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Impact of Functional Capacity on Nutritional Status of Hospitalized Elderly in Qazvin, Iran

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Abstract

Background: Lack of independence and unwanted dependence on others for activities of daily living (ADL) and decreased functional capacity affect nutritional status of the elderly.
Objectives: The aim of this study was to determine the impact of functional capacity on malnutrition status in hospitalized elderly patients in the Qazvin city of Iran.
Patients and Methods: This cross sectional study was conducted on patients 60 years or older hospitalized in two teaching hospitals of Qazvin, Iran, from May to October 2011. The nutritional status was assessed using the mini nutritional assessment (MNA) questionnaire. Functional capacity of the elderly was assessed using self-report questionnaires of ADL and Instrumental Activities of Daily Living (IADL). Data were analyzed using the Chi-square test and logistic regression analysis.
Results: Of the 322 participant, 171 (53.1%) were male. The mean age was 70.36 ± 7.8 years. Based on MNA, 96 patients (29.8%) had normal nutritional status, 138 (42.9%) were at risk of malnutrition and 43 (13.4%) had malnutrition. Dependency on ADL and IADL was significantly associated with malnutrition and risk of malnutrition. In the logistic regression analysis, IADL was associated with malnutrition (OR: 1.19, 95% CI: 1.07 - 1.33; $P < 0.001$).
Conclusions: Risk of malnutrition as well as reduced functional ability was high among the hospitalized elderly of Qazvin. Nutritional status assessment of older adults is necessary, particularly when they are admitted to hospitals.

Keywords: Aged, Nutrition Assessment, Activities of Daily Living, Malnutrition

1. Background

The phenomenon of population aging is one of the most important economic, social and health challenges of the 21st century (1). Average annual growth of the elderly population in Iran was about 3.9%, between 2006 and 2011, which will reach 26% by 2050 (2). Life expectancy for Iranian males and females is estimated to be 72.2 and 73.9 years, respectively (3). Aging is associated with various physiological and psychological changes and makes older adults vulnerable to poor nutrition, which is followed by a higher risk of malnutrition (4, 5). Poor nutrition is associated with low quality of life, morbidities and higher mortality due to chronic diseases, sensory defects (vision or hearing loss), taking multiple drugs, poor socioeconomic status, physical disability, sedentary lifestyle and depression. All of these factors make older adults more likely to be malnourished and more prone to hospitalization (6-8). Malnourishment is a serious and common problem among older adults and can result in weakened physiological and functional conditions and physical performance (5, 9). Unintentional and unexplained weight loss is considered as a major indicator of malnutrition among the older population (10). Lack of independence and unwanted dependence on others for activities of daily living (ADL) as well as decreased functional capacity affect nutritional status of the elderly (4). Reduced functional capacity is defined as a defect in self-care skills, which, in many cases, can lead to prolonged hospital stays and increased mortality as well as high costs of care (11). Several studies have shown a close relationship between nutritional status and functional capacity, particularly among older adults (9, 12, 13). However, the current knowledge about the relevance of functional capacity and nutritional status is not enough for the Iranian population. Hospitalized olderly need more attention due to their morbidities and related disabilities. On the other hand, hospital admission as an access

point provides an opportunity for early identification and treatment of malnutrition. Evaluation of the nutritional status of elderly is extremely important considering the growing population of older adults in Iran, and lack of studies on the association of nutritional status and functional capacity of hospitalized olderly.

2. Objectives

The aim of this study was to determine the impact of functional capacity on malnutrition status in hospitalized elderly of Qazvin, Iran.

