

ORIGINAL ARTICLE

National study of the nutritional status of Korean older adults with dementia who are living in long-term care settings

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Abstract

Aim: To evaluate the nutritional status of older adults with dementia who were living in long-term care settings.

Methods: As a secondary analysis, this study used the data from the Nationwide Survey on Dementia Care in Korea that was conducted between December 1, 2010, and August 31, 2011, which surveyed 3472 older adults with dementia, aged ≥ 60 years (mean age: 81.24 years), who were residing in 248 randomly selected long-term care settings in South Korea. Twenty-three different variables that related to the participants' demographics, diseases, and functional and nutritional characteristics were selected. The nutritional status was assessed by using the Mini Nutritional Assessment (MNA). Descriptive statistics, an ANOVA, and a chi-squared test were used to analyze the data.

Results: The mean MNA score of the participants was 17.90. The malnutrition rate was 38.4% ($n = 1333$), with 54.7% ($n = 1900$) of the participants at risk for malnutrition. The largest population with malnutrition resided in long-term care hospitals (47.9%), followed by nursing homes (34.1%), and group homes (25.9%). Being older and female, while exhibiting higher cognitive impairment, more neuropsychiatric symptoms, higher functional dependency, and a higher number of disabilities, were associated with poor nutritional status.

Conclusion: The nutritional status of older adults with dementia who were living in long-term care settings in South Korea was poor and associated with multiple factors. Paying special attention to recognizing, assessing, preventing, and treating malnutrition in this population is necessary.

Key words: dementia, long-term care facility, nursing, nutrition, older persons.

INTRODUCTION

Nutritional status is a multidimensional concept that has a profound impact on the health and functional

capacity of older adults. Malnutrition is defined as an inadequate nutritional status that is characterized by insufficient dietary intake, poor appetite, muscle wasting, and weight loss (Ahmed & Haboubi, 2010). Malnutrition puts older adults at increased risk of infection, falls, fractures, pressure ulcers, depression, and low psychological well-being (Muurinen, Savikko, Soini, Suominen, & Pitkälä, 2015; Watterson *et al.*, 2009). In addition, malnutrition is a strong predictor of increased

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hospital admissions and length of stay, as well as increased morbidity and mortality rates (Agarwal, Miller, Yaxley, & Isenring, 2013). Older adults with dementia, the most prevalent cognitive disorder, have the most severe combination of factors for malnutrition because they are often unable to eat independently as many are unable to recognize hunger, chew, or swallow and thus must rely on caregivers for assistance. As dementia progresses, chronically low food intake due to ongoing mealtime difficulties negatively influences both the physical health and the quality of life of older adults with dementia and can be fatal (Starr, McDonald, & Bales, 2015).

In addition to the continuous decline in the competency of eating, other mechanisms underlying weight loss and malnutrition in dementia have been suggested. Some studies have confirmed that individuals with dementia more often have a history of weight loss, as compared to cognitively healthy persons, and the association between dementia and weight loss increases through the stages of dementia severity (Volkert *et al.*, 2015). Moreover, in all stages of the disease, older adults with dementia can be affected by individual conditions, such as age-related impairments, disabilities, and comorbidities (e.g. anorexia of aging, chewing problems, and depression), leading to a reduced dietary intake and malnutrition (Agarwal *et al.*, 2013).

Older adults with dementia who reside in long-term care (LTC) settings are more vulnerable to nutritional deficits than those who are living in community settings (Starr *et al.*, 2015; Volkert *et al.*, 2015; Watterson *et al.*, 2009). According to a systematic review of the state of nutritional compromise among nursing home patients (Bell, Tamura, Masaki, & Amella, 2013), the prevalence rate of malnutrition among older adults in LTC facilities varied: 6–15%, if measured by the Minimum Data Set (MDS) weight loss measure; 6–69%, if measured in terms of low Body Mass Index (BMI); and 0–71%, if measured by the Mini Nutritional Assessment (MNA), although the majority of studies reported that 20–39% of residents were classified as malnourished. However, little information is available nationally and internationally on the prevalence of malnutrition in older adults with dementia across LTC settings. Only one past study is known: it was conducted in Finland by using a sample of LTC (i.e. nursing homes and service housing) residents with dementia and it reported that 28% of the residents were malnourished and that 63% had a risk of malnutrition, as measured by the MNA (Muurinen *et al.*, 2015).

