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SELF-FEEDING DEPENDENCE INCIDENCE AND PREDICTORS AMONG NURSING HOME RESIDENTS: FINDINGS FROM A 5-YEAR RETROSPECTIVE REGIONAL STUDY

Alvisa Palese MNS, RN¹, Luca Grasseti PhD¹, Ranieri Zuttion MNS, RN², Barbara Ferrario MNS², Sandra Ponta MNS, RN², Illarj Achil, MNS, RN¹, Mark Hayter PhD, BA, RN, MSc, FAAN³, Roger Watson PhD BSc FRCP Edin FAAN³

¹Department of Medical Science, University of Udine, Udine, Italy

²Welfare Unit, Azienda per i Servizi Sanitari n. 2, Palmanova, Udine, Italy

³Faculty of Health Sciences, University of Hull, Hull, UK

Corresponding Author: Alvisa Palese, Associate Professor in Nursing Science, Udine University, Viale Ungheria 20, 33100 Udine, Italy, + 39(0)432 590926; alvisa.palese@uniud.it

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Abstract

This regionally-based retrospective study aimed at describing the incidence of self-feeding dependence and predictors among elderly admitted from 2008 to 2013 in 105 Italian Nursing Homes (NHs). Data reported in a regional database collected at the time of NH admission and every six months up to the resident's death was accessed. The self-feeding degree of dependence was the dependent variable; at the individual and at the NH levels, explanatory variables were those collected at NH admission and every six months and recorded in the database. The Structural Equation Model and the ordinal polynomial logit regression analysis were performed. A total of 13,175 records of residents when admitted to the NH, and their following 69,341 records as collected in the 6-monthly assessments, were included. At the time of NH admission, 6,496 residents (49.3%) reported a certain degree of dependence in self-feeding and showed a slight worsening in their dependence every six months. At the individual level, the increased functional dependence raised the proportional odds ratios of approximately 4.36 times of an increased dependence in self-feeding; the degree of cognitive impairment, the lack of social interactions, the occurrence of pressure sores, co-morbidities, as well as the clinical instability and time **all** raised the risk of self-feeding dependence progression. At the NH level, an increased number of beds has emerged as a factor also increasing the proportional odds of dependence in self-feeding. Factors affecting self-feeding dependence are multifaceted at the individual and at the NH **levels**. Therefore, **multicomponent** strategies targeting **all** modifiable factors are suggested.

Key words: self-feeding, **eating**, dependence, nursing home, elderly, predictors, **retrospective study**; Italy

1 INTRODUCTION

Self-feeding, defined as the functional ability to get food into the mouth (Liu et al., 2016), is the most emergent issue perceived by carers involved in the daily care delivered to nursing homes (NHs) residents. Self-feeding independence has been reported to ensure nutritional and liquid intake and to reduce the occurrence of negative clinical outcomes (Abdelhamid et al., 2016); moreover, eating independently has been also documented as an important indicator of quality of life (Liu et al., 2016).

To date, a variable prevalence of NH residents requiring daily help in self-feeding has been documented from 22% to 65% (Palese et al., 2018a). With the increased dependence in Activities of Daily Living (ADLs) at NH admission (Hjaltadóttir, Hallberg, Ekwall, & Nyberg, 2012) due to services available in the community and support offered to families, an increased prevalence of individuals requiring assistance at meals is expected in future years (Palese et al., 2018a). In the NH settings, ensuring appropriate nutrition has been described as requiring > 30 minutes/meal (Lin, Huang, Watson, Wu, & Lee, 2011) thus suggesting the **need of health care professional during mealtimes, appropriate in number and education.**

Factors involved in self-dependence have been studied conceptually and empirically by several studies: for example, Chang, & Roberts (2008) have developed a concept analysis reporting that feeding difficulties are based not only on memory and cognitive impairments, but also on several contingent factors that have a probabilistic relationship (due to time or space patterns) with feeding difficulties. Among these, social and psychological factors, as well as the dining environment and culturally appropriate food choices, have been highlighted. Some years later, Aselage, & Amella (2010) have developed the concept of ‘mealtime difficulties’ including the relevance of environmental, sociocultural and contextual factors in determining these difficulties. Moreover, **to date** a few primary studies have been focused on self-feeding decline and predictors **and those available have provided a limited follow-up** (Palese et al., 2016) thus forcing this field of research to be still poorly explored.

As a consequence, despite 32 years of research started by the first study in the field published by Eaton, Mitchell-Bonair, & Friedmann (1986) no conclusive evidence-based intervention(s) have been defined to date aimed at maintaining self-feeding performance for as long as possible (Abdelhamid et al., 2016). Accordingly, any intervention can be recommended as of now as a gold standard (Bunn, Jimoh, Wilsher, & Hooper, 2015).

Producing evidence on the incidence of self-feeding dependence and associated predictors over time, both at the individual and at the NH levels, can support in designing specific interventions and in testing their effectiveness. Therefore, with the purpose of improving the knowledge in the field, the study aims were (a) to describe the incidence of self-feeding dependence over time in a large sample of residents living in NH; and (b) to explore predictors increasing or preventing self-feeding dependence over time, at the resident and at the NH levels.

2 METHODS

2.1 Study design and setting

A regional-based retrospective study design by using data stored in a database for 5 years, was performed and reported here on the basis of the REporting of studies Conducted using Observational Routinely-collected Data recommendations (Benchimol et al., 2015).

