JRHS
Journal of Research in Health Sciences
journal homepage: www.umsha.ac.ir/jrhs

Original Article

Prevalence of Malnutrition and Its Correlates in Older Adults Living in Long Stay Institutions Situated in Beirut, Lebanon

Mohamad El Zoghbi (MS)[a], Christa Boulos (MD, PhD)[b], Sanaa Awada (PharmD, PhD)[a], Samar Rachidi (PharmD, PhD)[a], Amal Al-Hajje (PharmD, PhD)[a], Wafaa Bawab (PhD)[a], Nadine Saleh (PharmD, PhD)[c], and Pascale Salameh (PharmD, MPH, PhD)[a,c*]

[a] *Clinical and Epidemiological Research Laboratory, Faculty of Pharmacy, Doctoral School of Sciences & Technology, Lebanese University, Beirut, Lebanon*
[b] *Department of Nutrition, Faculty of Pharmacy, Saint Joseph University, Beirut, Lebanon*
[c] *Faculty of Public Health, Lebanese University, Fanar, Beirut, Lebanon*

ARTICLE INFORMATION

Article history:
Received: *04 November 2013*
Revised: *02 December 2013*
Accepted: *19 December 2013*
Available online: *25 December 2013*

Keywords:
Elderly
Malnutrition
Nutritional status
Lebanon

**** Correspondence***
Pascale Salameh (MPH, PhD)
Tel: *+96 1 3385542*
Fax: *+96 1 1696600*
E-mail1: *psalameh@ul.edu.lb*
E-mail2: *pascalesalameh1@hotmail.com*

ABSTRACT

Background: Malnutrition represents an important issue in older adults; unfortunately, there is lack of data concerning this topic in Lebanon. This paper aims to provide a description of nutritional status and its correlates in older adults living in long stay institutions situated in Beirut.

Methods: This cross-sectional study was conducted in three long stay institutions in Beirut in 2012. The study population was composed of people aged 65 years and above, having a score of Folstein Mini Mental State Examination (MMSE) greater than 14 and without renal failure requiring dialysis. Subjects meeting inclusion criteria filled out a questionnaire consisting of nutritional status scale (Mini Nutritional Assessment: MNA) and several other parts (demographic, self-assessment of the state health, smoking and alcohol, physical dependence, quality of life, frailty, depression, social isolation and loneliness). Data were entered and analyzed using the statistical software SPSS (Statistical Package for Social Sciences), version 17.0 (Chicago, IL, USA).

Results: Among 111 older adults (55 men and 56 women), 14 (12.6%) were malnourished, 54 (48.7%) were at risk of malnutrition and 43 (38.7%) had an adequate nutritional status. Multivariate analysis showed that physical exercise, depression, frailty and cognitive function were independent correlates of nutritional status of older adults. This model explained 42.2% (adjusted R^2=0.422) of the older adults nutritional status variability.

Conclusion: We found a moderate percentage of malnutrition in older adults living in long stay institutions situated in Beirut, and the correlates of malnutrition in older adults were low physical exercise, depression, frailty and low cognitive function.

Citation: El Zoghbi M, Boulos C, Awada S, Rachidi S, Al-Hajje A, Bawab W, Saleh N, Salameh P. Prevalence of Malnutrition and Its Correlates in Older Adults Living in Long Stay Institutions Situated in Beirut, Lebanon. J Res Health Sci. 2014;14(1):11-17.

Introduction

Nutritional status deterioration, favored by changes related to age, is a common phenomenon in the older adults' population and one of the main problems in geriatrics. It can be considered as one of the main factors of fragility in the older adults[1]. Malnutrition in older adults, in sense of under-nutrition (dietary deficiency), is the result of loss of appetite caused by changes in the oral apparatus, decrease salivary flow, reduced acid secretion by gastric parietal cells, gastric hypochlorhydria, slow intestinal transit by decreasing peristalsis and chronic constipation in addition to the reduction of taste, smell and vision. Loss of appetite in older adults can be exaggerated by other factors such as cognitive status[2], socio-economic (social isolation[3], low educational level or limited income[4]), neuropsychiatric disorders (depression[5]), diminished physique[6], polymedication[7] and various diseases of the digestive tube[8].