Maintaining a good nutritional status in older adults in a LTC setting is an important challenge for LTC professionals. Previous studies have reported the following risk factors for poor nutrition in institutionalized older populations: chronic illness, hospitalization, swallowing or chewing difficulties, mild cognitive impairment (MCI) or dementia, functional dependency, depression, and social isolation (Bell *et al.*, 2013; Orsitto, 2012). Institutional factors, such as the size of the institution, the ratio of care staff-to-patients, the supervision by nurses of the nursing assistants during mealtimes, and the daily food budget per resident, also have been identified as having an association with the nutritional status of older adults with dementia (Sloane, Ivey, Helton, Barrick, & Cerna, 2008). Although these studies have addressed nutritional issues in LTC settings, they do not specifically target individuals with dementia. Other studies that have looked at older adults with dementia in nursing homes have focused mainly on the factors that are associated with eating difficulties and low food intake, which are considered to be major contributors to malnutrition in this group (Lee & Song, 2015). These studies used convenience sampling and assessment tools that measured food intake (e.g. type and amount of food eaten) or eating difficulty (e.g. limitations in initiating, maintaining, and terminating eating; inability in using utensils; and problems in biting, chewing, and swallowing foods), rather than the overall nutritional status, and thus they were unable to identify the significant factors that contribute to malnutrition in older adults with dementia in LTC settings. Improving nutritional outcomes can enhance the overall quality of life among LTC residents with dementia, making it critical in understanding the factors that are associated with nutritional problems.

Unfortunately, despite older adults with dementia being at a particularly high risk of developing a nutritional disorder, concerns about nutrition often rank low on the list of evaluation and treatment priorities in LTC settings (Beattie, O'Reilly, Strange, Franklin, & Isenring, 2014; Isenring, Banks, Ferguson, & Bauer, 2012). As dementia becomes more prevalent worldwide, with an estimated number of new cases of dementia of >9.9 million each year (49% in Asia, 25% in Europe, 18% in the Americas, and 8% in Africa) (Alzheimer's Disease International, 2015), the amount of care that is necessary for these individuals takes on more and more importance. Accordingly, maintaining optimal levels of nutrition among older adults with dementia is a crucial requirement to manage their physical and psychosocial well-being. The

number of South Korean older adults with dementia is surging along with a rapidly aging population in Korea. According to a national survey on dementia prevalence rates in 2010, 9.6% of the elderly population (~610,000) were estimated to have dementia as of 2014 and the figure is expected to reach 10.4% by 2020 (~840,000) and 15% by 2050 (~2,710,000) (Kim *et al.*, 2011). Correspondingly, more and more family caregivers are seeking LTC for their loved ones, resulting in an increased demand for LTC (Korean National Health Insurance Corporation, 2013). This is mainly because the availability of informal or family caregivers has diminished due to changes in the traditional family structure, the increased participation of women in the workforce, and a decreased willingness to provide care (Kwon, 2009). In response to these challenges, the South Korean Government established a public LTC insurance program for the elderly in 2008 (Korean National Health Insurance Corporation, 2011). Since then, the number of LTC settings, such as nursing homes and senior congregate housing programs, has increased rapidly, from 1754 in 2008 to 5163 in 2016 (Korean Ministry of Health and Welfare, 2009, 2017). As in other countries, the Korean LTC system will face the challenge of providing care for older adults with dementia. Nevertheless, ample evidence exists that health professionals and care staff in Korean LTC settings are insufficiently trained to provide adequate care (Lee, Shin, & Harrington, 2015), as is the case in many other countries (Kuske *et al.*, 2007; Sloane *et al.*, 2008).

The quality of care for older adults with dementia in LTC settings can be optimized by administering interventions that fulfill the needs of each individual. Maintaining an optimal level of nutrition, a basic human need for good health, is especially critical for those who have to rely on others for care. Therefore, fully understanding the nutritional status of older adults with dementia in LTC settings is fundamental to building the groundwork for providing appropriate nutritional intervention.

METHODS

Aim

The aim of this study was to gain insight into the nutritional status of older adults with dementia who were living in LTC settings by determining how the nutritional status of this population varies according to demographic, disease, and functional characteristics.

