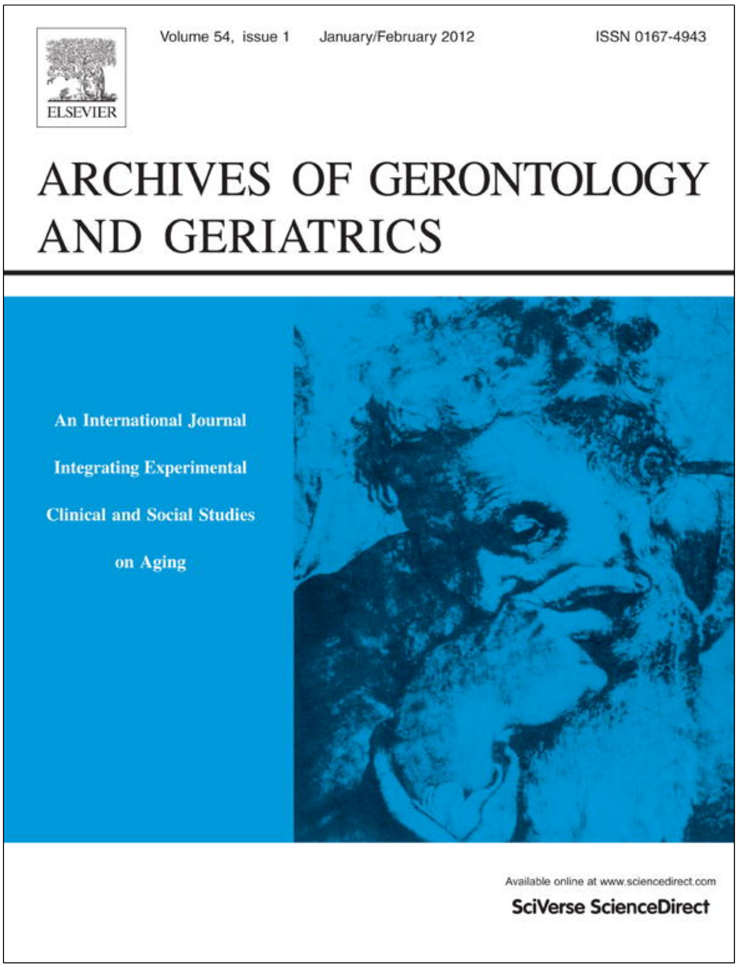
Volume 54, issue 1
January/February 2012
ISSN 0167-4943
ELSEVIER
ARCHIVES OF GERONTOLOGY AND GERIATRICS
An International Journal
Integrating Experimental
Clinical and Social Studies
on Aging
Available online at www.sciencedirect.com
SciVerse ScienceDirect

Archives of Gerontology and Geriatrics 54 (2012) 78–81

Contents lists available at ScienceDirect

Archives of Gerontology and Geriatrics

journal homepage: www.elsevier.com/locate/archger

Which body mass index (BMI) is better in the elderly for functional status?

Gulistan Bahat [a,*], Fatih Tufan [a], Bulent Saka [b], Sibel Akin [a], Hilal Ozkaya [c], Nurullah Yucel [c], Nilgun Erten [b], Mehmet Akif Karan [a]

[a] Department of Internal Medicine, Division of Geriatrics, Istanbul Medical School, Istanbul University, Capa, 34390 Istanbul, Turkey
[b] Department of Internal Medicine, Istanbul Medical School, Istanbul University, Capa, 34390 Istanbul, Turkey
[c] Istanbul Metropolitan Municipality, Department of Health and Social Services, Directorate of Darulaceze, Kayisdagi cad., No: 233, 34755 Atasehir, Istanbul, Turkey

ARTICLE INFO

Article history:
Received 15 November 2010
Received in revised form 18 April 2011
Accepted 19 April 2011
Available online 31 May 2011

Keywords:
Body mass index
Functional status of elderly
Nutrition of elderly malnutrition of the elderly