In Lebanon, a Middle Eastern Mediterranean country, retirement starts after 64 years and the person is therefore considered as an older adult. The Ministry of Social Affairs has estimated an increase from 7.5% in 2004 to 9.6% in 2009 of the population of older adults. There are 4000 older adults living in 41 long stay institutions, representing less than 1.4% of total Lebanese older adults; only five institutions are in Beirut[9]. As for the nutritional status of older adults in Lebanon, a single study has been published by Sibai and collaborators in 2003, comparing the nutritional status of 100 institutionalized older adults against 100 older adults living at home in Beirut area. It showed that the institutionalized older adults had a body mass index (BMI) and albumin levels lower than those living at home and therefore an inferior nutritional status[10]. However, the authors did not thoroughly look at malnutrition risk factors.

Ten years after this previous study[10], it was highly recommended to assess the prevalence of malnutrition (in sense of under-nutrition) and its risk factors, in older adults living in long stay institutions situated in Beirut. The findings of

this study provide an insight to this population nutritional status and possible guidance for prevention and intervention.

Methods

Study design and population

This cross-sectional study conducted from March to June 2012, was performed in three of the five long stay institutions, specialized for older adults in the area of Beirut. The study population was composed of people aged 65 years and more admitted for more than four weeks. The total number of eligible older adults in the five institutions was 495; among them, 460 (92.9%) lived in institutions participating to this study: 350 in Dar Al-Ajaza Al-Islamia Hospital, 75 in Saint George Foyer, 35 in Dar Al-Karama. In fact, in Beirut, there are only five long term care centers for older adults. Although we tried to involve the five long term care centers of Beirut, two refused to participate. The latter only include 7.1% of all older adults living in institutions of Beirut.

Among 460 potential participants, 91 refused to participate in this study from the beginning, and we excluded 28 with a renal dialysis and 206 with a score of Folstein Mini Mental State Examination (MMSE) <14 for their limited ability to understand, cooperate and communicate verbally during the interview[11]. Verbal consent was obtained for the 135 eligible older adults. After MMSE application, 24 (with MMSE ≥14) refused to continue to participate, and only 111 (22.4%) were included in this study: 72 in Dar Al-Ajaza Al-Islamia hospital, 23 in Dar Al-Karama and 16 in Foyer Saint George.

Measurements

We collected data through a face to face interview, after explanation of the study purpose. The questionnaire was divided into two parts; the first was necessary to include subjects in the study. This section included age, institutionalization length, and presence of renal failure with dialysis and evaluation of cognitive function using the MMSE score[11]. Subjects, who met the inclusion criteria, fill out the second part of questionnaire (socio-demographic information) and measurement scales with appropriate assessment tools. Patient file was used to confirm socio-demographic and health related data for each participant.

The questionnaire included five parts: socio-demographic data (gender, marital status, number of children, education level, occupation, personal resources, social coverage), health status (diseases, medications, dental problems, insomnia, digestive problems, chronic pain, hospitalization and physician visits), smoking and alcohol consumption, falls during last year and the following scales:

The Mini Nutritional Assessment (MNA) was used to assess nutritional status and diagnosing protein-energy malnutrition. It is a questionnaire of 18 items on anthropometry measures (body mass index (BMI), arm circumference, calf circumference and weight loss during the last three months), global evaluation (housing, medications number, acute diseases during the last three months, psychological stress during the last three months, mobility, bedsores), evaluation of dietary habits (number of meals per day, daily consumption of protein, consumption of fruits and vegetables, appetite during the last three months, weekly consumption of liquids and the ability to eat independently), subjective assessment (Patient self-perception of health and nutritional status). It consists of two steps; the first is a screening and includes six items. The maximum score for this section is 14; a score of 12 indicates satisfactory nutritional status. The second step consists of nine items with maximum score of 16 with more details of nutritional status. The MNA maximum score (for all items) is 30, and it is used to classify the nutritional status of older adults into three categories: a score inferior to 17 means a state of protein-energy malnutrition, a score between 17 and 23.5 means a risk of malnutrition and a score greater than 23.5 means a satisfactory nutritional status. This test is easy to use, highly sensitive (96%), specific (98%), and reliable[12].

MMSE score was used to evaluate cognitive functions and to classify older adults into two categories: a score between 14 and 24 reflected a cognitive impairment, while those with a score equal to or greater than 24 were considered normal[13]. The MMSE consists of 30 questions, with a total test score of 30 (minimum score=0). This test was used to ensure that the subjects included are eligible.

