Chronic Diseases Among the Older Population in India

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ABSTRACT

Background: In India, chronic diseases are the leading cause of death and their prevalence has constantly increased over the last decade. **Objective:** This study aimed to identify risk factors associated with common chronic diseases among people aged 50 years and over in India. Materials and **Methods:** Data from Wave 1 of the 2007/2008 *Indian Study on Global Ageing and Adult Health* (SAGE) was used to investigate the association between lifestyle choices and chronic diseases using logistic regression. **Result:** The fully adjusted model showed that significant independent risk factors for angina included area of residence, being diagnosed with diabetes, chronic lung disease (CLD) [highest odds ratio (OR) 4.77, 95% confidence interval (CI): 2.95-7.70] and arthritis. For arthritis, risk factors included having underlying diabetes, CLD diagnosis, or angina (highest OR 2.32, 95% CI: 1.63-3.31). Risk factors associated with CLD included arthritis, angina (highest OR 4.76, 95% CI: 2.94-7.72), alcohol use, and tobacco use. Risk factors associated with diabetes included level of education, area of residence, socioeconomic status, angina (highest OR 3.59, 95% CI: 2.44-5.29), CLD, arthritis, stroke, and vegetable consumption. Finally, risk factors associated with stroke included diabetes and angina (highest OR 3.34, 95% CI: 1.72-6.50). The presence of any other comorbidity was significantly associated with all five chronic diseases studied. **Conclusion:** The results show that within the older population, the contribution of lifestyle risk factors to the common chronic diseases investigated in this study was limited. Our findings showed that the major health issue within the study population was multimorbidity.

Keywords: Chronic diseases, Elderly health, India

Introduction

Chronic diseases are progressive long-term health problems that a patient manages for more than 3 months.[1] Their prevalence has steadily increased in countries almost in parallel with increased industrialization and life expectancy.[1] The common chronic diseases reported in India primarily include angina, arthritis, chronic lung disease (CLD), diabetes, and stroke.[1]

The current situation of diabetes mellitus in India can be classed as an epidemic, as over 62 million people are diagnosed with the disease.[2] India topped the chart in

Access this article online

Quick Response Code:

Website: www.ijcm.org.in

DOI: 10.4103/0970-0218.199802

Cite this article as: Adaji EE, Ahankari AS, Myles PR. An investigation to identify potential risk factors associated with common chronic diseases among the older population in India. Indian J Community Med 2017;42:46-52.

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Received: 21-12-2015, **Accepted:** 01-08-2016

the year 2000 as the country with the highest prevalence of diabetes with 31.7 million cases at that time. If this trend is not controlled it is predicted that in the year 2030, diabetes may affect up to 79.4 million people in India.[3] Similarly, the prevalence of angina and chest pain is high in South Asians. However, the determinants of angina remain unclear,[4] i.e., whether it is a result of genetic makeup or lifestyle and environmental factors which may play a major role in the causation.[5]

The overall arthritis prevalence in India is estimated at 15% of the entire population, which is equivalent to 180 million people in the country;[6] however, little is known on the risk factors influencing the disease.[7] Identifying potential factors associated with arthritis could be an initial step in limiting the rising prevalence in India. According to Khan *et al.*[8] intracranial atherosclerosis disease, which could lead to stroke, in North American Caucasians accounts for 8-10% of the total recorded cases but it was found to be higher among South Asians (30-50%). The death from CLD in India is estimated to be the highest in the world[1] with a burden of over 64.7 deaths per 100,000 among men and women, causing about 556,000 deaths in India annually.[1]

This study was conducted in the older population as most chronic diseases are often diagnosed within that age group in India.[9] The study investigated the association between potential risk factors including various lifestyle exposures (tobacco, alcohol, diet, and physical activity), sociodemographic characteristics and common chronic diseases (arthritis, angina, stroke, diabetes, and CLD) in India among people aged 50 years and over.