A region located in the North-East of Italy with around 1,200 million inhabitants and >9,000 living in NHs was selected. All existing NHs (=105) were included in the study: all of them were regulated by the same regional policies regarding the residents' admission criteria, their periodical assessment and the amount of care delivered by nursing staff and physicians.

On average, the NHs were equipped with 85 beds (min 10, max 445) and the majority (75; 71.4%) were non-profit facilities. A large proportion (85; 81%) was periodically accredited and supervised by the Local Health Trust (LHT) with regards to the quality of care offered, while the remaining (20; 19%) were independent. The approached NHs were regulated at the regional levels in four different profiles according to the degree of functional dependence of residents and the amount of daily care offered by Registered Nurses (RNs) and Nurses' Aides (NAs). The profiles were the following:

- a) polyfunctional NHs (27, 25.7%) where residents requiring some help **with ADLs** were admitted and received 60 minutes of daily care by RNs and NAs;
- b) protective NHs (32, 30.5%), admitting residents with an increased degree of dependence in ADLs, receiving 75 minutes of daily care/day by RNs and NAs;
- c) diversified NHs (32, 30.5%), including residents requiring some help or at increased need of care, thus receiving care in accordance with their needs (60 or 75 minutes day) by RNs and NAs, and

d) other NHs (14, 13.3%), admitting residents who were independent in ADLs, thus receiving only support from non-qualified personnel.

Physicians were available in some NHs (24; 22.8%) but their presence was not mandatory according to the regional rules.

2.2 Source of data and participants

Residents admitted in the included NHs from 2008 to 2013 were the target population, identified through the Val.Graf regional database (Pascazio et al., 2009) available at the Welfare Regional Unit (WRU) and populated by NHs via the web. The records belonging to residents > 65 years, who were recognisable with an identified code (ID) in the above-mentioned database, and who received at least one nursing assessment following that performed upon NH admission, were all included. Therefore, those residents a) who were short stayers, b) with naso-gastric tubes or percutaneous gastric stomas, and c) those with multiple ID codes due to being discharged from one NH and then being admitted into another NH, were excluded.

Two researchers performed the process of resident identification by accessing the database, and this process was repeated twice with the same outcomes for the total number of residents (=13,175), thus ensuring the internal validity of the database (Sorensen, Sabroe, & Olsen, 1996). In addition, aimed at ensuring the external validity, each ID code was linked with the health assurance identification code as a reference standard (Sorensen et al., 1996) and also in this case there was consistency in the data.

2.3 Variables

The dependent variable was the self-feeding dependence progression over time. The outcome was measured with an item based on an ordinal scale, ranging from 0 (total independence) to 4 (total dependence) as provided by the validated Val.Graf instrument (Pascazio et al., 2009).

As reported in Table 1, the independent variables were identified at the 1) individual, and at the 2) NH levels, according to the literature available in the field (e.g., Liu et al., 2016; Abdelhamid et al., 2016, Banaszak-Holl et al., 2011; Bürge, Von Gunten, & Berchtold, 2013). At the individual level, data was collected by trained RNs at the bedside via observation, interview or clinical records by using the Val.Graf tool (Pascazio et al., 2009) and then stored in the database of the WRU accessed by researchers; at the NH levels, data was collected

by researchers, from the official databases of the WRU at the study inclusion. This data was stable over time according to the stability of the rules and policies regulating the approached NHs over the study period.

2.4 Ethics

The study protocol was approved by the Ethical Committee of the Azienda Ospedaliera Universitaria di Udine, Italy, prot. N. 56449, 11 October 2013. Residents and NHs data were anonymized during the process of data extraction. **Before its use, there was ascertain that the Val.Graf instrument was usable as public domain and not copyrighted.**

2.5 Bias control

To avoid outcome misclassification (Bornhöft et al., 2006) a validated tool was used (Pascasio et al., 2009). Moreover, RNs working in the NHs and responsible for the resident assessment, were trained in the use of the Val.Graf tool thus ensuring accuracy in data collection. Selection bias (Bornhöft et al., 2006) was avoided by identifying residents from the same general population and from the same database, and by validating their identification. Chronology bias was prevented by assessing the measurement invariance over the occasions and the years; finally, performance bias (Bornhöft et al., 2006), such as differences in the care received by residents, was avoided by selecting a study period when NH rules and policies were stable over time.

2.6 Data analysis

Preliminarily, the measurement invariance in ADLs, CPS, DRS, BPS and SES scales over the occasions and over the years was assessed using the Multiple Group Confirmative Factor Analysis (MG-CFA) (findings available from the authors). Then, correlations among the constructs measured by the above-mentioned scales upon NH admission were assessed (Spearman rho [ρ_s]) by using a Structural Equation Model (SEM). Other scales (REL, Pain scale, co-morbidities and clinical instability) were not entered in the SEM in accordance with the nature of their variables (single dichotomous or single continuous item). The overall SEM model consonance of fit was assessed by the Minimum Function Testing (MFT) procedure through the following indices: Comparative Fit Index (CFI, > 0.95 as excellent), Tucker-Lewis Index (TLI, > 0.95 as excellent), Root

Mean Square Error of Approximation (RMSEA, < 0.06 as good) and Standardised Root Mean Square Residuals (SRMR, < 0.08 as good fit).