3. Patients and Methods

This cross sectional study was conducted on olderly patients hospitalized in the medical and surgical wards of two teaching hospitals of Qazvin from May to October 2011. The ethics committee of Qazvin University of Medical Sciences approved the study. All participants provided a written informed consent. Inclusion criteria were age ≥ 60 years and ability for verbal communication to answer the questions. Patients who had a history of severe mental diseases resulting in hospitalization within the last six months were excluded. The sample size was calculated using the following formula:

$$n = \frac{Z^2_{1-\frac{\alpha}{2}} P(1-P)}{d^2}$$

Considering Z as the statistic corresponding to the level of confidence, α: 0.05, precision (d): 6%, and prevalence of malnutrition (P): 55% (14), the calculated sample size (n) was 275. During the study period, all hospitalized patients that met the inclusion criteria (364) were selected to increase the study power. To avoid the influence of confounding factors such as changes in the patient's body mass index (BMI) due to hospital diets, treatment process and drugs, data collection was carried out during the first 24 hours after hospital admission. Demographic characteristics of the participants were recorded using their medical files. Two trained interviewers filled out the questionnaires. The nutritional status was assessed using the mini nutritional assessment (MNA) questionnaire (15). The MNA is a validated and widely used assessment tool that is effective for evaluating the nutritional status of older adults in various settings. The validity and reliability of the Persian version of this questionnaire have been previously confirmed by the study of Amirkalali et al. (16). The questionnaire consists of 18 items in four categories, including anthropometric data, general assessment, nutritional assessment and self-assessment. Scores of ≥ 24 are considered as normal nutritional status; 17-23 indicates the risk of malnutrition; and scores of < 17 are considered as malnutrition (15). Functional capacity of elderly was assessed using the ADL self-report questionnaire (17). Khoei et al. translated and validated these scales for the Iranian elderly population, previously (18). The ADL questionnaire includes questions about eating, putting on and taking off clothes, tasks related to adornment and grooming (such as combing hair, etc.), walking and mobility, and going to the bathroom and toilet. The instrumental activities of daily living (IADL) was assessed using six questions about using the telephone, shopping, preparing meals, housekeeping and laundry, taking medications as prescribed (i.e. self-medicating), and managing money. These activities are rated on a three-point scale, ranging from independent (without help 1) to relatively dependent (with a little help 2); to completely dependent (not able to do 3). Higher scores indicate greater dependence (19). Data were recorded as mean ± standard deviation (SD) or as numbers (percentages). Categorical variables were analyzed using the chi square test. Association of MNA scores, ADL and IADL was assessed using the Spearman correlation coefficient. A logistic regression analysis was used to examine the association of nutritional status and ADL and IADL. Scores of ≥ 24 were considered as normal nutritional status and scores of < 24 were considered as abnormal nutritional status for logistic regression analysis. P values of less than 0.05 were considered significant.

4. Results

Of the 364 eligible patients, 322 patients participated in the study. Of these 322 participants, 171 (53.1%) were male, and 216 (67.1%) and 106 (32.9%) were hospitalized in internal wards and surgical wards, respectively. The mean age was 70.36 ± 7.8 years and the mean BMI was 25.88 ± 4.88 kg/m^2. Based on MNA, 96 patients (29.8%) had normal nutritional status, 138 (42.9%) were at risk of malnutrition and 43 (13.4%) had malnutrition. Characteristics of the study subjects by nutritional status are shown in Table 1. Malnutrition was associated with a BMI of lower than 19, severe loss of appetite, weight loss in three months, and inability of motion (P < 0.001). The functional autonomy status for ADL and IADL among hospitalized elderly by nutritional status is shown in Tables 2 and 3. Overall, 29.2% of the participants had complete or some dependency for at least one component of the ADL while 86.6% needed assistance for at least one component of the IADL. Furthermore, 61.01% of the participants had complete or some dependency on meal prepation. Dependency was significantly associated with malnutrition and risk of malnutrition.

There was a negative significant correlation between MNA scores and ADL scores (r: -0.405, P < 0.001) and IADL scores (r: -0.492, P < 0.001). In the logistic regression analysis, IADL was associated with malnutrition. The higher the dependency for IADL, the higher the probability of malnutrition (OR: 1.19, 95% CI: 1.07 - 1.33; P < 0.001). However, there was not such association between ADL and malnutrition. Upper BMI (OR: 0.869, 95% CI: 0.809 - 0.934; P < 0.001), the ability to leave home (OR: 0.122, 95% CI: 0.052 - 0.291; P < 0.001), and independent living (OR: 0.424, 95% CI: 0.207 - 0.869; P = 0.019) were protective factors of malnutrition.