ABSTRACT

BMI is commonly used indicator of malnutrition and 18.5–24.9 kg/m^2 is generally regarded optimal. However, there is an ongoing debate on ideal range for elderly. BMI cut-off values vary also between ethnic groups. We aimed to investigate relationships between BMI, functional status and malnutrition in elderly living in a nursing home in Turkey. BMIs of 254 residents were calculated. Chronic diseases and currently used drugs were noted. Functional status was evaluated with Katz-activities-of-daily-living (ADL) and Lawton-instrumental-activities-of-daily-living (IADL). Nutritional assessment was performed by Mini-Nutritional-Assessment (MNA) test. Mean age was 75.2 $\pm$ 8.2 years. Subjects were classified into 4 groups as BMI <18.5, 18.5–24.9, 25–29.9, and $\geq$30.0 kg/m^2. ADL scores and IADL scores were higher in higher BMI groups. There were no differences in terms of age-number of chronic diseases. Even in BMI $\geq$35 kg/m^2 residents, ADL was significantly higher than 25–34.9 kg/m^2 residents. BMI was significantly correlated with ADL and IADL scores. In Groups 3 and 4, there were 22.2% and 9.1% residents without normal nutrition, respectively. Better functional status was associated with higher BMI values even in BMIs $\geq$30 kg/m^2. In elderly, relative high rates of undernutrition may be present in BMIs regarded as overweight or obese.

1. Introduction

Screening tools commonly include the measurement of body mass index (BMI) as the widely accepted gold-standard indicator of malnutrition (Cook et al., 2005). However, it may be an unreliable nutritional marker in cases of recent weight loss in an originally overweight or obese individual. BMI of 18.5–24.9 kg/m^2 is generally accepted as the optimal range (Obesity, 2006) but there is an ongoing debate on the ideal reference range for the older subjects (Cook et al., 2005). Some studies suggested the low BMI and some studies suggested the high BMI as a risk factor for functional dependency. On the other hand, BMI cut-off values vary also between ethnic groups (WHO, 2004). WHO Expert committee encourages the countries to collect their own data on anthropometric measures coupled with health and functional status evaluation (De Onis and Habicht, 1996). In this study, we aimed to investigate the relationships between BMI, the level of functional independency and malnutrition in a group of elderly living in a nursing home in Turkey.

2. Patients and methods

2.1. Patients

The study was conducted in a nursing home in Istanbul. The residents who were not bedridden were included in the study for exact anthropometric measurement.

2.2. Measurements

The heights and weights of all residents were measured and BMIs were calculated from weight (kg) divided by the square of height (m). We interviewed with the residents, nurse aides and the health team including the medical nurses and local MDs. Their chronic diseases and the currently used drugs were noted. Functional status were evaluated with the 5-item ADL and 7-item IADL. Nutritional assessment was performed by MNA. Residents with a MNA score <17 were assessed as undernourished, with a MNA score of 17–23.5 as at risk of undernutrition and $\geq$24 as well nourished (Guigoz et al., 1994). This study was conducted according to the guidelines laid down in the Declaration of Helsinki. Informed consent was obtained from all patients and/or their related conservators.

* Corresponding author. Tel.: +90 212 414 2000x33204; fax: +90 212 532 4208.
E-mail address: gbahatozturk@yahoo.com (G. Bahat).

0167-4943/$ – see front matter © 2011 Elsevier Ireland Ltd. All rights reserved.
doi:10.1016/j.archger.2011.04.019

2.3. Statistical analysis

The statistical analysis was carried out with Statistical Package for Social Sciences for Windows ver. 14.0 (SPSS Inc, Chicago, IL, USA). Numerical variables were given as mean ± S.D. Two groups were compared with paired Student's *t*-test or Mann Whitney *U* tests when necessary. Chi-square test with Yates correction and Fisher's exact test were used for 2 × 2 contingency tables when appropriate for non-numerical data. Correlations between numerical parameters were analyzed with Spearman's rho correlation test. Groups were compared with Student's *t*-test or analysis of variance (ANOVA) as necessary. Comparisons in the more than two groups were made by Kruskal Wallis-H analysis of variance when the distribution was abnormal. Tukey HSD was used for post-hoc comparisons. A $p < 0.05$ was accepted as significant.