Aiming at evaluating the relationship between the ordinal dependent variable (self-feeding dependence progression over time) and the predictors at the individual and at the NH levels, the ordinal polynomial logit regression **analysis was performed, by calculating also the Confidence of Interval, CI at 95%.**

The dataset presented multiple observations for each resident and these observations were ordered in time. In order to consider its hierarchical structure, a random effect model was estimated where the time effect was included as a linear component. Moreover, given that the estimation of ordered logistic regressions, considering that the presence of a random effect is computationally expensive and a large sample is included, the model estimation presented some convergence problems. As a consequence, a Bayesian estimation approach, considering highly non-informative priors, was used (Zhao, Staudenmayer, Coull, & Wand, 2006). Specifically, the estimated parameters of the linear predictor of an ordered logistic regression can be interpreted in terms of proportional odds ratios (PORs). Their exponential transformation can be read as the effect on the odds of moving from a certain level of the ordinal scale to the following one. This effect is constant for all the observed levels in the dependent variable.

3 RESULTS

3.1 Residents records included in the study

The records of 13,175 residents just admitted in the NH, and the following 69,341 records as collected in the 6-monthly assessments were included. There were on average 5.23 records/resident (SD 2.9; 1st Q 3.0; 2rd Q 7.0) suggesting that residents lived in the NHs for an average of 2.6 years.

3.2 Residents profile at the NH admission

As reported in Table 2, at admission residents' age was on average 83.5 years (range 65–109) and they were mainly female (9,848; 74.7%). At admission 6,496 residents (49.3%) reported a certain degree of dependence in self-feeding and the Barthel Index was on average 36.88 points out of 100. Moreover, the majority of residents (7,234; 54.9%) were suffering from moderate to severe cognitive impairments and 4,983 (37.8%)

from depressive disorders. Pain was not evaluated in 3,266 of residents (24.5%); and 43.9% (n=5,780) of those assessed, were not in pain.

Behavioural problems were rare with the exception of unsociability (average 1.44 out of 4; SD 1.44). Less than half of residents were supported by close relationships with family relatives (5,850; 44.9%) and less often with healthcare workers (3,334; 25.3%) and volunteers/spirituals supporters (1,039; 7.8%). The degree of social engagement was rated from rare to occasional. Moreover, the resident clinical instability was on average, 1.41 out of 4 (SD 1.02) thus moderately stable; the risk of falls (6,197; 47.0%), diabetes (2,279; 17.2%), neurological conditions (1,585; 12.0%) and pressure sores (1,288; 9.7%) were the most frequent clinical issues reported.

As shown in Figure 1 reporting the findings of the SEM with acceptable fit indexes, upon admission, ADL and SES scales reported high correlations with CPS (ρ s 0.67 and 0.77, respectively). Between ADL and SES scales, there was also a high correlation (ρ s 0.68). The CPS was moderately correlated (ρ s 0.35) with BPS and moderately correlated (ρ s 0.43) with DRS.

3.3 Progression of self-feeding dependence over time

A slight dependence in self-feeding over time emerged (e.g. from 1.18 [CI95% 1.16–1.20] on average at NH admission to 1.40 [CI95% 1.37–1.43] after 12 months). The median values suggest that six months after NH admission, the majority of residents were at need of feeding supervision and prompts (Table 3).

3.4 Self-feeding dependence predictors

In Table 4, findings from the ordered multivariate analysis are reported. The cut-off points differentiate the adjacent levels of the response variable and can be used to classify the observed statistical units on the basis of estimated latent continuous variables. Well-separated cut-off points emerged in our study, thus suggesting that the model is capable of distinguishing between different self-feeding degree of dependence.

At the individual level, given the other variables entered into the model constant, an increased ADL dependence increased the proportional odds ratios (PORs) approximately 4.36 times (CI95% 4.17–4.57) of moving to an increased level of dependence in self-feeding over time; similarly, cognitive impairment increased the PORs 3.10 times (CI95% 2.98–3.23) of moving to a major dependency level in self-feeding.

Social engagement deprivation (POR 1.43 CI95% 1.39–1.48), the occurrence of pressure sores (POR 1.51 CI95% 1.43–1.62), co-morbidities (POR 1.28 CI95% 1.25–1.31), and clinical instability (POR 1.17 CI95% 1.14–1.20) also increased the risk of self-feeding dependence. Time was also a predictor, indicating that from one assessment to the next at six months, the likelihood of being in a worse self-feeding condition increased (POR 1.06 CI95% 1.06–1.07). At the NH level, for each additional bed, the risk (POR 1.17 CI95% 1.06–1.29) of moving to a major degree of self-feeding dependence increased.

In contrast, female gender (POR .85 CI95% .77–.94), the occurrence of behavioural problems (POR .92 CI95% .90–.94), engagement with family, healthcare workers or volunteers (POR .94 CI95% .90–.97), depression (POR .96 CI95% .93–.96), and – to a less extent – increased age (POR .98 CI95% .98 –.99), were all protective factors against the progression of self-feeding dependence. At the NH level, those NHs with a polyfunctional mission (POR .65 CI95% .49–.86) and those that were periodically accredited by the LHT (POR .80 CI95% .63–1.04) reported lower proportional odds of self-feeding dependence progression over time among residents.