We also evaluated physical dependence of the older adults using the validated Katz scale for activities of daily living (ADL) [14]. This scale ranks adequacy of performance in the six functions of bathing, dressing, toileting, transferring, continence, and feeding. A score of six indicates full function.

We used the validated Arabic version of the World Health Organization well-being index (WHO-5) to evaluate quality of life level; this version had been validated by Sibai et al. in 2009[15]. This index consists of five questions with a maximum score of 25.

The simple version of the Study of Osteoporotic Fractures index (SOF index) was used to evaluate frailty[16], it consists of three questions. The maximum score of 3 indicates frailty.

The Geriatric Depression Scale (GDS) of five items was used to evaluate depression[17], a maximum score of five suppose a depression.

We used the Loucks Social Network Score (Loucks SNS) to assess the social isolation[18], and a maximum score of 6 indicates absence of social isolation.

Finally, the modified version of the scale Loneliness Scale Jong-Gierveld was used to assess loneliness[19], a higher score (maximum score =5) indicates a higher loneliness.

Statistical Analysis

Data were entered and analyzed using the statistical software SPSS (Statistical Package for Social Sciences), version 17.0 (Chicago, IL, USA). They were revised twice by two different people. A *P*-value <0.05 was considered significant. The chi-square test was used to compare qualitative variables and the Fisher exact test when expected values less than five. We used non-parametric tests: Wilcoxon for comparison of means between two groups and Kruskal-Wallis for more than two groups. A Spearman correlation was used to link two quantitative variables, such as MMSE and MNA scores, because both had a non normal distribution.

Moreover, a multivariate linear regression, using a forward stepwise method, was applied taking nutritional status

as the dependent variable and several independent variables into account (age, gender, institution, physical exercises, auto-evaluation of health, number of chronic diseases, dental problem, standing on one foot, alcohol consumption, depression, loneliness scale, frailty, ADL, well-being index and cognitive functions).

Results

Sample characteristics

Table 1 shows the distribution of socio-demographic characteristics of the sample by gender of older adults participating to the study. Among 111 older adults (55 men and 56 women), Women were older (78.05 ± 1.02) than males (74.49 ± 1.09) (P =0.013), including more widows (P = 0.006), previously unemployed (housewives) (P <0.001) and lower monthly income (P=0.025). Other socio-demographic characteristics did not show a significant difference between men and women participating in the study.

Mini Nutritional Assessment Items

Table 2 shows that 14 (12.6%) older adults were malnourished, 54 (48.7%) were at risk of malnutrition and 43 (38.7%) had adequate nutrition. All MNA items showed a significant difference between the three categories of classification (P<0.004).

Table 1: Comparison of characteristics of the study population by gender using Wilcoxon; chi-squared; or Fisher's Exact tests according to the condition

Characteristics	Males (n=55)	Females (n=56)	Total (n=111)	*P* value
Familial status				0.006
Married	21 (38.2)	9 (16.1)	30 (27.0)	
Divorce	9 (16.4)	5 (8.9)	14 (12.6)	
Single	18 (32.7)	22 (39.3)	40 (36.0)	
Widow	7 (12.7)	20 (35.7)	27 (24.3)	
Profession				0.001
Agriculture	1 (1.8)	0 (0.0)	1(0.9)	
Employer	28 (50.9)	14 (25.0)	42 (37.8)	
Director	2 (3.6)	2 (3.6)	4 (3.6)	
Freelance	23 (41.8)	16 (28.6)	39 (35.1)	
Unemployed	1 (1.8)	24 (42.9)	25 (22.5)	
Educational level				0.462
Illiterate	9 (16.4)	17 (30.4)	26 (23.4)	
Primary school	19 (34.5)	15 (26.8)	34 (30.6)	
Secondary school	15 (27.3)	11 (19.6)	26 (23.4)	
High school	7 (12.7)	8 (14.3)	15 (13.5)	
Academic	5 (9.1)	5 (8.9)	10 (9.0)	
Monthly income US$				0.025
<200	29 (59.2)	28 (77.8)	57 (67.1)	
200-400	12 (24.5)	8 (22.2)	20 (23.5)	
>400	8 (16.3)	0 (0.0)	8 (9.4)	

Table 2: Comparison of mini nutritional assessment (MNA) items description by different nutritional status using Kruskal-Wallis test