Table 1. Characteristics of the Study Subjects by Nutritional Status[a,b]

Variables	Malnutrition	At Risk of Malnutrition	Normal Nutritional Status	χ^2
BMI, kg/m²				46.08
< 19	10 (62.5)	4 (25)	2 (12.5)	
19 - 20.99	4 (15.4)	22 (84.6)	0	
21 - 22.99	4 (10.8)	18 (48.6)	15 (40.5)	
23 ≤	25 (12.6)	94 (47.5)	79 (39.9)	
The appetite in the last three months				86.49
Intensive decline in appetite	12 (57.1)	9 (42.9)	0	
Medium decline in appetite	27 (22.3)	75 (62)	19 (15.7)	
Without decline in appetite	4 (3)	54 (40)	77 (57)	
Weight loss in three months				100.1
> 3 kg	9 (25.7)	25 (71.4)	1 (2.9)	
1 - 3 kg	5 (8.5)	37 (62.7)	17 (28.8)	
Without weight loss	3 (2.9)	32 (30.5)	70 (66.7)	
No information	26 (33.3)	44 (56.4)	8 (10.3)	
Ability of motion				89.03
Enclosed in a bed or chair	13 (68.4)	6 (31.6)	0	
Able of get out of bed/chair but can not leave the house	22 (35.5)	32 (51.6)	8 (12.9)	
Able to leave the home	8 (4.1)	100 (51)	88 (44.9)	

[a]Values are expressed as No. (%).
[b]P Value < 0.001.

Table 2. Functional Autonomy for Activity of Daily Living (ADL) Among Hospitalized Elderly by Nutritional Status[a,b]

Variables	Total	Malnutrition (n = 43)	At Risk of Malnutrition (n = 138)	Normal Nutritional Status (n = 96)	χ^2
Eating					63.61
Independence	224	21 (9.4)	113 (50.4)	90 (40.2)	
Some dependence	20	5 (25)	13(65)	2 (10)	
Complete dependence	23	16 (69.6)	5 (21.7)	2 (8.7)	
Dressing					79.50
Independence	238	21 (8.8)	122 (51.3)	95 (39.9)	
Some dependence	22	8 (36.4)	13 (59.1)	1 (4.5)	
Complete dependence	17	14 (82.4)	3 (17.6)	0	
Grooming					92.43
Independence	233	20 (8.6)	119 (51.1)	94 (40.3)	
Some dependence	26	7 (26.9)	17 (65.4)	2 (7.7)	
Complete dependence	18	16 (88.9)	2(11.1)	0	
Walking					78.81
Independence	224	17 (7.6)	115 (51.3)	92 (41.1)	
Some dependence	31	10 (32.3)	18 (58.1)	3 (9.7)	
Complete dependence	22	16 (72.7)	5 (22.7)	1 (4.5)	
Transferring					93.94
Independence	220	15 (6.8)	113 (51.4)	92 (41.8)	
Some dependence	34	10 (29.4)	20 (58.8)	4 (11.8)	
Complete dependence	23	18 (87.3)	5 (21.7)	0	
Bathing					64.43
Independence	230	20 (8.7)	118 (51.3)	92 (40)	
Some dependence	23	7 (30.4)	13 (56.5)	3 (13)	
Complete dependence	24	16 (66.7)	7 (29.2)	1 (4.2)	
Toileting					65.41
Independence	238	22 (9.2)	123 (51.7)	93 (39.1)	
Some dependence	19	7 (36.8)	10 (52.6)	2 (10.5)	
Complete dependence	19	14 (73.7)	4 (21.1)	1 (5.3)	

[a]Values are expressed as No. (%).
[b]P Value < 0.001.