3. Results

3.1. Demographic data

The heights and weights were successfully measured in 254 residents composing the cohort of our study. Of them, 97 residents were female and 157 were male. Their mean age was 75.2 ± 8.2 years (60–98), 74 (29.1%) residents were ≥80 years of age and 140 (55.1%) residents were ≥75 years of age. Of them, 171 (67.3%) residents were well nourished, 58 (22.8%) were under malnutrition risk and 25 (9.8%) were malnourished. The distributions of demographic data of the study population according to the gender are outlined in Table 1.

3.2. Association of BMI with ADL and IADL

The residents were classified into 4 groups according to their BMI values as Group 1: BMI <18.5 (19 residents), Group 2: BMI 18.5–24.9 (90 residents), Group 3: BMI 25–29.9 (90 residents), and Group 4: BMI ≥30 kg/m^2 (55 residents). In Group 4, there were 14 residents with BMI ≥35 kg/m^2. The ADL scores, IADL scores, MNA scores, age, number of chronic diseases and no of currently used drugs were compared between the different BMI groups. The ADL scores, IADL scores and MNA scores were all significantly higher in higher BMI groups. Between these four groups, there were no differences in terms of age, number of chronic diseases but number of currently used drugs was also higher in higher BMI groups (Table 2). When the residents with BMI ≥35 kg/m^2 were compared with BMI 25–34.9 kg/m^2 (131 residents), ADL but not IADL was significantly higher in the BMI ≥35 kg/m^2 group (9.9 ± 0.5 vs. 8.8 ± 1.9, $p < 0.05$ for ADL and 9.7 ± 3.7 vs. 7.8 ± 5, $p = 0.168$ for IADL, respectively). Due to low number of BMI ≥35 kg/m^2 residents, any possible impact of gender on ADL could not be evaluated. BMI was significantly and positively correlated with ADL and IADL scores ($r = 0.23$, $p < 0.001$ and $r = 0.18$, $p = 0.003$, respectively). The correlation of BMI with ADL and IADL scores were more pronounced in females ($r = 0.37$, $p < 0.001$ and $r = 0.45$, $p < 0.001$ in females vs. $r = 0.20$, $p = 0.01$ and $r = 0.10$, $p = 0.21$ in males, respectively).

3.3. Association of BMI with nutritional status

Malnutrition and malnutrition risk rates were higher in the lower BMI groups. In Group 1, there were 17 (89.5%) residents; in Group 2, there were 41 (45.6%) residents, in Group 3, there were 20 (22.2%) residents and in Group 4, there were 5 (9.1%) residents with either malnutrition or malnutrition risk (Table 2). Having nutritional status other than normal nutrition (either malnutrition or malnutrition risk) was negatively correlated with ADL and IADL scores ($r = -0.27$, $p < 0.001$ and $r = -0.27$, $p < 0.001$). Again, the correlation of having nutritional status other than normal nutrition with ADL and IADL scores were more pronounced in females ($r = -0.41$, $p < 0.001$ and $r = -0.48$, $p < 0.001$ in females vs. $r = -0.20$, $p = 0.01$ and $r = -0.19$, $p = 0.02$ in males; respectively).

Table 1
The distribution of residents' data according to the gender, mean ± S.D. (range).