MNA characteristics, Mean ±SD	Malnutrition n=14	At risk of Malnutrition n=54	Normal n=43	Total n=111	*P* value
MNA full score	15.18 ±1.22	20.82 ±2.03	25.86 ±1.25	22.06 ±3.90	0.001
MNA items					
Screening	6.64 ±1.60	9.66 ±2.04	12.81 ±1.05	10.50 ±2.66	0.001
Evaluation	8.54 ±2.16	11.17 ±1.29	13.05 ±0.94	11.56 ±1.95	0.001
Body Mass Index (kg/m2)	25.48 ±6.48	25.35 ±4.71	29.18 ±5.40	26.85 ±5.50	0.001
Calf circumference (cm)	29.43 ±3.12	31.21 ±4.31	34.05 ±4.10	32.09 ±4.39	0.001
Brachial circumference (cm)	23.39 ±3.13	24.69 ±4.81	26.94 ±3.87	32.09 ±4.39	0.004

MNA and demographic characteristics

Among the various demographic characteristics (Table 3), MNA score presented a significant difference in relation to age: the mean MNA score of older adults aged between 65 and 80 years (21.50±3.99) was significantly lower than for those aged between 80 and 95 years (23.24±3.45) (P=0.025). We noted that all participants were receiving multiple vitamins and minerals oral preparations, but none of them was on intravenous medical nutritional support.

Table 3: Comparison of mini nutritional assessment (MNA) items description by demographic characteristics using Kruskal-Wallis test; chi-squared test; and Fisher's Exact test according to the condition

Characteristics; n (%)	Malnutrition (n=43)	At risk of Malnutrition (n=32)	Normal (n=85)	Total	*P* value
Age (yr)					0.243
65-80	11 (78.6)	39 (72.2)	25 (58.1)	75 (67.6)	
81-95	3 (21.4)	15 (27.8)	18 (41.9)	36 (32.4)	
Gender					0.297
Males	5 (35.7)	25 (46.3)	25 (58.1)	55 (49.5)	
Females	9 (64.3)	29 (53.7)	18 (41.9)	56 (41.9)	
Institution					0.231
Dar Al-Ajaza	10 (71.4)	37 (68.5)	25 (58.1)	72 (64.9)	
Dar Al-Karama	4 (28.6)	11 (20.4)	8 (18.6)	23 (20.7)	
Foyer Saint George	0 (00.0)	6 (11.1)	10 (23.3)	16 (14.4)	
Education					0.620
Low education	6 (42.9)	31 (57.4)	23 (53.5)	60 (54.1)	
High education	8 (57.1)	23 (42.6)	20 (46.5)	51 (45.9)	
Monthly income (US$)					0.915
<200	8 (80.0)	27 (62.8)	22 (68.7)	57 (67.1)	
200-400	2 (20.0)	11 (25.6)	7 (21.9)	20 (23.5)	
>400	0 (0.0)	5 (11.6)	3 (9.4)	8 (9.4)	

MNA score association with health status

Table 4 allows us to determine the health factors that have association with the nutritional status of older adults in this sample. Physical exercises (P=0.002), self-evaluation of health (P=0.045), number of chronic diseases (P=0.017) showed an association with nutritional status.

MNA, social, psychological and cognitive scales

Table 5 shows the presence of a significant association between MNA score and all measurement scales (GDS, loneliness scale, SOF frailty index, ADL, index of well-being and MMSE cognitive functions scale), with the exception of the social isolation scale (Loucks SNS). For Loneliness Scale, There is a significant association with MNA score, but it did not show a significant association with MNA classes.

Table 4: Comparison of mini nutritional assessment (MNA) items description by health status using Kruskal-Wallis test; Wilcoxon test; chi-squared test; and Fisher's Exact test according to the condition