Table 3. Functional Autonomy for Instrumental Activity of Daily Living (IADL) Among Hospitalized Elderly by Nutritional Status[a,b]

Variables	Total	Malnutrition (n = 43)	At risk of malnutrition (n = 138)	Normal nutritional status (n = 96)	χ^2
Phone use					27.23
Independence	141	8 (5.7)	74 (52.5)	59 (41.8)	
Some dependence	43	7 (16.3)	24 (55.8)	12 (27.9)	
Complete dependence	93	28 (30.1)	40 (43)	25 (26.9)	
Shopping					68.75
Independence	140	4 (2.9)	64 (45.7)	72 (51.4)	
Some dependence	57	8 (14)	35 (61.4)	14 (24.6)	
Complete dependence	80	31 (38.8)	39 (48.8)	10 (12.5)	
Meal preparation					33.21
Independence	108	4 (3.7)	54 (50)	50 (46.3)	
Some dependence	76	10 (13.2)	42 (55.3)	24 (31.6)	
Complete dependence	93	29 (31.2)	42 (45.2)	22 (23.7)	
Cleaning					33.94
Independence	97	3 (3.1)	47 (48.5)	47 (48.5)	
Some dependence	80	10 (12.5)	43 (53.8)	27 (33.8)	
Complete dependence	100	30 (30)	48 (48)	22 (22)	
Self-medicating					39.5
Independence	174	14 (8)	83 (47.7)	77 (44.3)	
Some dependence	51	9 (17.6)	33 (64.7)	9 (17.6)	
Complete dependence	52	20 (38.5)	22 (42.3)	10 (19.2)	
Handling money					45.23
Independence	129	6 (4.7)	57 (44.2)	66 (51.2)	
Some dependence	23	2 (8.7)	13 (56.5)	8 (34.8)	
Complete dependence	125	35 (28)	68 (54.4)	22 (17.6)	

[a] Values are expressed as No. (%).
[b] P Value < 0.001.

5. Discussion

Aging is associated with dependency in ADL due to reduced functional and physical abilities, so it can affect nutritional status of the elderly. Hospitalized old patients are expectedly at risk of malnutrition and nutritional disorders (20, 21). In the present study, 42.9% of the patients were at risk of malnutrition and 13.4% were malnourished. In a study by Tanjani et al. on a representative sample of elderly in Iran, 41.3% were at risk of malnutrition and 5.5% were malnourished (22). In another study, Amirkalali et al. reported 43.4% risk of malnutrition and 3.2% malnutrition in nursing home elderly (16). In the study of Kaiser et al. on 24 data sets from 12 countries and in four settings (hospital, rehabilitation, nursing home and community), the overall prevalence of malnutrition and at risk of malnutrition was 22.8% and 46.2% in elderly people, respectively. However, the prevalence of malnutrition in hospital settings was 38.7% (20). In a study by Andre et al. on 370 elderly people in Congo, malnutrition was found in 28.4% of the participants, while 57.8% were at risk of malnutrition (5). The present study showed an association between nutritional status and functional capacity among elderly, which is consistent with other studies (5, 21, 23-25). There was an interrelationship between nutritional status and functional capacity. It is known that functional impairment increases the vulnerability and may affect food consumption negatively. Lack of functional autonomy to look after one self, to prepare proper foods, and to eat foods is a factor that can result in malnutrition. However, the association of nutritional condition with physical performance, fatigue, and falling is not completely conceived because of the limitations of most studies or use of self-reported tools to evaluate physical function (26). In the present study, there was a significant relationship between BMI and nutritional status, which is consistent with previous studies (5, 24, 27, 28). Oliveira et al. stated that BMI is the best anthropometric indica-