	Females	Males	Total	*p*
Number	97	157		
Age (year)	78.6 ± 9.3 (60–98)	73.1 ± 6.7 (60–90)	75.2 ± 8.25 (60–98)	<0.001*
Weight (kg)	60.3 ± 15.3 (34.8–112.8)	67.0 ± 14.1 (38.9–105)	64.4 ± 14.9 (34.8–112.8)	<0.001*
Height (cm)	149 ± 8.2 (127–165)	162.2 ± 7.7 (145–181)	157 ± 10 (127–181)	<0.001*
BMI (kg/m^2)	26.8 ± 6 (16.3–49.5)	25.4 ± 5.0 (14.3–38.1)	25.9 ± 5.4 (14.3–49.5)	>0.05
No. of chronic diseases	3.7 ± 1.7 (1–9)	3.7 ± 1.8 (1–9)	3.7 ± 1.8 (1–9)	>0.05
No. of drugs	6.5 ± 3.3 (1–16)	7.5 ± 4.2 (0–18)	7.1 ± 3.9 (0–18)	>0.05
ADL score	8.4 ± 2.4 (0–10)	8.9 ± 2.0 (2–10)	8.6 ± 2.2 (0–10)	<0.001*
IADL score	5.3 ± 5.2 (0–14)	8.7 ± 4.6 (0–14)	7.4 ± 5.1 (0–14)	<0.001*
Malnutrition rate (%)	11.3	8.9	9.8	>0.05

* Statistically significant differences between genders.

Table 2
The comparison of the analyzed parameters between the different BMI groups, mean ± S.D. (range), *n*(%).

	BMI (kg/m^2) classes				*p*
	<18.5	18.5–24.9	25–29.9	≥30	
Number	19	90	90	55	
Fem/male (number)	7/12	25/65	38/52	27/28	0.057
Age (years)	76.2 ± 8.1 (60–96)	74.1 ± 7.2 (72–76)	76.2 ± 8.1 (60–98)	73.4 ± 8.2 (60–98)	0.238
ADL sc.	7.3 ± 3 (0–10)	8.4 ± 2.3 (0–10)	8.8 ± 2.1 (0–10)	9.2 ± 1.5 (0–10)	0.007*
IADL sc.	5.5 ± 5.4 (0–14)	6.9 ± 5.3 (0–14)	7.6 ± 5.0 (0–14)	8.7 ± 4.6 (0–14)	0.0074*
MNA sc.	16.1 ± 3.1 (8–20)	17.5 ± 3.2 (8.5–23.5)	19.5 ± 2.4 (15.5–22.5)	21.3 ± 0.7 (20.5–22.5)	<0.0001*
Malnutrition, *n* (%)	9 (47.3)	13 (14.4)	3 (3.3)	0 (0)	<0.001*
Malnutrition, risk, *n* (%)	8 (42.1)	28 (31.1)	17 (18.9)	5 (9.1)	<0.001*
Normal nutrition, *n* (%)	2 (10.5)	49 (54.4)	70 (77.8)	50 (90.9)	<0.001*
No. of chronic diseases	2.9 ± 1.4 (1–5)	3.5 ± 1.7 (1–9)	3.8 ± 1.7 (1–8)	4.0 ± 2.0 (1–9)	0.09
No. of drugs	5.7 ± 2.3 (1–10)	6.4 ± 3.7 (0–18)	7.3 ± 3.7 (0–17)	8.6 ± 4.4 (1–18)	0.003*

* Statistically significant differences.

4. Discussion

Anthropometry is the single most portable, universally applicable, inexpensive, and noninvasive method available to assess the proportions, size, and composition of the human body (De Onis and Habicht, 1996). It reflects both health and nutrition and may aid to predict performance, health, and survival (De Onis and Habicht, 1996). For these reasons, it is used for monitoring the health and nutrition of individuals and as a next step for selecting them for health and nutrition interventions. Among these anthropometric measures, BMI is commonly included in screening tools as MNA (Beck et al., 1999), Malnutrition Advisory Group Tool (BAPEN, 2000), Malnutrition Universal Screening Tool (BAPEN, 2003) as the widely accepted gold-standard indicator of malnutrition (Cook et al., 2005). The Malnutrition Advisory Group (BAPEN, 2000) also suggested that BMI is a simple and reproducible measure for assessing malnutrition in the older subjects.