Health status, n (%)	Malnutrition	Risk of malnutrition	Normal	Total	*P* value
Physical exercises					0.002
Yes	1 (7.1)	13 (24.1)	22 (51.2)	36 (32.4)	
No	13 (92.9)	41 (75.9)	21 (48.8)	75 (67.6)	
Auto-evaluation of health					0.045
Very good and good	4 (28.6)	20 (37.0)	25 (58.1)	49 (44.2)	
Moderate	7 (50.0)	22 (40.8)	16 (37.2)	45 (40.5)	
Bad and very bad	3 (21.4)	12 (22.2)	2 (4.7)	17 (15.3)	
Chronic diseases					0.430
Yes	12 (85.7)	48 (88.9)	34(79.1)	94 (84.7)	
No	2 (14.3)	6 (11.1)	9 (20.9)	17 (15.3)	
Number of diseases					0.017
0-3	9 (64.3)	40 (74.1)	40 (93)	89 (80.2)	
4-6	5 (35.7)	9 (16.7)	2 (4.7)	16 (14.4)	
>7	0 (0.0)	5 (9.2)	1 (2.3)	6 (5.4)	
Dental problem					0.207
Yes	7 (50.0)	19 (35.2)	11 (25.6)	37 (33.3)	
No	7 (50.0)	35 (64.8)	32 (74.4)	74 (66.7)	
Gastro-Intestinal problem					0.056
Yes	1 (7.1)	22 (40.7)	15 (34.9)	38 (34.2)	
No	13 (92.9)	32 (59.3)	28 (65.1)	73 (65.8)	
Falls					1.000
Yes	4 (28.6)	17 (31.5)	14 (32.6)	35 (31.5)	
No	10 (71.4)	37 (68.5)	29 (67.4)	76 (68.5)	
Standing on one foot					0.061
Yes	2 (14.3)	16 (29.6)	20 (46.5)	38 (34.2)	
No	12 (85.7)	38 (70.4)	23 (53.5)	73 (65.8)	
Smoking					0.611
Yes	4 (28.6)	20 (37.0)	12 (27.9)	36 (32.4)	
No	10 (71.4)	34 (63.0)	31 (72.1)	75 (67.6)	
Alcohol					0.140
Yes	0 (0.0)	2 (3.7)	6 (14.0)	8 (7.2)	
No	14 (100.0)	52 (96.3)	37 (86.0)	103 (92.8)	

Table 5: Comparison of mini nutritional assessment (MNA) items description by social, psychological and cognitive scales using Kruskal-Wallis test; Wilcoxon test; chi-squared test; and Fisher's exact test according to the condition

Scales	Malnutrition	Risk of malnutrition	Normal	Total	*P* value
Depression (geriatric depression scale)					
Mean ±SD	3.07 ±1.38	2.41 ±1.31	1.67 ±1.13	2.21 ±1.33	0.002
0-1 (no depression), n (%)	2 (14.3)	13 (24.1)	20 (46.5)	35 (31.5)	0.025
2-5 (depression), n (%)	12 (85.7)	41 (75.9)	23 (53.5)	76 (68.5)	
Loucks social network score					
Mean ±SD	1.86 ±1.51	2.26 ±1.39	2.30 ±1.39	2.22 ±1.40	0.566
0-2 (social isolation), n (%)	10 (71.4)	31 (57.4)	28 (65.0)	69 (62.2)	0.832
3 (second quartile), n (%)	2 (14.3)	10 (18.5)	6 (14.0)	18 (16.2)	
4 (third quartile), n (%)	1 (7.15)	11 (20.4)	6 (14.0)	18 (16.2)	
5-6 (no isolation), n (%)	1 (7.15)	2 (3.7)	3 (7.0)	6 (5.4)	
Loneliness Scale					
Mean ±SD	3.64 ±1.45	2.78 ±1.45	2.51 ±1.55	2.78 ±1.52	0.063
0-2 (low), n (%)	4 (28.6)	21 (38.9)	21 (48.8)	46 (41.4)	0.355
3-5 (high), n (%)	10 (71.4)	33 (61.1)	22 (51.2)	65 (58.6)	
Study of osteoporotic fractures frailty index					
Mean ±SD	1.29 ±0.82	1.50 ±0.93	0.79 ±0.74	1.20 ±0.90	0.001
0 (non-frail), n (%)	2 (14.3)	9 (16.7)	17 (39.5)	28 (25.2)	0.004
1 (intermediate), n (%)	7 (50.0)	16 (29.6)	18 (41.9)	41 (36.9)	
2-3 (frail), n (%)	5 (35.7)	29 (53.7)	8 (18.6)	42 (37.9)	
Activities of daily living					
Mean ±SD	3.21 ±2.11	4.17 ±1.74	5.06 ±1.57	4.39 ±1.82	0.001
0-4.5 (dependent), n (%)	9 (64.3)	27 (50)	9 (20.9)	45 (40.5)	0.002
5-6 (independent), n (%)	5 (35.7)	27 (50)	34 (79.1)	66 (59.5)	
Well-being index					
Mean ±SD	40.57 ±24.20	57.56 ±20.97	64.65 ±19.85	58.16 ±22.08	0.022
Cognitive (Mini Mental Status Examination)					
Mean ±SD	20.21 ±4.61	22.61 ±4.25	24.37 ±3.63	22.99 ±4.25	0.008
Cognitive impairment (MMSE score: 14- 24)	10 (17.2)	33 (56.9)	15 (25.9)	58 (52.3)	0.011
Normal (MMSE score=24-30)	4 (7.5)	21 (39.6)	28 (52.8)	53 (47.7)	