Materials and Methods

This study used data from phase one of the multi-country *Studies on Global Ageing and Adult Health* (SAGE) conducted in India in 2007; the SAGE survey was a standardized, validated household, and individual survey.[10] A stratified multistage cluster sampling design was used for the survey. The study population comprised individuals aged 50 years and above. India has 28 states, 19 of which were included in the study, thus representing 96% of the entire national population.[10] A post stratification factor was calculated to adjust the data to conform more to the general population. There were 7,150 participants in this study. The study protocol was reviewed and approved by the University of Nottingham (UK) Division of Epidemiology and Public Health ethics subcommittee and no additional ethical approval was required for the project because this study involved a secondary analysis of a publically available anonymized dataset. Permission to use these data for secondary research was nevertheless obtained from the Institute of Population Sciences (IIPS), Mumbai.[11]

Logistic regression was used to investigate the association between lifestyle factors, sociodemographic factors, and chronic diseases. The multiple regression models adjusted for age, sex, socioeconomic status, and other risk factors previously reported in the literature for each disease of interest.[12-16] SAGE survey sampling weights were applied using the survey commands in Stata 13 in order to achieve a nationally representative sample, which takes into account the unequal probability of sample selection as a result of nonresponse, survey design, and areas not covered.

Results

The study population comprised 7,150 participants aged 50 years and above (n = 7,150), with nearly 95% of the population aged between 50 and 70 years [Table 1]. Sex was approximately evenly split within the population (50.7% males). Over 50% of the sample had no formal education; only 14% had qualifications above high school. Lifestyle exposures varied within the study population. Tobacco use among the study participants was high with 48% of the participants having consumed tobacco in their lifetime. And 14% drank alcohol, 29% engaged in physical activities, 64% consumed fruits regularly; while 98% ate vegetables regularly. Chronic disease prevalence in this population is summarized in [Table 1]: arthritis (17.90%), angina (4.91%), stroke (2.24%), chronic lung disorder (4.07%), and diabetes (7.29%).

Tables 2 to 4 summarize the unadjusted and adjusted results for the various chronic diseases. Risk factors significantly associated with angina after adjustment included age, sex, residence, diabetes, CLD, arthritis, and comorbidities [Tables 2]. There was a 2% increase in the risk of developing angina for every year increase in age (OR 1.02, 95% CI: 0.99-1.03). Women were 40% less likely to develop angina compared with men (OR 0.60, 95% CI: 0.45-0.80). People residing in rural areas were 46% less likely to develop angina compared with residents in urban areas (OR 0.54, 95% CI: 0.32-0.91). In general having any comorbidity increased the risk of angina 3.73 times as compared with the absence of any comorbidity (OR 3.73, 95% CI: 2.80-4.98).

Age, sex, diabetes, angina, CLD, and comorbidities were associated with the risk of arthritis as shown in [Table 3]. There was a 1% increase in the risk of arthritis for every year increase in age (OR 1.01, 95% CI: 1.00-1.02). The results suggested that women were 47% more likely to develop arthritis as compared with men (OR 1.47, 95% CI: 1.21-1.80). In addition, having diabetes (OR 2.19, 95% CI: 1.47-3.27), CLD (OR 2.06, 95% CI: 1.42-2.99) or angina (OR 2.32, 95% CI: 1.63-3.31) doubled the risk of arthritis. Also having any comorbidity more than doubled the risk of arthritis in an individual (OR 2.26, 95% CI: 1.75-2.92).

For CLD, significant risk factors included age, sex, arthritis, angina, diabetes, and comorbidity. There was a 2% increase in the risk of CLD for every year increase in age (OR 1.02, 95% CI: 1.00-1.04) and women were 59% less likely to develop the disease compared with men (OR 0.41, 95% CI: 0.31-0.54). Alcohol use more than doubled the risk of developing CLD (OR 2.18, 95% CI: 1.11-4.26). Tobacco use was significantly associated with CLD (OR 1.86, 95% CI: 1.38-2.51). Having arthritis almost doubled an individual's risk of developing CLD compared with not having arthritis (OR 1.95, 95% CI: 1.35-2.82). Patients who were diagnosed with angina were nearly five times more likely to have CLD than people who did not have angina (OR 4.76, 95% CI: 2.94-6.72). Finally, having any comorbidity almost tripled the risk of CLD (OR 2.73, 95% CI: 1.61-4.65).