Design, setting, and samples

The present study used data from the Nationwide Survey on Dementia Care in Korea (NaSDeCK) that was conducted between December 1, 2010, and August 31, 2011. Funded by the Ministry of Health and Welfare, the NaSDeCK is a cross-sectional national survey that was designed to provide a nationally representative sample of older adults with dementia who were aged ≥ 60 years in South Korea and were living in either the community or institutions (Kim *et al.*, 2011). The community sample in the NaSDeCK consisted of 731 pairs of community-dwelling dementia patients and their caregivers, with data collected from 13 dementia clinics in 12 geographical areas. The institutional sample in the NaSDeCK was collected from facilities that were located in seven major cities and adjacent rural areas in Korea that were stratified in terms of size (small, medium, large) and facility type (LTC hospital: a medical institution that is equipped with facilities to accommodate ≥ 30 patients suffering from geriatric diseases, including dementia, and chronic diseases and in which general doctors or herb doctors give health care with the aim of providing medical service; nursing home: a facility in which the elderly who need assistance due to geriatric diseases, such as dementia and stroke, can stay and be provided with food service, care, and other conveniences that are necessary for daily living; group home: a facility to provide residential conditions like home, food service, care, and other conveniences that are necessary for daily living to the elderly who need assistance due to geriatric diseases, such as dementia and stroke) (Korean Ministry of Health and Welfare, 2017). Of the 655 randomly selected facilities that were invited, 248 institutions agreed to participate and a total of 3525 older adults with dementia and 647 formal caregivers was included in the NaSDeCK institutional study. The present study used only patient data from the NaSDeCK institutional study. In total, 3472 older adults with dementia were included in the final analysis because the MNA, the major dependent variable, was incomplete for 53 of the participants. None of the other variables had a missing data rate of $>3\%$.

Participants who were ≥ 60 years in a LTC facility and who had been diagnosed with dementia at the time of data collection were eligible for the NaSDeCK institutional study. The diagnosis of dementia was confirmed by a medical practitioner and based on the *Diagnostic and Statistical Manual of Mental*

Disorders, Fourth Edition (American Psychiatric Association, 1994), the National Institute of Neurological and Communicative Disorders and Stroke, and the Alzheimer's Disease and Related Disorders Association (McKhann *et al.*, 1984). For the NaSDeCK, all the questionnaires were administered via in-person interviews by trained nurses acting as research assistants. The present study selected 20 variables from the NaSDeCK institution dataset to identify the nutritional status of older adults with dementia in LTC settings. A standardized analysis procedure was developed in order to record the demographic characteristics (age, sex, education, and facility type), disease characteristics (using the Cumulative Illness Rating Scale [CIRS], Neuropsychiatric Inventory Questionnaire [NPI-Q], Mini-Mental Status Examination-Dementia Screening [MMSE-DS], and the number of medications), BMI, nutritional status (using the MNA), and functional characteristics (activities of daily living [ADLs], disability, hand-grip strength, vision, hearing, and paralysis).

Ethical considerations

The NaSDeCK study procedure was approved by the Institutional Research Review committee (Seoul National University Bundang Hospital). All the participating organizations and individuals were requested to provide written informed consent after being informed of the purpose of the study via an information sheet. Those who verbally agreed and whose responses indicated that they understood the informed consent material were asked to sign the form. If a participant disagreed, no further request for participation was made. If a participant agreed to participate but there was some doubt as to their understanding of what the participation involved, an adult family member also was asked to sign the informed consent form. Permission was received from the Institutional Review Board (IRB, Seoul National University Bundang Hospital) for informed consent by legally appointed proxy. Access to the data from the medical documents was included in the informed consent and also was approved by the IRB.

Measurements

The nutritional status was assessed by using the MNA, the well-validated nutrition screening tool for the elderly (Chung & Sohn, 2005; Vellas *et al.*, 2000). It has been translated and used as a reliable instrument in many countries worldwide, including Korea. The maximum score is 30. The scores were used to classify the participants into one of the following three categories:

malnutrition (≤ 17), at risk of malnutrition (between 17 and 23.5), and adequate nutrition (≥ 24). The MNA consists of 18 items that are classified into four sections: anthropometric assessment (weight, height, and body circumference), overall evaluation (individual lifestyle, medications, and mobility), dietetic assessment (daily food intake and mode of feeding), and an individual evaluation of self-perception regarding health and nutrition.

The demographic, disease, and functional characteristics were measured by using the following instruments. The CIRS evaluates comorbidities and the degree of impairment for 14 bodily organ systems (Miller *et al.*, 1992). The NPI-Q (Kaufer *et al.*, 2000) is adapted from the NPI (Cummings *et al.*, 1994), a validated informant-based interview that assesses the severity of 12 neuropsychiatric symptoms over the previous 1 month. In this study, the sums of the NPI-Q severity score were analyzed, which ranged from 0 to 36. The MMSE-DS was used to assess cognitive impairment. The maximum MMSE-DS score is 30 and a score of <24 indicates a cognitive disorder (Kim *et al.*, 2010). The functional status was evaluated by using the Barthel Index (Mahoney & Barthel, 1965). The individual's ability to perform basic ADLs was measured with a maximum score of 100; a higher score indicates that the participant has less impairment in ADLs. The BMI was calculated with the formula $\text{weight (kg)}/\text{height (m)}^2$ (Keys, Fidanza, Karvonen, Kimura, & Taylor, 1972). The hand-grip strength was measured twice by using a dynamometer (Tanita, Japan) with the dominant hand. In addition, data that included the participants' age, sex, education, facility type, number of medications, number of disabilities, vision, hearing ability, and paralysis were analyzed.