4 DISCUSSION

4.1 Residents records included in the study

Long-term facilities providing 24-hour of care for residents with functional dependence until their end-of-life were involved. Specifically, we have included > 13,000 records of residents' assessment performed at their NH admission, and the following > 69,000 assessments performed every six months. To our best knowledge, only Banaszak-Holl et al. (2011) have documented the functional decline in US NHs-dwelling elderly from their admission to 58.7 months; however, they have included 3,634 residents and the focus was not specifically the self-feeding dependence.

4.2 Residents profile at the NH admission

Our residents were mainly female and aged, in line with previous studies in the field (e.g., Banaszak-Holl et al., 2011; Helvik, Engedal, Benth, & Selbæk, 2014). Around 50% of them had a certain degree of dependence in self-feeding higher to that reported previously (e.g., in Phillips et al., 1997 = 22.2% of 77,337 residents; in Liu et al., 2016 = 32.2% of 199 residents). More than half of residents were moderately cognitively

impaired as previously documented as predictor of NH admission and self-feeding dependence (Liu et al., 2016). Depression was reported more frequently (37.8%) as compared to that reported in UK NHs (29.6%, Stewart et al., 2014): moreover, behavioural problems were occasionally documented at lowest levels as compared to previous studies (Drageset, Kirkevold, & Espehaug, 2011) while a higher occurrence of unsocial behaviour emerged possibly due to the recent NHs admission and the sense of loneliness (Drageset et al., 2011). Residents' clinical condition was moderately stable with the risk of falls; around 13% of them suffered from moderate to severe pain, which is fewer than the 22.2% recently reported in US NHs (Shen, Zuckerman, Palmer, & Suart, 2015).

As documented by the SEM, the degree of dependence in ADLs, the cognitive performance, the degree of social engagement, the occurrence of behavioural problems and the degree of depression were all interdependent to each other, suggesting a need for a holistic approach in nursing care. Specifically, DRS has reported moderate correlations with the BPS, and also weak correlations with ADL, CPS, and SE scales. This suggest that depression predicts a decline of higher-level ADLs such as the instrumental ones, and leads to deterioration of the more basic ADLs over time (Kazama et al., 2011). The weak correlation between DRS and CPS scales, instead, can express the role of late-life depression, which has been documented as an antecedent of dementia, with a twofold increase in risk (Cherbuin, Kim, & Anstey, 2015). Moreover, the weak correlation between social engagement and depression can be explained by the increased depression occurring at the NH admission and the lack of participation in social activities, which are often limited upon facility entry.

4.3 Progression of self-feeding dependence over time

After six months and two years of NH admission, around 3.2% and 7.5% of residents, respectively, lost their complete independence in self-feeding. Previous studies showed that 1.8% (Phillips et al., 1997) to 12.4% (Wang et al., 2010) of residents have demonstrated a decline in self-feeding six months after NH admission. The trajectory of self-feeding decline emerged in our data was slow, ranging from 0.2 to 0.13 out of four points/semester. A similarly slow trajectory was documented among 890 residents where the decline was around 0.3 points out of 5 six months after NH admission and 0.4 points after one year (Carpenter, Hastie, Morris, Fries, & Ankri, 2006). However, the self-feeding dependence trajectory emerged is non-linear: after some semesters the decline was around 0.6 out of four points (e.g. the seventh and the eighth semester) while

in others the decline was higher (e.g., from 0.9 to 0.13 points out of four, in the second and in the third semester): this can be explained by the process of resident adaptation to the NH context and to the effects of different individual, nursing care and institutional factors that can prevent or increase the decline (Frytak, Kane, Finch, Kane, & Maude-Griffin, 2001).

4.4 Predictors and protective factors of self-feeding dependence progression

A set of predictors increasing or preventing the likelihood of dependence in self-feeding over time has emerged at the individual and at the NH levels.

At the resident levels, dependence in ADLs has emerged as the major predictor of increased dependence in self-feeding, confirming the order in which the ADL are lost during life (Liu et al., 2011; Gerrard, 2013): therefore, aiming at preventing dependence in self-feeding, interventions are required to be performed before its onset, promoting independence of middle-loss ADLs.

Cognitive impairments have also emerged as a major predictor of self-feeding dependence, as previously documented (e.g., Liu et al., 2011; Banaszak-Holl et al., 2011). Rare or occasional involvement in social activities have been shown as increasing the decline in self-feeding with less extent as reported by Chen et al. (2013), thus confirming that better social engagement can increase functional independence and quality of life (Hong, De Gagne, & Shin, 2018). Clinical instability and co-morbidities have been shown to increase the risk, but to a lesser extent as compared to factors abovementioned. In this case, findings suggest that special attention should be given to residents discharged from the hospital whom can have lost their residual self-feeding performances due to clinical instability.

Moreover, residents who reported pressure sores were also the ones most likely to decline in their self-feeding independence: pressure sores can be considered as a proxy indicator of the quality of nursing care offered to residents e.g., ensuring appropriate mobilization and preventive measures that can be threatened due to high NH workloads (Basso, Bonaudo, Di Monte, & Campagna, 2018). Self-feeding assistance requires also adequate nursing time, and if there is a high work pressure, this can in turn reduce the nutritional intake thus increasing the risk of pressure sores. Therefore, the occurrence of pressure sores and that of other adverse events sensitive to nursing care should be detected early (Palese et al., 2018b) as being a condition at risk of further increasing self-feeding dependence.