Multivariate analysis

The multivariate analysis performed (Table 6) showed that physical exercise, depression, frailty and cognitive functions were correlates of nutritional status in older adults. Physical exercise is the most important positive correlate with a better nutritional status (Standardized Beta = 0.39). Depression is also an important inverse correlate (Standardized Beta = -0.39), more depressed are being more likely to have malnutrition. Moreover, frail older adults are more likely to be malnourished (Standardized Beta = -0.18). Older adults with better cognitive functions have a better nutritional status (Standardized Beta = 0.07). This model explained 42.2% (adjusted R^2 = 0.422) of the older adults nutritional status variability.

Table 6: A linear regression model for prediction of malnutrition

	Unstandardized Coefficient		Standardized Coefficient				
Characteristics	**B**	**SE**	**Beta**	***t***	***P* value**	**95% CI for B**	
Constant	21.30	1.81		11.78	0.000	17.71	24.88
Physical exercises	3.20	0.63	0.39	5.11	0.000	1.96	4.44
Depression	-1.13	0.22	-0.39	-5.24	0.000	-1.56	-0.70
Frailty	-0.80	0.33	-0.18	-2.38	0.020	-1.46	-0.13
Cognitive status	0.14	0.07	0.15	2.04	0.040	0.00	0.27

Discussion

To our knowledge, this is the first study describes the prevalence and risk factors of malnutrition in older adults living in long stay institutions situated in Beirut. In this study, 12.6% of older adults were malnourished, 48.7% at risk of malnutrition while 38.7% had a satisfactory nutritional status. In comparison with Sibai and collaborators study (2003), the current study shows higher level of unsatisfactory nutritional status, while their study shows that 42.5% of older adults with anemia and 27.5% had low albumin level[10]. This may be due to the fact that we did not use the same methods for nutritional status assessment. Similarly, an Egyptian study conducted by Khater and collaborators (2011), shows that 10.8% of older adults having malnutrition, 40.8% at risk of malnutrition and 48.3% as well nourished[20]. The majority of international studies show a high rate of malnutrition, ranging from 30 to 60% in older adults living in institutions or hospitals [21].

The findings of this study are slightly more alarming than cited studies; the percentage of malnutrition is moderate, while the percentage of risk of malnutrition is high. This high percentage of unsatisfactory nutritional status (61.3%) may be due to the institutions type, which are medical care institutions, where the majority of older adults have at least one chronic disease (84.7% of our population).

Furthermore, several factors were associated with the nutritional status: physical exercise, depression, frailty and cognitive functions were considered as correlates of nutritional status of older adults. These factors have been shown to be correlated with nutritional status in other studies.

This study showed that regular and irregular exercise have been associated with a significant improvement of the nutritional status of older adults (24.53 ±2.59 vs. 20.88 ±3.87; P<0.001). A French study conducted by Chatard and collaborators in 1998, suggested that older adults sportsmen had a good nutritional status. The good nutritional status of older adults' sportsmen was related to the increased of hunger induced by exercise and the increased of food intake relatively[22]. Therefore, the increase in energy expenditure in sports reduces the risk of nutritional deficiencies. Another study showed that limited mobility is suggested as a risk factor of malnutrition[6].