Although, a BMI of 18.5–24.9 is generally accepted as an indicator of the optimal weight (Obesity, 2006), there is an ongoing debate on the ideal reference range for the older subjects (Cook et al., 2005). On the other hand, BMI cut-off values vary between ethnic groups (WHO, 2004). The WHO Expert Committee, did not recommend the use of universal reference data, but rather the collection of data describing local levels and patterns (De Onis and Habicht, 1996). The prevalence of thinness and overweight varies widely from country to country and there are no indications that different populations with the same distributions of BMI have similar relative and attributable risks of morbidity and mortality associated with different degrees of overweight and thinness (De Onis and Habicht, 1996). There is no evidence that what is normal for an i.e. 75-year-old man in the United States is also normal for a 75-year-old man in a developing country (De Onis and Habicht, 1996). For example, compared with Western populations, the percentage of body fat and associated risk factors for cardiovascular disease at a given BMI are generally higher among Asian people. The WHO has suggested that the risk of obesity related diseases among Asian people rises from a BMI of 23 kg/m^2 compared to 25 kg/m^2 for non-Asian groups (WHO, 2004). Therefore, the WHO Expert Committee encouraged countries to collect anthropometric data on adults aged $\geq$60 years through anthropometric surveys coupled with the monitoring of health and functional status of this segment of the population (De Onis and Habicht, 1996). On the other hand, the elderly represent the fastest-growing segment of populations throughout the world, with the distinctive feature of being a very heterogenous group. A healthy 80-year-old person is not compatible with a healthy 60-year-old person. Indeed, the concept of functional or biological age should gain more consideration in the elderly. Currently, few anthropometric data exist for the elderly, especially for those >80 years and for the elderly in developing countries (De Onis and Habicht, 1996). In clinical practice, easy, inexpensive, universally applicable and portable means to predict nutritional status are needed. This study investigates the relationships between a very easy to use anthropometric measurement as an index for nutrition and health status: BMI, functional status and nutritional status in one of developing country: Turkey and in a group of relatively old cohort with a near 1/3 of residents $\geq$80 years and more than half $\geq$75 years of age.

Our cohort was composed of residents with BMIs of mostly in optimal range or overweight. The indexes of good functional status were significantly higher in each higher BMI groups. BMI was significantly and positively correlated with ADL and IADL scores. This study suggests that in a group of elderly nursing home residents, the better functional status was associated with higher BMI values even in BMIs $\geq$30 kg/m^2. Between these four groups, there was no difference in terms of age and number of chronic diseases suggesting that the association of higher BMI with better functional status was not due to better age and chronic disease profiles. At this point, our study has a limitation. Chronic diseases were evaluated by only the number but not any specific namely characterization. However, it is known that the major causes of morbidities in the elderly as hypertension, diabetes, ischemic heart disease, hyperlipidemia and osteoarthritis are more prevalent in higher BMIs. Therefore, although the specific names of the diseases were not included in this study, we suggest that the better functional status in the higher BMI groups were not quite possibly due to better disease profile. Among the studies on BMI and functional status in the elderly, some (Galanos et al., 1994; Stuck et al., 1999; Covinsky et al., 2006; Imai et al., 2008) suggested the low BMI and some (Galanos et al., 1994; Stuck et al., 1999; Friedmann et al., 2001; Jensen and Friedmann, 2002; Covinsky et al., 2006; Imai et al., 2008) suggested the high BMI as a risk factor for functional dependency. The more the extreme of BMI (either higher or lower), the greater the risk for functional impairment was reported (Galanos et al., 1994). The high BMIs associated with poor functional status were generally >35 or 40 kg/m^2 (Friedmann et al., 2001; Jensen and Friedmann, 2002; Imai et al., 2008). Also in the most recent study reported from USA, the association of BMI with functional status and how the association differs by age were examined. Underweight and severe obesity were again consistently associated with increased disability in all ages whereas overweight and moderate obesity showed associations that vary considerably by age. Overweight elderly ($\geq$65 years) and moderate obese elderly men ($\geq$65 years) had lower risks of disability (Imai et al., 2008). However, in our study, the correlation of both BMI and nutritional status with functional status were more pronounced in females. The optimal range of BMI for American elderly people is suggested as 24–29 kg/m^2 by the 1989 report of the American Committee on Diet and Health (Ham, 1992). However, in regard of these findings the upper cut-off level of BMI for elderly functional independency may be put forward as 30 kg/m^2, if not higher.