The time that elapses from one assessment to another, which was, on average, six months, has returned limited proportional odds values, suggesting that living in a NH makes a limited contribution to self-feeding decline as compared with the other clinical, cognitive, and social factors. In contrast, despite the relationship between large NHs and better functional decline of residents previously documented (Li, Cai, Mukamel, & Glance, 2010), according to our findings, an increased number of NH beds has increased the proportional odds of dependence progression in self-feeding over time. Personalised approaches to residents' need in large facilities can be more challenging; however, developing more research aimed at establishing the effect of the NHs size or more complex set of structural variables characterising large NHs is needed.

Among protective factors, at the individual level female residents have reported less deterioration in self-feeding over time, in contrast to that documented previously (Phillips, Shen, Chen, & Sherman, 2007) and this should be explored with further studies behind the role of age which emerged as protective. Increased depression was also protective most likely because mood alterations initially affect instrumental ADLs and later basic ADLs (Drageset et al., 2011); moreover, the increased occurrence of behavioural problems was protective, possibly due to the overall ADL independence of these residents.

Having a close relationship with family members, healthcare workers or volunteers has emerged as protective for self-feeding dependence progression. Durkin et al. (2014) have documented that the presence of family caregivers during mealtime increases resident independence, well-being and quality of life due to the individualised care offered (Salvà et al., 2011).

At the NH level, residents admitted to polyfunctional NHs who required only some help in ADLs and who received 60 minutes/day from RNs and NAs have reported around 35% lower odds of moving to a higher degree of self-feeding dependence as compared to those living in other types of NHs. Residents requiring minimal help in ADLs and who receive competent nursing care by RNs and basic care by NAs may develop a slow progress in dependence in accordance to the hierarchical order of ADLs loss (Gerrard, 2013), suggesting that preventive interventions are required to be performed before self-feeding dependence onset, by promoting independence of middle-loss ADLs.

Moreover, residents cared for in NHs that are supervised and periodically accredited by the LHS have shown a lower likelihood of self-feeding dependence progression. Quality improvement programmes and close

surveillance of resident outcomes may create supportive environments for nursing care continuing **improvement** (Slaughter, Eliasziw, Morgan, & Drummond, 2010; Koss, & Gilmore, 2002).

4.5 Limitations

The study is affected by several limitations. Firstly, 14% of residents were totally dependent in self-feeding on NH admission and they were not excluded from the database. Episodes of ‘excess disability’ as a temporary decline (Slaughter et al., 2010) have been reported in residents admitted to NH and later improved as soon as they receive the required support. Secondly, the number of hospital admissions, a complete consideration of the clinical conditions and medications administered upon NH admission and in the following months, were not considered due to limitation of the database. Thirdly, the quality of care in the involved NHs was not assessed and limited variables were considered with regards to nursing care offered due also to the limitations in the database available. Moreover, findings emerged reflect residents living in the same region, where NH are influenced by the same rules: thus, any generalization to other contexts should be made with caution. Larger studies, designed and conducted at the international levels, with data collected longitudinally, can prevent all these limitations.

5 CONCLUSIONS

To our best knowledge this is the first large study aimed at developing evidence on the progression of self-feeding dependence from residents’ NH admission to their death. Factors involved in self-feeding dependence have been recommended to be studied given that they can further support the design of effective interventions to promote feeding performance over time.

Self-feeding dependence affects around 50% of residents upon NH admission, with different degrees of severity. Self-feeding dependence upon facility admission has emerged as a complex phenomenon interdependent with several other individual factors (e.g., cognitive performance, social engagement, behavioural problems, depression): this suggest that a resident’s care should be based upon a holistic approach since NH admission, not limited to a problem-solving approach focused on independence in eating.

The decline in self-feeding performance over time is continuous and slow, caused by multifaceted factors at the individual and at the NH levels. Part of these factors reflect the progression of chronic illnesses, thus unmodifiable; other factors can be modifiable through appropriate interventions.

At the individual level, multiple strategies targeting modifiable factors, such as strengthening interventions to develop independence in middle-loss ADLs, increasing nursing surveillance of self-feeding in clinically unstable patients, stimulating social engagement and the presence of family caregivers, are strongly recommended. At the institutional level, in large NHs, designing independent units where individualised nursing care may be offered thus avoiding any form of routinization and standardisation of care, is also strongly recommended. There is also the need to supervise and periodically accredit NH processes and outcomes aimed at supporting facilities to create a favourable tension towards resident functional independence promotion. Moreover, the occurrence of adverse events that are associated with nursing care should be detected early, given their value in providing information on the quality of care, which may also affect the rapid progression of self-feeding dependence.

AUTHOR CONTRIBUTIONS

Study design: AP, RZ, MH, RW

Data collection: AP, BF, SP, IA

Data analysis: AP, LG

Manuscript writing: AP, LG, BF, SP, IA

Manuscript revisions for important intellectual content: MH, RW

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Table 1. Independent variables at the individual and at the NH level