Women and residents of rural areas were both less likely to have diabetes, with ORs of 0.67 (95% CI: 0.52-0.85) and 0.40 (95% CI: 0.30-0.54) respectively. People were 21% more likely to have diabetes for every level of education obtained compared with people with no formal education ($P < 0.001$). People were 25% more likely to develop diabetes as their socioeconomic status improved compared with people at the lowest social class ($P < 0.001$). Higher vegetable consumption was associated with an increased risk of diabetes in individuals by 23% for every unit increase in vegetable consumed (OR 1.23, 95% CI: 1.12-1.34). Having angina more than tripled the risk of diabetes (OR 3.59, 95% CI: 2.44-5.29). Tobacco use was associated with a 40% reduction of diabetes (OR 0.60, 95% CI: 0.44-0.82). Also, people with CLD and arthritis had twice the risk of diabetes as compared with those without these diseases [(OR 2.40, 95% CI: 1.02-5.64) and (OR 2.10, 95% CI: 1.39-3.16) respectively]. Finally, having any comorbidity almost tripled the risk of having diabetes (OR 2.69, 95% CI: 1.79-4.04).

There was a 3% increase in stroke for every year increase in age (OR 1.03, 95% CI: 1.00-1.05). Women were 22% less likely to have stroke (OR 0.78, 95% CI: 0.46-1.30) [Table 3]. Patients with diabetes were 74% more likely to experience a stroke (OR 1.74, 95% CI: 1.16-2.61) and those with angina were about three times more likely to have a stroke (OR 3.34, 95% CI: 1.72-6.50).

Table 1: Summary characteristics of the study sample, World Health Organization Study on Global Ageing and Adult Health, India, 2007 (n = 7,150).

Characteristics	Number	%
Age (years)		
50--59	3,182	44.50
60--69	2,448	34.24
≥70	1,520	21.26
Sex		
Male	3,623	50.67
Female	3,527	49.33
Socioeconomic status		
Lowest	1,312	20.00
Low	1,312	20.00
Middle	1,313	20.02
Richer	1,311	19.98
Richest	1,312	20.00
Residence		
Urban	1,861	26.03
Rural	5,289	73.97
Education (Completed)		
No formal education	3,635	50.84
Less than primary	815	11.40
Primary	979	13.69
Secondary	706	9.87
High school	645	9.02
College/university	258	3.61
Postgraduate (PG) Degree	111	1.55
Disease		
Arthritis	1174	17.90
Angina	322	4.91
Chronic lung disease	267	4.07
Diabetes	478	7.29
Stroke	147	2.24

Discussion

In summary, the fully adjusted models [Table 3] showed that significant independent risk factors for angina included residence, diabetes, CLD, and arthritis. Risk factors associated with arthritis included diabetes, CLD, and angina. Risk factors associated with CLD were arthritis and angina, with tobacco use showing an apparent protective effect. Risk factors associated with diabetes included level of education, area of residence, socioeconomic status, angina, CLD, arthritis and vegetable consumption. Finally risk factors associated with stroke included diabetes and angina. In addition, the presence of any chronic comorbidity significantly increased the likelihood of all five chronic diseases [Table 4], thus demonstrating the importance of multimorbidity in this population.

Our findings that individuals living in rural areas were less likely to have angina is in agreement with other studies in India.[17,18] However, another study[4] reported angina to be common in rural dwellers (adjusted OR 2.82, 95% CI: 1.68-4.73). This inconsistency might be due to the sampling variation and differences in study design and analysis. Having a diagnosis of any other chronic disease, however, increased the risk of developing arthritis.[12,14,19] Other studies have similarly found that individuals with CLD are more likely to have other comorbidities.[19,20] Our study also supported findings from other studies that tobacco users were almost twice as likely to have CLD (OR 1.86, 95% CI: 1.38-2.51).[21-25]

Our results show that educational level was associated with a significantly increased risk of developing diabetes, which was in contrast to those reported by Choi *et al.* and Borrell *et al.* in study populations from America.[26,27] The difference in results between these studies and the current study could be the difference in age-groups studied as other studies included adults aged 18 years and older. It could also be that there is an increased tendency for the well-educated older population in India to be more successful; hence, the affordability of high-sugar high-calorific diets is also increased among this group.[28] It is also possible that better educated individuals are more proactive in seeking health care and therefore more likely to be diagnosed with chronic diseases like diabetes.[29] Residents who lived in rural cities were 60% less likely to develop diabetes compared with residents in urban cities (OR 0.40), which was consistent with the findings of Kapoor *et al.*[30] in India, that the prevalence of diabetes was higher among urban dwellers compared with rural dwellers. Similarly, Phaswana-Mafuya's study from South Africa[14] reported that greater wealth and residing in urban areas increased the risk of a chronic disease, which was consistent with the results obtained in our analysis. On the contrary, a French study between January 2003 and December 2006[31]showed that the risk of diabetes increases linearly with increase in deprivation level, which opposes the result of the current study, which found that for every level increase in wealth there is a 25% increase in the risk of developing diabetes compared with individuals in the lowest wealth quintile ($P < 0.001$). The epidemiological transition theory proposed