Data analysis

IBM SPSS Statistics for Windows v. 20.0 (IBM Corporation, Armonk, NY, USA) was used to analyze the data. Descriptive statistics, means, standard deviations, and 95% confidence intervals for the mean and range were obtained for the demographic, disease, and functional variables. An ANOVA was carried out in order to examine the differences among the three groups (malnutrition, at risk of malnutrition, and adequate nutrition) for the continuous variables (age, education, CIRS-total, NPI-Q, MMSE-DS, number of medications, BMI, ADLs, number of disabilities, hand-grip strength, vision, and hearing). Chi-squared tests were used for

the comparison of proportions among the groups (sex, facility type, and type of paralysis).

The results of those analyses were considered to be statistically significant at the level of $P < 0.05$. Prior to the analysis, all the assumptions were checked, including univariate normality, linearity, homoskedasticity, and diagnostic testing for multicollinearity and error independence. All the values for skewness and kurtosis, except the NPI-Q, ranged between -2 and $+2$, which was considered to be acceptable in order to prove normal univariate distribution (George & Mallery, 2010). After examining the univariate normality, the NPI-Q score was converted by using the log function. There was no difference between the transformed score and the original score.

RESULTS

Demographic, disease, and functional characteristics

The demographic, disease, and functional characteristics of the participants are shown in Table 1. Of the 3472 participants, 79.2% ($n = 2752$) were female. The mean age of the study participants was 81.24 years (standard deviation, $SD = 7.54$). Three types of facilities were included in this study: nursing homes accounted for the largest portion of the study population (53.3%). The mean NPI-Q and MMSE-DS scores were 9.34 ($SD = 4.58$) and 8.33 ($SD = 3.19$), respectively. The participants were, on average, taking 4.57 medications ($SD = 3.02$). The mean MNA score was 17.90 ($SD = 4.15$). The MNA identified 38.4% ($n = 1333$) of the participants as suffering from malnutrition, with approximately half (54.7%; $n = 1900$) at risk of malnutrition.

The mean ADL score was 35.32 ($SD = 15.21$), showing a relatively low level of independent daily living. On average, the participants had more than seven disabilities, with a mean of 7.71 ($SD = 3.07$). The participants had slightly impaired vision and hearing. Left lower-extremity paralysis was the most common disability (12.1%), followed by right lower-extremity paralysis (10.7%) and left upper-extremity paralysis (7.6%).

Nutritional status by demographic, disease, and functional characteristics

The nutritional status of the participants according to their demographic characteristics is presented in Table 2. The average age among the participants in the malnutrition group was slightly higher than the age of

the participants who were adequately nourished or who were at risk for malnutrition. Comparing the distribution of the participants by sex, a slightly greater proportion of male participants was in the adequate nutrition group, while a relatively higher percentage of female participants was placed in the malnutrition group. Statistically significant differences were seen, based on the type of facility: a higher portion of individuals in the malnutrition group was in LTC hospitals (47.9%), compared with those in nursing homes (34.1%) or group homes (25.9%). In contrast, the participants from the group homes had a relatively better nutritional status than those in the LTC hospitals and nursing homes ($\chi^2 = 177.452$, $P < 0.001$). The participants in the malnutrition group used more medications than the participants in the other groups ($F = 15.660$, $P < 0.001$).

As for the disease characteristics, the MMSE-DS and the NPI-Q showed significant differences between the participants' nutritional status. The participants in the malnutrition group recorded the lowest MMSE-DS score, with a mean score of 6.61 ($SD = 3.69$); significantly higher scores were calculated for the at-risk group (mean = 9.09, $SD = 3.10$) and the adequate nutrition group (mean = 11.91, $SD = 4.78$). These results were consistent with the NPI-Q, which scores the severity of the behavioral and neuropsychiatric symptoms of dementia, in that the malnutrition group had significantly higher scores than did the other groups.

Table 3 shows the nutritional status of the participants and their functional characteristics. The mean ADL scores differed significantly according to nutritional status ($F = 533.956$, $P < 0.001$): the mean score of the participants in the malnutrition group was almost threefold lower than that of the adequate nutrition group (19.70 *vs* 72.51). The nutritional status was associated with other functional characteristics: the number of disabilities ($F = 440.441$, $P < 0.001$), hand-grip strength ($F = 109.394$, $P < 0.001$), vision ($F = 24.042$, $P < 0.001$), and hearing ($F = 32.463$, $P < 0.001$). The functional impairment of those in the malnutrition group was significantly higher than the functional impairment in the other groups. Poorer nutritional status was significantly associated with the presence of paralysis in all parts of the body, except for facial paralysis ($P < 0.001$).