tor of nutritional status in the elderly while arm circumference alone is not a good indicator (8). In the study of Cereda et al., malnutrition and poor functional capacity were associated with low BMI, poor nutritional habits, severe weight loss, reduced food intake and disability (13). In the present study, 29.2% of the participants needed help for at least one component of the ADL, which was consistent with the results of the study of Danielewicz et al. (25). In another study by Mattos et al. from the Netherlands, only 15% of older adults needed help for their activities of daily living (29). In the present study, 61.01% of the participants had some kind of dependency in meal predation. Such results clearly denote the need of elderly for support from family members or health-care providers. However, the reality is that there are almost no formal services to take care of the elderly in their daily activities in rural areas and family members are their only source of support. Functional dependence may affect personal values, interpersonal communication, and emotions of older adults as well as their nutritional condition. Lack of adequate nutrition is one of the causes of malnutrition whereas physical and functional limitations lead to a lack of adequate food intake (8). Decreased functional capability causes dependence in ADL and can strongly influence nutritional status of the elderly (4). In the present study, there was a significant association between malnutrition and risk of malnutrition with reduced functional capacity and dependency of the elderly. In contrast, other studies have shown that nutritional condition and MNA can be considered as an indicator or predictive factor for functional capacity of older adults (9, 11, 13). In a study on old Taiwanese individuals, by brief nutritional assessment, lower nutritional status predicted a higher risk of dependency on others for ADL and IADL. Hence, the assessment of nutritional status may be a predictive factor for reduced functional capacity in the elderly (10). In the present study, the dependency of older adults in IADL was associated with 1.19 times decrease in the likelihood of malnutrition. It might be rational to consider IADL and BMI as the predictors of nutritional status of hospitalized elderly patients. Many studies have indicated that BMI, IADL and reduced food intake are powerful predictors for the nutritional status of the elderly (4, 9, 13). In the study of Cereda et al., the poorer functional status was found to be associated with low BMI, sarcopenia and reduced oral intake, and the MNA identified at risk elderly needing more care, specialy for eating (13). It has also been confirmed that the prevalence of malnutrition is associated with the level of dependence in older populations and all the ADL and IADL variables are significantly more prevalent among the malnourished elderly (8). On the other hand, it has been shown that functional incapacity is positively associated with health conditions and sociodemographic factors among the elderly (30, 31). The present study had some limitations including its cross sectional design. More comprehensive studies with larger sample sizes are needed in different hospital wards and in different variable settings to establish the association of nutritional status and functional capacity in the elderly.

5.1. Conclusion

Risk of malnutrition as well as reduced functional ability is high among the hospitalized elderly of Qazvin. Currently, there is no specific nutritional status screening for the elderly population during hospital admissions. Nutritional status assessment of the older adults is necessary particularly when they are admitted to hospitals. Considering the high prevalence of malnutrition among the hospitalized elderly in the present study, early detection of malnutrition among elderly is important to improve their nutritional status by appropriate and on time interventions. Hospital admission prepares a good opportunity to interact with older adults and teach them about proper nutrition and functional capacity to improve their quality of life. Establishing comprehensive and social programs for the elderly is also a necessity for the upcoming years.

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Footnotes

Authors' Contribution: Study concept and design: Azam Ghorbani, Leila Dehghankar; analysis and interpretation of data: Sonia Oveisi; drafting of the manuscript: Akram Shahrokhi; critical revision of the manuscript for important intellectual content: Akram Ghorbani, Neda Esmailzadehha and Akram Shahrokhi; acquisition of data: Sonia Oveisi; statistical analysis: Sonia Oveisi and Neda Esmailzadehha; administrative, technical and material support: Leila Dehghankar; study supervision: Azam Ghorbani.