Table 2: Risk factors for chronic disease: unadjusted analysis

Risk factor	Chronic disease (unadjusted OR, 95% CI)				
	Angina	Arthritis	Diabetes	Chronic Lung Disease	Stroke
Age (in years)	1.02 (1.01--1.03)	1.02 (1.01--1.03)	1.02 (1.01--1.03)	1.01 (1.00--1.03)	1.03 (1.01--1.05)
Sex					
• Male	1	1	1	1	1
• Female	[750.] (0.60--0.94)	[371.] (1.2--1.55)	[840.] (0.70--1.01)	[470.] (0.36--0.61)	[640.] (0.46--0.90)
Education (Completed)					
• No formal education	1	1	1	1	1
• Less than primary	[062.] (1.49--2.85)	[321.] (1.09--1.59)	[691.] (1.21--2.36)	[990.] (0.65--1.49)	[690.] (0.35--1.35)
• Primary	[521.] (1.09--2.12)	[041.] (0.86--1.26)	[582.] (1.96--3.40)	[161.] (0.81--1.66)	[931.] (1.26--2.96)
• Secondary	[671.] (1.15--2.42)	[880.] (0.70--1.11)	[103.] (2.31--4.17)	[561.] (1.08--2.26)	[321.] (0.76--2.31)
• High school	[511.] (1.01--2.26)	[730.] (0.57--0.95)	[013.] (2.20--4.11)	[960.] (0.60--1.54)	[321.] (0.74--2.38)
• College/university	[481.] (0.80--2.71)	[161.] (0.83--1.62)	[795.] (3.99--8.40)	[690.] (0.30--1.58)	[941.] (0.92--4.09)
• Postgraduate degree	[922.] (1.48--5.74)	[460.] (0.23--0.91)	[245.] (3.06--8.98)	[051.] (0.38--2.90)	[772.] (1.09--7.04)
Residence					
• Urban	1	1	1	1	1
• Rural	[610.] (0.48--0.78)	[930.] (0.81--1.07)	[300.] (0.25--0.37)	[341.] (0.99--1.82)	[720.] (0.51--1.02)
Socioeconomic status					
• Poorest	1	1	1	1	1
• Poor	[041.] (0.70--1.56)	[051.] (0.86--1.28)	[421.] (0.91--2.20)	[920.] (0.64--1.32)	[032.] (1.15--3.59)
• Middle	[261.] (0.86--1.86)	[980.] (0.81--1.20	[982.] (2.00--4.41)	[810.] (0.56--1.17)	[681.] (0.93--3.03)
• Richer	[691.] (1.17--2.44)	[091.] (0.90--1.33)	[883.] (2.65--5.69)	[630.] (0.42--0.93)	[571.] (0.86--2.85)
• Richest	[851.] (1.29--2.65)	[940.] (0.77--1.15)	[435.] (3.74--7.88)	[670.] (0.46--0.99)	[092.] (1.18--3.68)
Stroke	2.82 (1.72--4.65)	2.32 (1.83--2.95)	3.65 (2.73--4.86)	4.54 (3.23--6.37)	-
Diabetes	3.65 (2.73--4.86)	1.68 (1.38--2.05)	-	1.66 (1.18--2.32)	1.70 (1.19--2.44)
Chronic lung disease	4.54 (3.23--6.37)	1.60 (1.28--2.00)	1.59 (1.07--2.36)	1.69 (1.23--2.33)	-
Arthritis	2.63 (2.08--3.35)	-	1.83 (1.48--2.25)	1.75 (1.33--2.29)	1.28 (0.99--1.66)
Angina	-	2.32 (1.83--2.94)	3.65 (2.73--4.86)	4.54 (3.23--6.37)	2.82 (1.72--4.65)
Fruit consumption	1.24 (1.14--1.36)	1.16 (1.11--1.22)	1.31 (1.22--1.41)	0.89 (0.84--0.95)	0.97 (0.88--1.07)
Physical activity	[700.] (0.54--0.90)	[770.] (0.67--0.88)	[500.] (0.39--0.63)	[900.] (0.69--1.17)	[560.] (0.38--0.84)
Tobacco use	[001.] (0.80--1.26)	[890.] (0.79--1.01)	[750.] (0.63--0.91)	[132.] (1.63--2.78)	[121.] (0.81--1.56)
Alcohol use	[201.] (0.90--1.61)	[980.] (0.83--1.17)	[221.] (0.96--1.55)	[951.] (1.47--2.59)	[980.] (0.62--1.53)
Vegetable consumption	1.07 (0.96--1.18)	0.96 (0.90--1.02)	1.18 (1.09--1.28)	0.93 (0.82--1.05)	1.06 (0.92--1.23)