The reason why higher BMIs are associated with better functional outcome in the elderly is yet not clear. One explanation is that the stature decreases with age because of senile kyphosis, shortening of spinal vertebrae and thinning of weight bearing cartilages and this may reflect as increased BMI value for a given weight in the elderly. The seemingly high BMI may be present even in the malnourished elderly. Therefore, an elderly patient with a BMI of e.g., 23 or even 30 kg/m^2 should not be necessarily considered to be in good nutritional status. Hence, the association of BMI with functional status may vary significantly across ages.

In this study, we evaluated the nutritional status via MNA. The MNA is a simple tool, useful in clinical practice to measure nutritional status in elderly persons. From its validation in 1994, the MNA has been used in hundreds of studies and translated into more then 20 languages. It is a well-validated tool, with high sensitivity, specificity, and reliability (Vellas et al., 2006). We compared the role of BMI alone to predict malnutrition with MNA in the elderly. MNA scores were all significantly higher in each higher BMI groups and similarly malnutrition and malnutrition risk rates were higher in the each lower BMI groups. However, even in 25–29.9 kg/m^2 BMI group, there were 3 (3.3%) residents with overt malnutrition and 17 (18.9%) residents with malnutrition risk determined by MNA. So, almost more than 1/5 of the residents with BMI: 25–29.9 kg/m^2 were not free of malnutrition (either malnourished or under malnutrition risk). Also, in BMI: $\geq$30 kg/m^2 group, there was no overt malnourished resident but 5 (9.1%) residents with malnutrition risk.

In their paper on use of simple means for detecting malnutrition on medical wards, Nightingale et al. (1996) used and compared 3 methods for malnutrition detection: BMI, midarm muscle circumference and percentage weight loss in the preceding 3 months and concluded that %weight loss detected most patients as malnourished.

Similar to our study, they reported that four of seven patients who had been detected as malnourished only via %weight loss, had had BMI >25 kg/m^2. In our study, in the residents with malnutrition or with malnutrition risk determined by MNA, ADL and IADL scores were significantly lower when compared with the residents without malnutrition. Having nutritional status other than normal nutrition (either malnutrition or malnutrition risk) was negatively correlated with ADL and IADL scores.

We suggest that in the elderly, the relative high rates of malnutrition or malnutrition risk may be present in even higher BMIs regarded as overweight or obese in the younger counterparts and the better nutrition profile may be the responsible factor for the association of even as high as >30 kg/m^2 BMIs with better functional status. Beck and Ovesen (1998) concluded that any extent of weight loss or BMI of <24 kg/m^2 should be used in combination with other variables when aiming the most favorable outcome in the elderly. Our findings also support the idea that not only BMI but percentage weight loss and the other health related parameters of the individual as included in MNA (e.g., associated medical problems, current nutrition intake, etc.) should be incorporated in nutritional evaluation of the elderly. In elderly individuals, the nutritional support shall be introduced much earlier than in younger age groups with BMI values those are regarded as optimal or even overweight. BMI may be regarded as a tool for rapid insight for nutritional screening but should not be used to replace exact nutritional evaluation.

In conclusion, in a group of elderly nursing home residents in Turkey, better functional status was associated with higher BMI values even in BMIs >30 kg/m^2. There were significant percentage of residents having malnutrition despite having BMI >25 kg/m^2. In elderly, relative high rates of undernutrition may be present in BMIs regarded as overweight or obese.

Conflict of interest statement

None.

References

BAPEN (British Association for Parenteral and Enteral Nutrition), 2000. Malnutrition Advisory Group Guidelines for Detection and Management of Malnutrition. Reddich, Worcs.