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References

1. Prettner K. Population aging and endogenous economic growth. *J Popul Econ*. 2013;**26**(2):811–34. doi: 10.1007/s00148-012-0441-9. [PubMed: 23576847]
2. Ministry of Cooperatives and social welfare work dcs Statistics selection of Number Eleven. *Department of Cooperative work and social welfare*. 2012.
3. Ostovar R, Salesi M, Mirzaee M, Hajivandi A, Mansorian MA. Life expectancy at birth for the rural population of Islamic Republic of Iran, by sex and age groups, 2007. *Life Science Journal*. 2012;**9**(3)
4. Han Y, Li S, Zheng Y. Predictors of nutritional status among community-dwelling older adults in Wuhan, China. *Public Health Nutr*. 2009;**12**(8):1189–96. doi: 10.1017/s1368980008003686. [PubMed: 18789169]

5. Andre MB, Dumavibhat N, Ngatu NR, Eitoku M, Hirota R, Suganuma N. Mini Nutritional Assessment and functional capacity in community-dwelling elderly in Rural Luozi, Democratic Republic of Congo. *Geriatr Gerontol Int.* 2013;**13**(1):35–42. doi: 10.1111/j.1447-0594.2012.00852.x. [PubMed: 22530787]
6. Morley JE. Undernutrition in older adults. *Family Practice.* 2012;**29**(suppl 1):i89–93. doi: 10.1093/fampra/cmr054. [PubMed: 22399563]
7. Karimzadeh T, Azadmanesh Y. Nutritional assessment in elderly hospitalized patients in Qazvin Teaching Hospitals in 2011. *Iranian Journal of Ageing.* 2013;**8**(28):33–40.
8. Oliveira MRM, Fogaça KCP, Leandro-Merhi VA. Nutritional status and functional capacity of hospitalized elderly. *Nutrition Journal.* 2009;**8**(1):54. doi: 10.1186/1475-2891-8-54. [PubMed: 19919711]
9. Lee LC, Tsai AC. Mini-Nutritional Assessment predicts functional decline of elderly Taiwanese: result of a population-representative sample. *Br J Nutr.* 2011;**107**(11):1707–13. doi: 10.1017/s0007114511004880. [PubMed: 21910948]
10. Ucak S, Basat O, Karatemiz G. Functional and Nutritional State in Elderly Men With Compensated Hypogonadism. *J Am Med Dir Assoc.* 2013;**14**(6):433–6. doi: 10.1016/j.jamda.2013.03.006. [PubMed: 23623521]
11. Abd-Al-Atty MF, Abou-Hashem RM, Abd Elaziz KM. Functional capacity of recently hospitalized elderly in relation to nutritional status. *Eur Geriatr Med.* 2012;**3**(6):356–9. doi: 10.1016/j.eurger.2012.08.003.
12. Saka B, Kaya O, Ozturk GB, Erten N, Karan MA. Malnutrition in the elderly and its relationship with other geriatric syndromes. *Clinical Nutrition.* 2010;**29**(6):745–8. doi: 10.1016/j.clnu.2010.04.006. [PubMed: 20627486]
13. Cereda E, Valzolgher L, Pedrolli C. Mini nutritional assessment is a good predictor of functional status in institutionalised elderly at risk of malnutrition. *Clin Nutr.* 2008;**27**(5):700–5. doi: 10.1016/j.clnu.2008.06.001. [PubMed: 18625540]
14. Mokhber N, Majdi M, Ali-Abadi M, Shakeri M, Kimiagar M, Salek R, et al. Association between Malnutrition and Depression in Elderly People in Razavi Khorasan: A Population Based-Study in Iran. *Iran J Public Health.* 2011;**40**(2):67–74. [PubMed: 23113074]
15. Guigoz Y, Lauque S, Vellas BJ. Identifying the elderly at risk for malnutrition. *Clinics in Geriatric Medicine.* 2002;**18**(4):737–57. doi: 10.1016/s0749-0690(02)00059-9. [PubMed: 12608501]
16. Amirkalali B, Sharifi F, Fakhrzadeh H, Mirarefin M, Ghaderpanahi M, Larijani B. Evaluation of the Mini Nutritional Assessment in the elderly, Tehran, Iran. *Public Health Nutrition.* 2010;**13**(09):1373–9. doi: 10.1017/s1368980010000303. [PubMed: 20188008]