DISCUSSION

The present study analyzed the nutritional status of South Korean older adults with dementia in LTC

Table 1 Descriptive statistics for the demographic, disease, and functional characteristics of older adults with dementia in long-term care institutions ($n = 3472$)

Variable	Mean (SD) or N (%)	95% CI	Range (min-max)
Age (years)	81.24 (7.54)	80.99–81.49	60–109
Sex		–	–
Male	720 (20.80)		
Female	2752 (79.20)		
Education	2.69 (1.25)	–	–
Facility type		–	–
LTC hospital	1280 (37.00)		
Nursing home	1842 (53.30)		
Group home	350 (9.70)		
CIRS: total score (0–56) [†]	3.90 (2.81)	3.80–3.99	0–19
NPI-Q (0–36): severity [†]	9.34 (4.58)	9.09–9.61	0–36
MMSE-DS (0–30) [†]	8.33 (3.19)	8.13–8.54	0–24
Number of medications (0–10)	4.57 (3.02)	4.46–4.67	0–10
Body Mass Index [†]	22.80 (5.65)	22.59–23.01	0–49
MNA (0–30)	17.90 (4.15)	17.40–18.20	0–28
ADLs (0–100)	35.32 (15.21)	34.33–36.29	0–95
Number of disabilities	7.71 (3.07)	7.61–7.81	0–10
Hand-grip strength (kg)	9.75 (5.36)	9.54–9.97	0–39
Vision (0–4) [‡]	3.01 (0.88)	2.98–3.04	0–4
Hearing (0–4) [‡]	3.10 (0.86)	3.08–3.13	0–4
Facial paralysis	77.00 (2.20)	–	–
Left upper-extremity paralysis	261.00 (7.60)	–	–
Right upper-extremity paralysis	216.00 (6.30)	–	–
Left lower-extremity paralysis	414.00 (12.10)	–	–
Right lower-extremity paralysis	373.00 (10.70)	–	–

[†] Missing data were excluded.

ADLs, activities of daily living; CI, confidence interval; CIRS, Cumulative Illness Rating Scale: 0 = “Normal” ~ 4 = “Extremely severe impairment”; LTC, long-term care; MMSE-DS, Mini-Mental State Examination-Dementia Screening; MNA, Mini Nutritional Assessment; NPI-Q, Neuropsychiatric Inventory Questionnaire: 1 = “Mild” ~ 3 = “Severe”; SD, standard deviation.

[‡]0 = “Very impaired” ~ 4 = “Normal”.

settings and how it varied with demographic, disease, and functional characteristics. Overall, the mean MNA score for the study's participants was 17.90 and the prevalence rate of malnutrition was 38.4%, indicating that malnutrition in Korean older adults with dementia in LTC settings is common. This is higher than the malnutrition prevalence of 30% in community-dwelling Korean older adults (Korea Center for Disease Control and Prevention, 2012) and that of 28% in LTC residents with dementia in Finland (Muurinen *et al.*, 2015). It is, however, similar to what Watterson *et al.* (2009) reported in their systematic review: that the prevalence of malnutrition internationally ranged from 40% to 70% in residential aged care settings and from 30% to 50% in rehabilitation settings. As this study only included individuals with dementia who reside in LTC settings, it is not appropriate to directly compare the prevalence of malnutrition in this study to that of the previous studies

that were included in the Watterson *et al.* review, which sampled all the LTC residents, regardless of a diagnosis of dementia or not. However, that the majority of the LTC residents had dementia (Sloane *et al.*, 2008) needs to be considered when interpreting the prevalence, as reported by previous studies.

For the demographic characteristics, age and sex were statistically significant variables in understanding nutritional status, despite the differences being too small to show meaningful clinical relevance. In this study, the female older adults with dementia were slightly more susceptible to nutritional deficits than were the male older adults. In their systematic review of 16 international studies, Bell *et al.* (2013) reported that the female sex and older age were the factors that were most consistently associated with a low BMI among nursing home patients, while older age, but not sex, was associated with poor nutrition. Considering that being an older female was associated with a low food intake in

Table 2 Comparison of the demographic and disease characteristics of older adults with dementia in long-term care institutions, based on the Mini Nutritional Assessment categories ($n = 3472$)