- 1) At the individual level:
 - Age, gender and the number of RN assessments performed after NH admission;
 - Activity of Daily Living Scale (ADLs): early- (dressing, personal hygiene), middle- (bathing, walking/locomotion, making stairs, transferring and toileting) and late- loss (bed mobility, urinary and faecal continence) ADLs (Gerrard, 2013) were collected using an ordinal score (0 =independent, 4 =dependent). The Barthel Index measuring the degree of dependence in all ADLs (0 =total dependence, 100 =total independence, Mahoney, & Barthel, 1965) was also measured.
 - Cognitive Performance Scale (CPS): the degree of cognitive impairment was assessed using the CPS score, which ranges from 0 (intact) to 6 (severe impairment). **Scores ≥ 4** indicate moderate/severe cognitive impairment (Morris et al., 1994).
 - Depression Rating Scale (DRS): the degree of depression was evaluated using the DRS, which is made up of 14 items (anger with self or others, expression of unrealistic fears, repetitive health complaints, repetitive anxious complaints/concerns, sad, in pain, worried facial expression, crying, tearfulness). The total score ranges from 0 to 14; scores ≥ 3 indicate minor or major depressive disorders (Burrows, Morris, Simon, Hirdes, & Phillips, 2000).
 - Pain Scale (PS): the frequency and the intensity of pain was measured using the PS, with scores ranging from 0 (no pain) to 3 (severe pain) (Fries, Simon, Morris, Flodstrom, & Bookstein, 2001).
 - Behavioural Problems Scale (BPS): insomnia, night restlessness, wandering, verbal/physical aggressiveness, social inadequacy (such as undressing in public), non-sociability (such as a resident who prefers loneliness, avoid companionship and social contact), and resistance in daily care cooperation, were all evaluated using items that were scored from 0 (absent) to 4 (always present). The total scores were calculated by adding the score obtained for each item as reported in the Val.Graf tool (Pascazio et al., 2009): the higher scores indicate a higher occurrence of the above-mentioned behavioural problems.
 - Relationship with Others Scale (RES): the presence of close intimate relationships with a) family relatives, b) healthcare workers, and c) volunteers/spiritual supporters was also assessed using dichotomous variables (yes/no) (Pascazio et al., 2009).
 - Social Engagement Scale (SES): the frequency of participation in social activities offered by NH, in individual activities (e.g. reading books/newspapers), or in doing something useful (e.g. gardening), and/or going outside of the facility was assessed using items with a score ranging from 0 (always) to 4 (never) (Pascazio et al., 2009). The total scores were obtained by adding the score for each item as reported in the Val.Graf tool: higher scores indicate lower levels of or lack of social engagement (Pascazio et al., 2009).
 - Co-morbidities: the presence of pressure sores and their stage (National Pressure Ulcer advisory Panel, 2014), risk of fall(s), episodes of fever, dysphagia, ineffective cough, vomit, dehydration, unintentional weight loss ($> 5\%$ in the last month), infection(s), pneumonia, delirium/mental

confusion, hallucinations, coma, diabetes, neurological conditions (e.g. post-stroke, Parkinson disease), and degenerative neurological conditions (multiple sclerosis) were also evaluated with dichotomous variables (yes/no); the number of co-morbidities assessed upon the NH admission were also considered (Pascazio et al., 2009).

- Clinical Instability Score (CIS): clinical condition scores ranging from 0 (stable) to 4 (higher levels of instability), thus requiring close RN monitoring and surveillance (Pascazio et al., 2009) was considered.
- 2) At the NH level:
- NH profile with regards to the mission: polyfunctional, protective, diversified and other NHs;
 - **Beds available, number;**
 - Periodical supervision and accreditation processes performed by the LHT (yes/no);
 - Amount of care offered by RNs and NAs as defined by the regional rules for each NH profile (60 minutes/day or higher). It was found that 78 (74.3%) of the NHs offered more care by NAs on a daily basis beyond the standards as defined by regional rules during the study period, while 83 (79%) offered more nursing care by RNs. A total of 74 (70.5%) facilities offered both more NA and RN care (average five minutes/day/resident), and the amount of care offered (> standards required, or in line with standards) was included in the analysis. A variable expressing the interaction between care offered by RNs and NAs was also identified and included in the model.

RNs, Registered Nurses; NAs, Nursing Aides; NH, Nursing Home

Table 2 Residents profile upon NH admission

Variables	N 13,175 <i>n</i> (%), average (SD)
Female	9,848 (74.7)
Age, years	83.5 (9.5)
1 st Q	79.0
3 rd Q	90.0
Self-feeding	
Independent	6,643 (50.4)
Requiring prompts and supervision	2,613 (19.8)
Requiring minimal help	482 (3.7)
Requiring constant help	1,555 (11.8)
Totally dependent	1,846 (14.0)
Missing	36 (.3)
ADL	
Dressing (0–4)	2.54 (1.39)
Bathing (0–4)	2.85 (1.08)
Transferring (0–4)	2.41 (1.76)
Personal hygiene (0–4)	2.28 (1.51)
Stairs (0–4)	2.94 (1.49)
Walking (0–4)	2.14 (1.69)
Bowel Control (0–4)	2.71 (1.61)
Bladder Control (0–4)	1.91 (1.73)
Bed mobility (0–4)	1.71 (1.74)
Barthel index (0–100)	36.88 (32.02)
CPS (0–6)	2.97 (2.05)
Cognitive Performance Scale ≥ 4	7,234 (54.9)
DRS (0–14)	2.49 (2.89)
Depression Rating Scale ≥ 3	4,983 (37.8)
Pain Scale, severity of pain	
Absent	5,780 (43.9)
Slight	2,461 (18.7)
Moderate	1,514 (11.5)
Severe	194 (1.5)
Missing data	3,226 (24.5)
Behavioural problems	
Insomnia (0–4)	.49 (.88)
Night restlessness (0–4)	.51 (1.01)
Wondering (0–4)	.24 (.74)
Verbal aggressiveness (0–4)	.34 (.77)
Physical aggressiveness (0–4)	.17 (.56)
Social inadequacy (0–4)	.22 (.69)
Unsociability (0–4)	1.44 (1.32)
Resistance in daily care cooperation (0–4)	.38 (.83)
Relationship with	
Family relatives	5,850 (44.4)
Healthcare workers	3,334 (25.3)
Volunteers and/or spiritual supporters	1,039 (7.8)
Social engagement patterns	
Participation in NH social activities (0–4)	2.27 (1.65)
Performing individual activities (0–4)	2.11 (1.83)
Doing something useful (0–4)	3.32 (1.32)