17. Katz S, Ford AB, Moskowitz RW, Jackson BA, Jaffe MW. Studies of Illness in the Aged. The Index of Adl: A Standardized Measure of Biological and Psychosocial Function. *JAMA.* 1963;**185**:914–9. [PubMed: 14044222]
18. Khoei MA, Akbari ME, Sharifi F, Fakhrzadeh H, Larijani B. Translation and validation of the activities of daily living scale with Iranian elderly cancer patients treated in an oncology unit. *Asian Pac J Cancer Prev.* 2013;**14**(5):2731–7. [PubMed: 23803023]
19. Lawton MP, Brody EM. Assessment of older people: self-maintaining and instrumental activities of daily living. *Gerontologist.* 1969;**9**(3):179–86. [PubMed: 5349366]
20. Kaiser MJ, Bauer JM, Rämsch C, Uter W, Guigoz Y, Cederholm T, et al. Frequency of Malnutrition in Older Adults: A Multinational Perspective Using the Mini Nutritional Assessment. *J Am Geriatr Soc.* 2010;**58**(9):1734–8. doi: 10.1111/j.1532-5415.2010.03016.x. [PubMed: 20863332]
21. Chen CC, Schilling LS, Lyder CH. A concept analysis of malnutrition in the elderly. *J Adv Nurs.* 2001;**36**(1):131–42. [PubMed: 11555057]
22. Tanjani PT, Motlagh ME, Nazar MM, Najafi F. The health status of the elderly population of Iran in 2012. *Archives of Gerontology and Geriatrics.* 2015;**60**(2):281–7. doi: 10.1016/j.archger.2015.01.004. [PubMed: 25619817]
23. Alipanah N, Varadhan R, Sun K, Ferrucci L, Fried LP, Semba RD. Low serum carotenoids are associated with a decline in walking speed in older women. *J Nutr Health Aging.* 2009;**13**(3):170–5. [PubMed: 19262947]
24. Aliabadi M, Kimiagar M, Ghayour-Mobarhan M, Shakeri MT, Nematy M, Ilaty AA, et al. Prevalence of malnutrition in free living elderly people in Iran: a cross-sectional study. *Asia Pac J Clin Nutr.* 2008;**17**(2):285–9. [PubMed: 18586650]
25. Danielewicz AL, Barbosa AR, Del Duca GF. Nutritional status, physical performance and functional capacity in an elderly population in southern Brazil. *Rev Assoc Med Bras.* 2014;**60**(3):242–8. [PubMed: 25004270]
26. Sharkey JR. Nutrition risk screening: the interrelationship of food insecurity, food intake, and unintentional weight change among homebound elders. *J Nutr Elder.* 2004;**24**(1):19–34. doi: 10.1300/J052v24n01_02. [PubMed: 15339718]
27. Fontana L, Klein S. Aging, adiposity, and calorie restriction. *JAMA.* 2007;**297**(9):986–94. doi: 10.1001/jama.297.9.986. [PubMed: 17341713]
28. Ledikwe JH, Smiciklas-Wright H, Mitchell DC, Jensen GL, Friedmann JM, Still CD. Nutritional risk assessment and obesity in rural older adults: a sex difference. *Am J Clin Nutr.* 2003;**77**(3):551–8. [PubMed: 12600842]
29. Mattos IE, do Carmo CN, Santiago LM, Luz LL. Factors associated with functional incapacity in elders living in long stay institutions in Brazil: A cross-sectional study. *BMC Geriatr.* 2014;**14**(47) doi: 10.1155/2014/358137.
30. Barbosa BR, Almeida JM, Barbosa MR, Rossi-Barbosa LA. [Evaluation of the functional capacity of the elderly and factors associated with disability]. *Cien Saude Colet.* 2014;**19**(8):3317–25. [PubMed: 25119071]
31. Gobbens RJJ, Van Assen MlALM. The prediction of adl and iadl disability using six physical indicators of frailty: A longitudinal study in the netherlands. *Curr Gerontol Geriatr Res.* 2014;**2014**:1–10. doi: 10.1155/2014/358137.