	Adequate nutrition (<i>n</i> = 239, 6.9%)	At risk of malnutrition (<i>n</i> = 1900, 54.7%)	Malnutrition (<i>n</i> = 1333, 38.4%)		
Variable	Mean (SD) or N (%)			<i>F</i> - or χ^2 -value	<i>P</i> -value
Age (years)	80.27 (7.32)	80.99 (7.58)	81.77 (7.50)	6.288	0.002
Sex				10.197	0.006
Male	62.00 (8.60)	415.00 (57.60)	244 (33.80)		
Female	177.00 (6.40)	1485.00 (54.00)	1090 (39.60)		
Education	3.08 (1.27)	2.80 (1.31)	2.46 (1.13)	3.058	0.047
Facility type				177.452	<0.001
LTC hospital	57.00 (4.40)	610.00 (47.70)	613.00 (47.90)		
Nursing home	127.00 (6.90)	1086.00 (58.30)	629.00 (34.10)		
Group home	55.00 (15.70)	204.00 (57.30)	91.00 (26.00)		
CIRS: total score	3.84 (1.17)	3.94 (1.83)	3.84 (1.72)	0.562	0.570
NPI-Q	7.75 (3.30)	9.63 (3.60)	9.19 (3.57)	6.684	0.001
MMSE-DS	11.91 (4.78)	9.09 (3.10)	6.61 (3.69)	112.472	<0.001
Number of medications	3.99 (3.06)	4.40 (3.01)	4.92 (2.99)	15.954	<0.001
BMI (kg/m ²)	27.38 (5.00)	24.28 (5.28)	19.42 (4.53)	398.874	<0.001

BMI, Body Mass Index; CIRS, Cumulative Illness Rating Scale; LTC, long-term care; MMSE-DS, Mini-Mental State Examination-Dementia Screening; NPI-Q, Neuropsychiatric Inventory Questionnaire; SD, standard deviation.

Table 3 Comparison of the functional characteristics of older adults with dementia in long-term institutions, based on the Mini Nutritional Assessment categories ($n = 3472$)

	Adequate nutrition (<i>n</i> = 239, 6.9%)	At risk of malnutrition (<i>n</i> = 1900, 54.7%)	Malnutrition (<i>n</i> = 1333, 38.4%)		
Variable	Mean (SD) or N (%)			<i>F</i> - or χ^2 -value	<i>P</i> -value
ADLs	72.51 (23.40)	41.59 (20.09)	19.70 (10.17)	533.956	< 0.001
Number of disabilities	3.67 (3.35)	7.28 (3.09)	9.05 (2.02)	440.441	< 0.001
Hand-grip strength (kg)	13.74 (6.72)	10.00 (5.12)	7.90 (4.50)	109.394	< 0.001
Vision	3.33 (0.74)	3.05 (0.88)	2.92 (0.93)	24.042	< 0.001
Hearing	3.39 (0.71)	3.16 (0.81)	2.97 (0.92)	32.463	< 0.001
Facial paralysis				0.430	0.890
No	235.00 (98.30)	1846.00 (97.70)	1286.00 (97.80)		
Yes	4.00 (1.70)	44.00 (2.30)	29.00 (2.20)		
Left upper-extremity paralysis				25.763	<0.001
No	232.00 (97.90)	1762.00 (93.50)	1171.00 (89.80)		
Yes	5.00 (2.10)	123.00 (6.50)	133.00 (10.20)		
Right upper-extremity paralysis				30.853	<0.001
No	234.00 (98.70)	1786.00 (94.70)	1181.00 (91.00)		
Yes	3.00 (1.30)	96.00 (5.30)	117.00 (9.00)		
Left lower-extremity paralysis				73.057	<0.001
No	234.00 (98.70)	1696.00 (90.30)	1074.00 (82.40)		
Yes	3.00 (1.30)	182.00 (9.70)	229.00 (17.60)		
Right lower-extremity paralysis				70.783	<0.001
No	232.00 (97.90)	1715.00 (91.70)	1085.00 (83.70)		
Yes	5.00 (2.10)	156.00 (8.30)	212.00 (16.30)		

ADL, activities of daily living; SD, standard deviation.

older adults with dementia (Galesi, Leandro-Merhi, & de Oliveira, 2013), facilities would do well to closely monitor these individuals' oral intake in order to prevent inadequate nutrition.

The results of the present study demonstrated that the participants who were taking fewer (<4) medications were found to have better nutrition than were those who were taking more medications. This was similar to

Brownie's (2006) finding that medications can interfere with nutrient absorption, metabolism, and excretion and result in nutritional decreases, but it is not consistent with the study by Smoliner *et al.* (2009) that showed that the number of prescriptions was not a significant factor for malnutrition in nursing home residents in Germany. Medication can induce unintentional weight loss and malnutrition that are related to side-effects, such as anorexia and/or nausea, gastrointestinal irritation, constipation, diarrhea, cognitive impairment, hypermetabolism, and/or somnolence (Sloane *et al.*, 2008). Therefore, it might be very important to regularly review the medications of residents in LTC settings and closely monitor them for the adverse effects described above when residents take one of the common agents that cause eating and nutritional problems.