Depression was shown as another risk factor of malnutrition in older adults[6]. In this current study, depressed older adults showed a nutritional status significantly lower of that of non-depressed older adults (P=0.001). A cross-sectional study, conducted in 2009, with 114 residents in nursing home, suggested the presence of association between depression and malnutrition[23]. In addition, another study (1495 older adults) showed that malnutrition had a higher prevalence in depressed older adults [24]. This relation can be explained by the fact that loss of appetite is one of depression symptoms. Moreover, in a recent study, functional disability, depression, and cognitive impairment were suggested as factors that increased the risk of malnutrition[2]. The relationship between cognitive impairment and malnutrition is a complex and reciprocal problem. Therefore many articles evaluated this correlation. In the majority of papers treating this topic, malnutrition is suggested as risk factor of cognitive impairment [25,26]. In a retrospective study, older adults with cognitive dysfunction seem to lose predominantly fat mass with weight loss[27]. A new cross-sectional study conducted by Orsitto and collaborators, suggested the presence of association between cognitive impairment and malnutrition[28].

Concerning frailty, a recently published article suggested that MNA short form is a good assessment tool to predict under-nutrition and frailty of hospitalized older adults[29]. In the current study, non-frail older adults had a nutritional status significantly better than frail older adults (P<0.001). This result can be explained by the presence of one question concerning weight loss over three questions of SOF frailty index.

This study has several limitations: it is a cross-sectional study where temporality and causality cannot be proven. In addition, the small sample size can lead to non-significant results in the estimation of relationships between risk factors and malnutrition of older adults. Several biases may also arise in our study: a selection bias is possible due to refusals to participate. There is also a possibility of information bias, as in all studies based on a questionnaire. Older adults with impaired cognition may cause a differential memorization bias because of their difficulty to remember information (for example the MNA items related to food, liquids, number of meals per day), while older adults with normal cognition can better remember this information. Furthermore, residents with MMSE below 14 (compatible with moderate to severe dementia) were excluded because of communication problems. As malnutrition is found to be related to cognitive

function [27, 30], if these excluded residents were examined it is probable that the prevalence of malnutrition would be higher. In addition, the subjectivity bias can exist by an underestimation or overestimation of the health status and also for all scales based on self-assessment. These biases must be taken into account in other studies working on the same subject.

Conclusions

This study shows a moderate percentage of malnutrition and a high percentage of older adults at risk of malnutrition; the correlates of malnutrition in older adults were physical exercise, depression, frailty and cognitive function. In addition to the good nutritional intake, monitoring physical, psychological and cognitive functions can help in reducing the prevalence of malnutrition in older adults. Encouraging them to perform physical and mental exercise if possible, improving their psychological well-being, and tailoring interventions to those with lowest capacities would be expected to improve their nutritional status.

Acknowledgements

The authors thank the Lebanese University for funding this project.

Conflict of interest statement

No potential conflicts of interest were disclosed.

Funding

This project was funded by the Lebanese University. The Lebanese University administration had no role in study designing or article writing.