*Statistically significant results are highlighted in bold. CI = Confidence interval, OR = Odds ratio

by Omran might explain the contrasting findings related to socioeconomic status and diabetes risk[32]

Patients with diabetes were 41% more likely to experience a stroke compared with individuals without diabetes (OR 1.41); this was a statistically significant association and is consistent with the findings of Kim *et al*.[33] and the National Stroke Association (2013).[34] We observed a nonsignificant increased risk of stroke in patients with angina (OR 2.27). Finally, in keeping with other studies, we found that having a pre-existing chronic disease increases the risk of developing other chronic diseases.[12,14,19] Your findings are consistent with other SAGE wave 1 studies in different countries; these studies are directly comparable because of similar sampling approaches and standardized data collection/coding protocols. Wu *et al*.[16] identified daily tobacco use, high alcohol consumption, low levels of exercise, and insufficient vegetable and fruit intake as common risk factors for chronic diseases as outlined earlier in this study. A study in South Africa[14] also reported higher incidence of chronic disease among older age group.

India is a developing country currently going through an epidemiological transition, which includes economic growth, better health care, and better nutrition.[35] As a result, there has been a reduction in infectious disease prevalence and an overall increase in life expectancy within the Indian population.[35] However, there has been a corresponding rapid increase in chronic disease cases.[35] The results from this study show that multimorbidity due to chronic diseases is becoming a growing problem within the older age group in India.

Table 3: Risk factors for chronic disease: adjusted analysis (Model 1)