BAPEN (British Association for Parenteral and Enteral Nutrition), 2003. British Association for Parenteral and Enteral Nutrition Malnutrition Advisory Group 'Malnutrition Universal Screening Tool' (MUST), 2003. http://www.bapen.org.uk/pdfs/Must/MUST-Complete.pdf.

Beck, A.M., Ovesen, L., 1998. At which body mass index and degree of weight loss should hospitalized elderly patients be considered at nutritional risk? Clin. Nutr. 17, 195–198.

Beck, A.M., Ovesen, L., Osler, M., 1999. The 'Mini Nutritional Assessment' (MNA) and the 'Determine Your Nutritional Health' Checklist (NSI Checklist) as predictors of morbidity and mortality in an elderly Danish population. Br. J. Nutr. 81, 31–36.

Cook, Z., Kirk, S., Lawrenson, S., Sandford, S., 2005. Use of BMI in the assessment of undernutrition in older subjects: reflecting on practice. Proc. Nutr. Soc. 64, 313–317.

Covinsky, K.E., Hilton, J., Lindquist, K., Dudley, R.A., 2006. Development and validation of an index to predict activity of daily living dependence in community-dwelling elders. Med. Care 44, 149–157.

De Onis, M., Habicht, J.P., 1996. Anthropometric reference data for international use: recommendations from a World Health Organization Expert Committee. Am. J. Clin. Nutr. 64, 650–658.

Friedmann, J.M., Elasy, T., Jensen, G.L., 2001. The relationship between body mass index and self-reported functional limitation among older adults: a gender difference. J. Am. Geriatr. Soc. 49, 398–403.

Galanos, A.N., Pieper, C.F., Cornoni-Huntley, J.C., Bales, C.W., Fillenbaum, G.G., 1994. Nutrition and function: is there a relationship between body mass index and the functional capabilities of community-dwelling elderly? J. Am. Geriatr. Soc. 42, 368–373.

Guigoz, Y., Vellas, B.J., Garry, P.J., 1994. The Mini Nutritional Assessment (MNA): a practical assessment tool for grading the nutritional state of elderly patients. In: Vellas, B.J., Guigoz, Y., Garry, P.J., Albarede, J.L. (Eds.), Nutrition in the Elderly-Gerontology. 2nd ed. Serdi Publisher, Paris, pp. 15–61.

Ham, R.J., 1992. Indicators of poor nutritional status in older Americans. Am. Fam. Physician 45, 219–228.

Imai, K., Gregg, E.W., Chen, Y.J., Zhang, P., De Rekeneire, N., Williamson, D.F., 2008. The association of BMI with functional status and self-rated health in US adults. Obesity (Silver Spring) 16, 402–408.

Jensen, G.L., Friedmann, J.M., 2002. Obesity is associated with functional decline in community-dwelling rural older persons. J. Am. Geriatr. Soc. 50, 918–923.

Nightingale, J.M., Walsh, N., Bullock, M.E., Wicks, A.C., 1996. Three simple methods of detecting malnutrition on medical wards. J. R. Soc. Med. 89, 144–148.

Obesity, 2006. Guidance on the Prevention, Identification, Assessment and Management of Overweight and Obesity in Adults and Children. National Institute for Health and Clinical Excellence (NICE) Clinical Guideline 43. NICE, London.

Stuck, A.E., Walthert, J.M., Nikolaus, T., Büla, C.J., Hohmann, C., Beck, J.C., 1999. Risk factors for functional status decline in community-living elderly people: a systematic literature review. Soc. Sci. Med. 48, 445–469.

Vellas, B., Villars, H., Abellan, G., Soto, M.E., Rolland, Y., Guigoz, Y., Morley, J.E., Chumlea, W., Salva, A., Rubenstein, L.Z., Garry, P., 2006. Overview of the MNA—its history and challenges. J. Nutr. Health Aging 10, 456–463.

WHO (World Health Organisation), 2004. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet 363, 157–163.