Going outside of the facility (0–4)	2.30 (1.04)
Table 2 Residents profile upon NH admission (continue)	
Variables	N 13,175 <i>n</i> (%), average (SD)
Clinical instability (0–4)	1.42 (1.02)
Clinical condition	
Unstable equilibrium, at risk for falls	6,197 (47.0)
Diabetes	2,279 (17.2)
Neurological condition	1,585 (12.0)
Bedsores	1,288 (9.7)
	I grade ^a 316 (24.5)
	II grade ^a 414 (32.1)
	III grade ^a 315 (24.4)
	IV grade ^a 243 (18.8)
Hallucinations	921 (6.9)
Delirium/mental confusion	840 (6.3)
Dysphagia	728 (5.5)
Unintentional weight loss ($\geq 5\%$ last month)	499 (3.7)
Ineffective cough	380 (2.8)
Episodes of fever	373 (2.8)
Comatose status	143 (1.0)
Repeated episodes of vomit	135 (1.0)
Pneumonia	103 (.7)
Degenerative neurological condition	74 (.5)
Terminal ill condition	58 (.4)
Other (e.g. septicaemia, hemorrhage)	36 (.2)

^a National Pressure Ulcer **Advisory** Panel, 2014

ADL, Activity of Daily Living, 0 independent, 4 dependent; Barthel Index, 0 total dependence, 100 total independence; Behavioural problems, 0 never, 4 always present; Clinical instability, 0 stable, 4 high instability; CPS, Cognitive Performance Scale, 0 cognitive status intact, 6 severe impaired; DPR, Depression Rating Scale, 0 no depression, 14 major depression; n, number; NH, Nursing Home; Q, quartile; Social engagement patterns, 0 always, 4 never; SD, standard deviation.

Table 3 Rate for self-feeding dependence over the assessments

Assessment	Valid^a	Mean^b	CI95%	Median	1st-3rd Q	% Independent^c
1 st at admission	13,139	1.18	1.16–1.20	0	0–3	50.5
2 st	13,139	1.31	1.29–2.33	1	0–3	47.3
3 rd	10,243	1.40	1.37–1.43	1	0–3	44.6
4 th	8,298	1.46	1.43–1.49	1	0–3	43.0
5 th	6,648	1.55	1.51–1.59	1	0–3	41.3
6 th	5,252	1.62	1.58–1.66	1	0–4	40.1
7 th	4,044	1.68	1.63–1.73	1	0–4	39.2
8 th	3,069	1.74	1.68–1.80	1	0–4	27.8
9 th	2,279	1.80	1.73–1.87	1	0–4	37.1
10 th	1,516	1.82	1.73–1.91	1	0–4	36.5

^a assessment records available: at the baseline, 36 (0.3%) records were missed; ^baverage in the self-feeding performance from 0, independent, to 4 total dependent; CI, Confidence of Interval; Q, quartile; ^cproportion (%) of residents independent in self-feeding out of the total observed in each point.

Table 4 Predictors of self-eating dependence in residents living in NHs over time