In the present study, the nutritional status of the older adults with dementia varied according to the type of LTC setting. The LTC hospitals had the highest occurrence of malnutrition (47.9%), followed by nursing homes (34.1%) and group homes (25.9%). It also was found that the percentage of residents who were at risk of malnutrition was the highest in nursing homes and that the proportion of residents with adequate nutrition was the highest in group homes. Considering the rising levels of frailty as a resident moves from a group home to a nursing home to a LTC hospital, it is not unexpected that a higher percentage of patients in LTC hospitals suffer from malnutrition or that residents in nursing homes face the highest risk of malnutrition. This finding suggests that nutritional issues may differ by facility type. Accordingly, nutrition goals and management strategies need to take the setting into account in order to adequately address the nutrition problems of residents in different types of care. Institutional factors, such as staff members who conduct the screening for malnutrition, feeding times, the level of staff training, and the level of residents' frailty, also need be considered (Sloane *et al.*, 2008; Volkert *et al.*, 2015).

In terms of disease characteristics, the present study found that the MMSE-DS and the NPI-Q were significant variables in understanding the nutritional status of older adults with dementia. This is consistent with previous studies that showed a significant association between cognitive decline and poor nutritional status (Lee & Song, 2015; Muurinen *et al.*, 2015; Orsitto, 2012). The study by Orsitto revealed that the participants with cognitive decline were less well-nourished than those whose cognition was normal (dementia = 62%, MCI = 47%, normal = 19%). Decreased cognitive function was found to affect ADLs, particularly

those related to eating, such as the ability to bring food to the mouth and the ability to chew (Galesi *et al.*, 2013; Lee & Song, 2015). Behavioral psychological symptoms, such as agitation, wandering, and hyperactivity, also might make mealtimes difficult and increase energy requirements, leading to a reduced food intake and malnutrition (Volkert *et al.*, 2015).

Consequently, the food intake of residents with dementia in LTC settings should be supervised, encouraged, and supported by appropriate nursing that is tailored to individual needs and resources in order to overcome existing problems and behavioral symptoms, as well as to promote independence as much as possible (Volkert *et al.*, 2015). Although most of the studies to date have not been randomized controlled trials and thus have not had rigorous designs, a few key interventions have been effective in improving the eating performance of LTC residents with dementia: mealtime assistance that is offered by nursing staff (e.g. verbal prompts and cues, positive reinforcement, appropriate praise and encouragement), increased time spent by nurses on feeding, specific behavioral and communication strategies during meals, and training programs that target older adults (e.g. Montessori methods and spaced retrieval) (Keller, 2016; Liu, Galik, Boltz, Nahm, & Resnick, 2015; Volkert *et al.*, 2015).

The present study unexpectedly found that nutritional status was not significantly different according to the CIRS (i.e. the number and severity of comorbid diseases). This finding implies that it might be difficult to accurately convey the burden of multiple conditions on older adults with dementia by using a single index. A study by Borson, Scanlan, Lessig, and DeMers (2010) suggested that a combination of a comprehensive measure, the Cumulative Illness Rating Scale for Geriatrics and a simple and automatic measure, the Chronic Disease Score, would be ideal to measure the comorbidities in the older population. On the contrary, in the present study, ADLs had the most significant association with nutritional status in all measures of functional characteristics. This result is consistent with previous studies that found diminished functional ability was significantly correlated with the nutritional status of LTC residents with or without dementia (Lee & Song, 2015; Sloane *et al.*, 2008). Therefore, the functional ability, regardless of whether it is overall or specific, rather than the number of diseases, is a better indicator for recognizing LTC residents with dementia who are at risk for malnutrition.

This finding also suggests that older adults with dementia in LTC settings need different levels of

assistance while eating, depending on their degree of physical disability. Regular screening, followed by an individual assessment, should include a more detailed evaluation of the functional ability of the resident, including specific eating problems and behavioral symptoms during mealtimes (Gaskill *et al.*, 2008; Lee & Song, 2015; Watterson *et al.*, 2009). Although screening tools for malnutrition focus on relevant problems that affect older adults' nutritional status, they are not a substitute for an individualized nutritional assessment that systematically addresses the types and causes of malnutrition, defines the nutritional problems, and leads to planned interventions (Skates & Anthony, 2012). Reliable and valid instruments, such as the Edinburgh Feeding Evaluation in Dementia scale (Watson & Deary, 1994) and the Eating Behavior Scale (Tully, Matrakas, Muir, & Musallam, 1997), might be helpful in assessing the eating behavior of LTC residents with dementia and in planning an appropriate multidimensional intervention so that they can continue to feed themselves at mealtimes. In addition, nutritional management programs should focus on maintaining as long as possible both the physical and cognitive functions that are needed for eating.