Risk factor	Chronic disease (adjusted OR, 95% CI)				
	Angina	Arthritis	Diabetes	Chronic Lung Disease	Stroke
Age (in years)	1.02 (1.00--1.04)	1.01 (1.01--1.02)	1.00 (0.98--1.03)	1.02 (1.00--1.04)	1.03 (1.00--1.05)
Sex					
• Male	1	1	1	1	1
• Female	[600.] (0.45--0.80)	[471.] (1.21--1.80)	[670.] (0.52--0.85)	[410.] (0.31--0.54)	[780.] (0.46--1.30)
Education (Completed)					
• No formal education	1	1	1	1	1
• Less than primary	[841.] (1.19--2.85)	[281.] (0.93-1.77)	[271.] (0.69-2.34)	[940.] (0.50-1.76)	[480.] (0.20-1.15)
• Primary	[491.] (0.95--2.33)	[101.] (0.84-1.44)	[801.] (1.11-2.91)	[101.] (0.71-1.70)	[361.] (0.75-2.46)
• Secondary	[551.] (0.90--2.67)	[880.] (0.60-1.29)	[403.] (2.12-5.43)	[251.] (0.78-2.00)	[031.] (0.42-2.49)
• High school	[271.] (0.69--2.33)	[191.] (0.73-1.96)	[813.] (2.26-6.41)	[151.] (0.60-2.20)	[441.] (0.66-3.12)
• College/university	[082.] (0.53--8.13)	[351.] (0.74-2.47)	[136.] (3.48-10.8)	[480.] (0.18-1.27)	[131.] (0.30-4.24)
• Postgraduate degree	[342.] (1.01--5.46)	[380.] (0.15-1.01)	[156.] (2.85-13.3)	[770.] (0.29-2.10)	[711.] (0.50-5.87)
Residence					
• Urban	1	1	1	1	1
• Rural	[540.] (0.32--0.91)	[021.] (0.75-1.37)	[400.] (0.30-0.54)	[041.] (0.39-2.78)	[690.] (0.44-1.08)
Socio-economic status					
• Poorest	1	1	1	1	1
• Poor	[111.] (0.50--2.45)	[211.] (0.93--1.56)	[232.] (1.05--4.74)	[920.] (0.60--1.39)	[871.] (0.73--4.82)
• Middle	[591.] (0.78--3.23)	[940.] (0.66--1.32)	[322.] (1.32--4.07)	[141.] (0.77--1.70)	[272.] (0.85--6.11)
• Richer	[471.] (0.88--2.43)	[101.] (0.80--1.49)	[683.] (2.11--6.42)	[600.] (0.34--1.04)	[191.] (0.46--3.06)
• Richest	[122.] (1.01--4.44)	[930.] (0.68--1.27)	[915.] (3.38--10.4)	[870.] (0.58--1.31)	[432.] (0.99--6.00)
Stroke	2.27 (0.75--6.85)	1.21 (0.90--1.64)	1.41 (1.01--1.97)	1.26 (0.82--1.93)	-
Diabetes	3.60 (2.45--5.29)	2.19 (1.47--3.27)	-	2.42 (1.02--5.70)	1.74 (1.16--2.61)
Angina	-	2.32 (1.63--3.31)	3.59 (2.44--5.29)	4.76 (2.94--7.72)	3.34 (1.72--6.50)
Chronic lung disease	4.77 (2.95--7.70)	2.06 (1.42--2.99)	2.40 (1.02--5.64)	-	1.43 (0.90--2.29)
Arthritis	2.21 (1.53--3.17)	-	2.10 (1.39--3.16)	1.95 (1.35--2.82)	1.40 (0.98--2.01)
Fruit consumption	1.03 (0.83--1.28)	1.07 (0.91--1.27)	0.97 (0.80--1.19)	0.96 (0.83--1.04)	0.96 (0.82--1.13)
Vegetable consumption	0.99 (0.85--1.15)	1.01 (0.91--1.12)	1.23 (1.12--1.34)	0.91 (0.80--1.02)	0.87 (0.52--1.45)
Physical activity	[780.] (0.48--1.26)	[990.] (0.80--1.23)	[760.] (0.50--1.16)	[880.] (0.63--1.21)	[640.] (0.38--1.06)
Alcohol use	[141.] (0.75--1.72)	[151.] (0.87--1.53)	[021.] (0.64--1.61)	[182.] (1.11--4.26)	[750.] (0.34--1.65)
Tobacco use	[830.] (0.60--1.14)	[960.] (0.79--1.17)	[600.] (0.44--0.82)	[861.] (1.38--2.51)	[830.] (0.51--1.37)

*Statistically significant results are highlighted in bold. CI = Confidence interval, OR = Odds ratio Model 1: Adjusted for all other covariates listed in column 1 including other individual chronic diseases.

Our study has a number of strengths. To our knowledge, this study is the first detailed analysis conducted to identify risk factors associated with chronic diseases in India. Furthermore, the SAGE wave 1 dataset had more than 7,000 people with each of the analyses including a minimum of 5,000 people. While a formal *a priori* sample size calculation was not carried out as this was secondary research, it is reasonable to assume that this study was adequately powered. Moreover, the survey sampling strategy and subsequent statistical analysis ensured that the study findings are generalizable to the older population across India. However, generalizability over time would be questionable because the World Health Organization SAGE phase 1 survey was conducted in older people who may have had a very different lifestyle to the current older Indian population.[36] The entry of the Global Multinational Corporations into India and population wide exposure to western cultural/lifestyle factors occurred in the early-mid 90s.[36] This may explain why lifestyle factors in this study were not significantly associated with common chronic disease of interest as the study population may have been largely unaffected by these newer cultural influences.

However, first, a few limitations exist; data on chronic diseases were based on self-reports, which may have introduced ascertainment or recall bias. In addition, response bias may have affected the data on tobacco and alcohol use, diet and physical activity because of participants' attempts to provide socially desirable responses. Second, our analyses are based on the SAGE phase 1 data that were collected at a single time point (year 2007/2008), thereby limiting the opportunity to investigate changes and trends in the population over time. Importantly, no causal inferences could be made from these data because they were gathered as part of a cross-sectional survey.