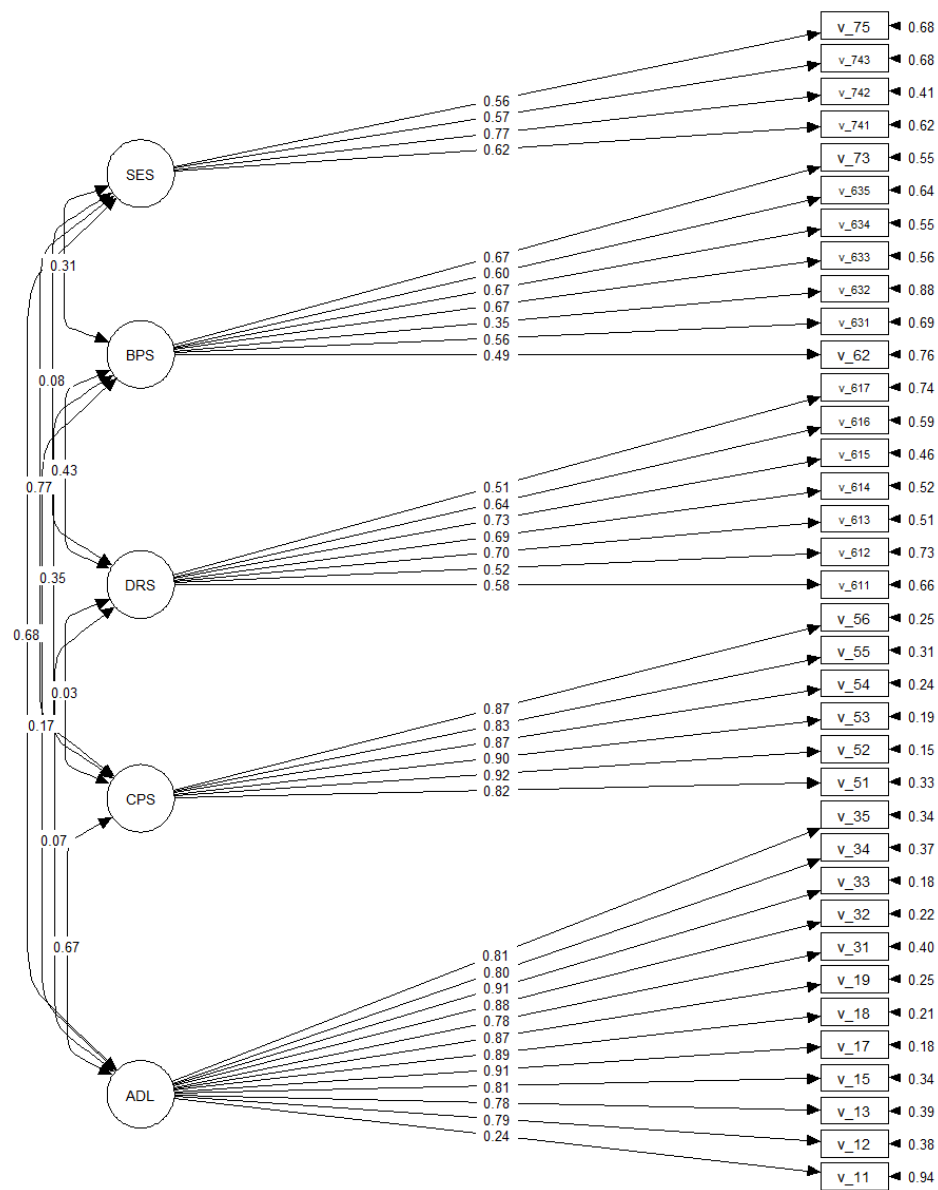
Variables	Est.Coeff	POR	CI95%	p-value
(Intercept)	.56	1.76	.97–3.27	.
Individual-level variables				
Age, in years	-.02	.98	.98–.99	***
Female vs. Male	-.16	.85	.77–.94	**
ADLs ^a	1.47	4.36	4.17–4.57	***
CPS	1.13	3.10	2.98–3.23	***
DRS	-.04	.96	.93–.98	***
Pain Scale	.02	1.02	.99–1.05	
BPS	-.08	.92	.90–.94	***
RES	-.07	.94	.90–.97	***
SES	.36	1.43	1.39–1.48	***
Clinical instability	.16	1.17	1.14–1.20	***
Co-morbidities	.25	1.28	1.25–1.31	***
Pressure sores	.42	1.52	1.43–1.62	***
Time order	.06	1.06	1.06–1.07	***
NH-level variables				
Daily care provided by NAs, > of the standards	-.19	.83	.56–1.19	
Daily care provided by RNs, > of the standards	.11	1.11	.95–1.33	
Interaction: care offered by NAs and RNs	-.06	.94	.62–1.44	
Polyfunctional mission	-.43	.65	.49–.86	**
Protective mission	.11	1.12	.87–1.46	
Diversified mission	.09	1.09	.86–1.42	
Supervised and accredited by the LHT	-.22	.80	.63–1.04	.
Beds, number	.16	1.17	1.06–1.29	**
Cut-points				
Eating scale 1	1.78		1.75–1.82	
Eating scale 2	2.19		2.15–2.24	
Eating scale 3	3.74		3.67–3.80	

^a self-feeding independence was excluded from these ADLs

p- values = *** 0.000; ** 0.001; * 0.01; . 0.05

ADLs, Activity of Daily Living score, 0 independent, 4 dependent; BPS, Behavioral Problems Scale, 0 never, 4 always present; Clinical Instability, 0 stable, 4 high instability requiring close monitoring; CPS, Cognitive Performance Scale, 0 cognitive status intact, 6 severely impaired; DRS, Depression Rating Scale, 0 no depression, 14 major depression; Est.Coeff, Estimated coefficients; LHT, Local Health Trust; NAs, nurses aides; NH, nursing homes; POR proportional odds ratio; RES, Relationship with Others scale, yes/no; RNs, registered nurses; SES, Social Engagement Scale, 0 always, 4 never.

Figure 1 Structural Equation Model (SEM) of the assessment scales used at the residents' NH admission



lavaan (0.5-19) converged normally after 92 iterations		
	Used	Total
Number of observations	52949	69341
Estimator	ML	
Minimum Function Test Statistic	221185.799	
Degrees of freedom	584	
P-value (Chi-square)	0.000	
Model test baseline model:		
Minimum Function Test Statistic	1365258.992	
Degrees of freedom	630	
P-value	0.000	
User model versus baseline model:		
Comparative Fit Index (CFI)	0.838	
Tucker-Lewis Index (TLI)	0.826	
Root Mean Square Error of Approximation:		
RMSEA	0.084	
90 Percent Confidence Interval	0.084-0.085	
P-value RMSEA <= 0.05	0.000	
Standardized Root Mean Square Residual:		
SRMR	0.072	

ADL, Activity of Daily Living scale; CPS, Cognitive Performance Scale; DRS, Depression Rating Scale; BPS, Behavioral problems scale; SES, Social Engagement Scale; RES, Relationship with others Scale