References

1. Pepersack T. Nutritional problems in the elderly. *Acta clin Belg*. 2009;64(2):85-91.
2. Rodríguez-Tadeo A, Wall-Medrano A, Gaytan-Vidana ME, Campos A, Ornelas-Contreras M, Novelo-Huerta HI. Malnutrition risk factors among the elderly from the US-Mexico border: the "one thousand" study. *J Nutr Health Aging*. 2012;16(5):426-431.
3. Ferry M, Sidobre B, Lambertin A, Barberger-Gateau P. The Solinut study: analysis of the interaction between nutrition and loneliness in persons aged over 70 years. *J Nutr Health Aging*. 2005;9:261-268.
4. Cabrera C, Rothenberg E, Eriksson BG, Wedel H, Eiben G, Steen B, et al. Socio-economic gradient in food selection and diet quality among 70-year olds. *J Nutr Health Aging*. 2007;11(6):466-473.
5. Johansson L, Sidenvall B, Malmberg B, Christensson L. Who will become malnourished? A prospective study of factors associated with malnutrition in older persons living at home. *J Nutr Health Aging*. 2009;13(10):855-861.
6. Wojszel ZB. Determinants of nutritional status of older people in long-term care settings on the example of the nursing home in Bialystok. *Adv Med Sci*. 2006;51:168-173.
7. Bouteloup C. Polymédication et prise alimentaire. *Nutrition Clinique Et Métabolisme*. 2005;19(1):20-24.
8. Wilson MM, Morley JE. Physiology of Aging Invited Review: Aging and energy balance. *J Appl Physiol*. 2003;95:1728-1736.
9. Lebanese Ministry of Social Affairs. Guidebook of elderly institutions. Beirut. LMSA Web Site; 2010 [updated 5 October, 2010; cited 21 March, 2012]; Available from: http://www.socialaffairs.gov.lb/docs/guide.pdf
10. Sibai AM, Zard C, Adra N, Baydoun M, Hwalla N. Variations in nutritional status of elderly men and women according to place of residence. *Gerontology*. 2003;49:215-224.
11. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practi¬cal method for grading the cognitive state of patients for the clinician. *J Psychiatr Res*. 1975;12(3):189-198.
12. Guigoz Y, Vellas B, Garry JP. Assessing the nutritional status of the elderly: The Mini Nutritional Assessment as part of the geriatric evaluation. *Nutr Rev*. 1996;54:59-65.
13. Tombaugh TN, McIntyre NJ. The mini-mental state examination: A comprehensive review. *J Am Geriatr Soc*. 1992;40(9):922-935.
14. Katz S, Downs T, Cash H, Grotz R. Progress in the development of the index of ADL. *Gerontology*. 1970;1:20-30.
15. Sibai AM, Chaaya M, Tohme RA, Mahfoud Z, Al-Amin H. Validation of the Arabic version of the 5-item WHO Well Being Index in elderly population. *Int J Geriatr Psychiatry*. 2009;24:106-107.
16. Ensrud KE, Ewing SK, Taylor BC, Fink HA, Cawthon PM, Stone KL. et al. Comparison of 2 frailty indexes for pre-diction of falls, disability, fractures, and death in older women. *Arch Intern Med*. 2008;168(4):382-389.
17. Rinaldi P, Mecocci P, Benedetti C, Ercolani S, Bregnocchi M, Menculini G. et al. Validation of the five-item geriatric depression scale in elderly subjects in three different settings. *J Am Geriatr Soc*. 2003;51(5):694-698.
18. Loucks EB, Berkman LF, Gruenewald TL, Seeman TE. Social Integration Is Associated With Fibrinogen Concentration in Elderly Men. *Psychosomatic Medicine*. 2005;67:353-358.
19. Wilson RS, Krueger KR, Arnold SE, Schneider JA, Kelly JF, Barnes LL, et al. Loneliness and risk of Alzheimer disease. *Arch Gen Psychiatry*. 2007;64(2):234-240.
20. Khater MS, Abouelezz NF. Nutritional Status in older adults with mild cognitive impairment living in elderly homes in Cairo, Egypt. *J Nutr Health Aging*. 2011;15(2):104-108.
21. Vellas B, Guigoz Y, Baumgartner M, Garry PJ, Lauque S, Albarede JL. Relationship between nutritional markers and the mini-nutritional assessment in 155 older persons. *J Am Geriatr Soc*. 2000;48:1300-1309.
22. Chatard JC, Boutet C, Tourny C, Garcia S, Berthouze S, Guézennec CY. Nutritional status and physical fitness of elderly sportsmen. *Eur J Appl Physiol*. 1998;77:157-163.
23. Smoliner C, Norman K, Wagner KH, Hartig W, Lochs H, Pirlich M. Malnutrition and depression in the institutionalised elderly. *Br J Nutr*. 2009;102(11):1663-1667.
24. 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 Publ Health*. 2011;40(2):67-74.
25. Knopman DS. Mediterranean diet and late-life cognitive impairment: a taste of benefit. *JAMA*. 2009;302:686-687.
26. Féart C, Samieri C, Barberger-Gateau P. Mediterranean diet and cognitive function in older adults. *Curr Opin Clin Nutr Metab*. 2010;13:14-18.

27. Wirth R, Smoliner C, Sieber CC, Volkert D. Cognitive function is associated with body composition and nutritional risk of geriatric patients. *J Nutr Health Aging*. 2011;15(8):706-710.

28. Orsitto G. Different components of nutritional status in older inpatients with cognitive impairment. *J Nutr Health Ag-ing*. 2012;16(5):468-471.

29. Dent E, Visvanathan R, Piantadosi C, Chapman I. Use of the mini nutritional assessment to detect frailty in hospitalised older people. *J Nutr Health Aging*. 2012;16(9):764-777.

30. El Zoghbi M, Boulos C, El Hajje A, Saleh N, Awada S, Rachidi S, Bawab W, Salameh P. Association between cognitive function and nutritional status in elderly: a cross-sectional study in three institutions of Beirut – Lebanon. *Geriatric Mental Health Care*. 2013;1(4);73-81.