Conclusion

Our study shows that within the older population, risk factors associated with lifestyle only partially explain the increased prevalence of the chronic conditions explored in this study. Our findings showed that the major health issue within the study population was multimorbidity. Public health interventions should integrate early diagnosis and management programs for chronic diseases as a whole, rather than advocating policies that focus exclusively on one disease. Moreover, public health should target patients early at a younger age, because if chronic diseases are not contained it could increase the patient's risk of multimorbidity at

Table 4: Risk factors for chronic disease: adjusted analysis (Model 2)

Risk factor	Chronic disease (adjusted OR, 95% CI)				
	Angina	Arthritis	Diabetes	Chronic lung disease	Stroke
Age (in years)	1.02 (0.99--1.04)	1.01 (1.00-1.02)	1.01 (0.99-1.03)	1.02 (1.00-1.04)	1.03 (1.00-1.05)
Sex					
• Male	1	1	1	1	1
• Female	[570.] (0.42--0.78)	[651.] (1.34-2.03)	[890.] (0.64-1.24)	[410.] (0.29-0.57)	[750.] (0.44-1.25)
Education (Completed)					
• No formal education	1	1	1	1	1
• Less than primary	[491.] (0.96--2.32)	[351.] (0.98-1.87)	[920.] (0.49-1.74)	[910.] (0.55-1.50)	[390.] (0.16-1.00)
• Primary	[171.] (0.71--1.91)	[121.] (0.83-1.52)	[251.] (0.75-2.08)	[091.] (0.70-1.70)	[131.] (0.61-2.10)
• Secondary	[051.] (0.58--1.91)	[880.] (0.58-1.31)	[122.] (1.28-3.54)	[261.] (0.70-2.28)	[790.] (0.34-1.81)
• High school	[760.] (0.35--1.66)	[241.] (0.73-2.12)	[012.] (1.17-3.45)	[171.] (0.67-2.06)	[011.] (0.44-2.29)
• College/university	[021.] (0.34--3.12)	[431.] (0.74-2.76)	[522.] (1.13-5.66)	[440.] (0.13-1.47)	[650.] (0.19-2.26)
• Postgraduate degree	[311.] (0.48--3.04)	[410.] (0.16-1.10)	[932.] (1.28-6.72)	[870.] (0.27-2.78)	[111.] (0.28-4.40)
Residence					
• Urban	1	1	1	1	1
• Rural	[620.] (0.33--1.14)	[071.] (0.73-1.55)	[570.] (0.42-0.78)	[051.] (0.40-2.73)	[740.] (0.46-1.20)
Socio-economic status					
• Poorest	1	1	1	1	1
• Poor	[041.] (0.47--2.31)	[171.] (0.91--1.50)	[951.] (1.00-3.84)	[880.] (0.58--1.34)	[861.] (0.73--4.74)
• Middle	[391.] (0.74--2.61)	[860.] (0.59--1.26)	[811.] (0.99--3.29)	[091.] (0.70--1.69)	[232.] (0.85--5.82)
• Richer	[231.] (0.74--2.05)	[031.] (0.74--1.43)	[652.] (1.52--4.61)	[540.] (0.28--1.07)	[101.] (0.44--2.78)
• Richest	[661.] (0.76--3.62)	[820.] (0.59--1.15)	[113.] (1.63--5.95)	[830.] (0.51--1.33)	[172.] (0.90--5.23)
Comorbidities	3.73 (2.80--4.98)	2.26 (1.75--2.92)	2.69 (1.79--4.04)	2.73 (1.61--4.65)	1.77 (1.12--2.80)

*Statistically significant results are highlighted in bold. CI = Confidence interval, OR = Odds ratio Model 2: Each variable adjusted for all other variables in the first column; the variable comorbidity indicates the presence of any other chronic comorbidity

older age. Given our results, future research should seek to understand the variations that exist in social and health care circumstances in relation to health behavior practices. Finally, future studies should include a clinical assessment and confirmation of chronic disease rather than relying on self-reports.

Financial support and sponsorship
Nil

Conflicts of interest
There are no conflicts of interest.

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