As nurses are the primary interface between the patient and the LTC system, it is recommended that they play an important role in advocating for nutritional care of the general LTC population at risk (Gaskill, Isenring, Black, Hassall, & Bauer, 2009; Skates & Anthony, 2012), especially in settings with limited access to the services of a registered dietitian. However, more evidence is needed in order to explore the role of nurses in undertaking nutrition screening and basic nutrition treatment in order to prevent malnutrition in LTC residents with dementia, who are quite heterogeneous and complicated in terms of nutritional management. Meanwhile, many studies have identified that caregivers' lack of awareness of, and knowledge about, nutrition is a major barrier in efforts to prevent residents' malnutrition and dehydration (Beattie *et al.*, 2014; Lindorff-Larsen *et al.*, 2007), suggesting that improvements in the management of nutritional issues within LTC facilities should begin with nutritional education of their care staff members (Gaskill *et al.*, 2008, 2009).

Indeed, various studies have reported that education programs that are designed to increase staff awareness regarding preventing, recognizing, assessing, and implementing the necessary nutritional changes for LTC residents, including those with dementia, were effective in improving staff knowledge and competency and

residents' nutritional status (Gaskill *et al.*, 2009; Volkert *et al.*, 2015). However, training, especially regarding effective techniques for assisting residents with dementia during mealtimes and snacks, is often inadequate (Beattie *et al.*, 2014; Sloane *et al.*, 2008). Gaskill *et al.* (2009) suggested implementing a nutrition coordinator program in which key health professionals, most appropriately registered nurses, are appointed as care coordinators. Among their functions would be to: attend educational workshops; take responsibility for the nutritional care of the residents by acting as the liaison with the nursing staff, dietitians, speech pathologists, physical and occupational therapists, and kitchen and housekeeping staff; and facilitate in-service sessions about the nutritional strategies that they learned in the workshops. The implementation of this program will probably require a shift in the culture of LTC facilities, not only in Korea but also in many countries worldwide. This shift would be consistent with the current move to provide more individual-directed care and thus improve the quality of life of LTC residents with dementia. Therefore, the effort is likely to be worthwhile.

The present study has the merit of adding Korean information to the body of literature that exists. However, some limitations need to be mentioned. First, even though the sample size was large enough to produce reliable national estimates, only ~38% of the 655 randomly selected LTC facilities participated in the study, which could have affected the results. Second, the study was cross-sectional, which does not allow causal relationships to be established among the variables. It would add much value to conduct further cohort studies in order to examine the relationships between changes in nutritional status and the related factors according to dementia progress. Third, the study did not consider the different types of dementia and their relationship with nutritional status. Therefore, it is difficult to examine the association between the disease type and nutritional status and compare this study's results with other studies. It is recommended that further research include the types of dementia in data collection because the nature and pathophysiology of other common dementias, such as vascular dementia, differ from that of Alzheimer's disease. Finally, the study did not include psychosocial and environmental variables and thus it was impossible to discuss the multifactorial aspects of malnutrition in older adults with dementia in LTC settings. Future studies could investigate the impact of psychosocial and environmental factors on the maintenance of nutritional status, as well as improvements in quality of life and health outcomes for LTC residents with dementia.

CONCLUSION

The nutritional status of Korean older adults with dementia living in LTC settings is at great risk and these residents require special attention so that they can achieve optimal nutrition levels. As did previous studies, this study found that cognitive function, physical function, and dementia-related behavioral and psychological symptoms were positively associated with nutritional status. Both effective nutritional screening that can identify those with malnutrition or who are at risk of malnutrition and individualized nutritional assessments that systematically address the types and causes of malnutrition are necessary in order to maintain or to restore the nutritional status of older adults with dementia in LTC settings. Different types of LTC facilities have different priorities for addressing nutritional issues; thus, systematic approaches, based on the best evidence available, need to focus on individualizing each resident's nutritional management. More studies with similar LTC systems in different cultures could help to understand the effects of the facility type on the nutritional status of these older adults.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

M. P. and J-A. S. contributed to the conception and design of the study; M. P., J-A. S., M. L., H. J., S. L., H. L., C-G. K., J. S. K., K.S.K., Y. W. L., Y. M. L., Y. S. P., J. C. Y., K.W.K., and G-R. S. H. acquired the data; M. P. and J-A. S. contributed to the analysis and interpretation of the data; M. P., J-A. S., M. L., H. J., and S. L. drafted the article and revised it critically for important intellectual content. All the authors made a

final approval of the version of the manuscript to be submitted.

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