Papers on Anthropology XXII, 2013, pp. 41–53

BODY COMPOSITION ANALYSIS ON ELDERLY LIVING IN NURSING HOMES

Timur Gültekin, Başak Koca Özer

History and Geography, Department of Anthropology, Faculty of Languages, Ankara University, Turkey

ABSTRACT

Body composition is a good indicator of an individual's health and physical status. In addition to total body fat, fat distribution is a major risk factor for cardiovascular diseases and insulin resistance/diabetes in elderly. There are a limited number of studies focused on the body composition of elderly populations in Turkey.

The primary objective of this study is to evaluate body composition in the Turkish elderly living in nursing homes.

The sample included a total of 164 adults (91 females and 73 males), aged 65 years and over, living in Ankara nursing homes. According to the standard anthropometric protocols weight, height, skinfold thicknesses, and arm circumference were taken, and the body mass index (BMI), fat mass, fat free mass and arm fat area were calculated. The study results showed that males were significantly heavier and taller, whereas BMI were higher in females. The comparison of arm fat area between sexes showed that females have significantly ($p<0.001$) greater values. Total body fat (kg) was higher in females and decreases with age for both sexes, where this decline is greater in elderly females.

In conclusion, the body composition of elderly can provide information on the general health status, and support clinicians to understand more in their treatment progress.

Keywords: *anthropometry, body composition, body fat, elderly*

http://dx.doi.org/10.12697/poa.2013.22.05

INTRODUCTION

The world population is rapidly ageing. Elderly populations have grown because of worldwide improvements in health services, educational status, and economic development [1]. According to the Turkish Statistical Institute (TurkStat) today Turkey's population reached about 72.5 million, half of Turkey's population is under the age of 28.8 and a number that has risen 3.6 months in the span of a year. The population aged 65 and over constitutes 7.0 percent of the overall population [2]. Older age groups will gradually assume more weight in 2025 and this proportion will be expected to increase to 9% [3]. With increasing ageing trends, it is necessary to consider older people's cognitive strengths, capabilities and health risk.

Changes in the body composition occur over lifetime. At every stage of life, there are physical changes in the human body. Ageing is associated with changes in the body composition that including an increase and redistribution of adipose tissue and a decrease in skeletal muscle, bone mass and physical function, the beginning as early as the fourth decade of life [4]. Anthropometric measurements, which are convenient, non-invasive, easy and inexpensive to collect, are highly reliable for indirectly determining the body composition evaluation when compared with more sophisticated methodologies such as underwater weighing, air displacement, Dual Energy X-Ray Absorptiometry etc. [5, 6]. The body composition is a good indicator of an individual's health and physical status. A link between age-related changes in the body composition and the increased prevalence of disease and disability in old age has been well established [7]. In recent years advances in technology have permitted the construction of body composition which defines the body in terms of more than two components. The two-component model (fat-free mass and fat mass), in which the body is divided into lean and fat [8] (Figure 1). These methods can be used in laboratories or clinical settings to measure the total body composition.

The WHO Expert Committee on Physical Status stressed the need for local gender- and age-specific reference values for the elderly [9]. In Turkey, only a limited number of anthropometric and nutritional studies have been carried out in the elderly [10, 11, 12, 13, 14].

The main objective of this study is to determine the anthropometric and body composition characteristics and evaluate their variation according to age and gender for the elderly living in nursing homes in Ankara.

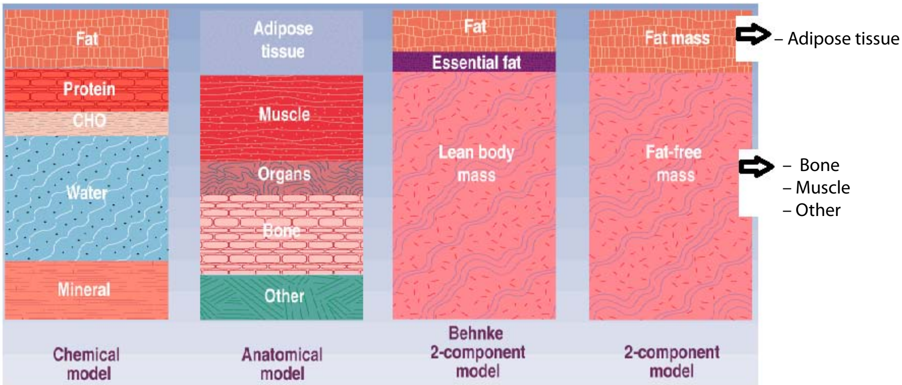

Figure 1. Models of Body Composition (Modified from Wang ZM, et al.,(15))

MATERIAL AND METHODS

Study location, population, and data source

All the participants were verbally informed and verbally agreed to participate in research voluntarily. All the measurements were gathered from four elderly Nursing Homes which are located in Ankara, the capital city of Turkey. All the subjects provided a brief medical history and were free of disease which might have been relevant to consideration of the body composition (diagnosis of osteoporosis, renal or hepatic disease, malignancy, cardiovascular diseases).

Anthropometric Measurements

Height was measured to the nearest 0.1 cm using a Martin® type anthropometer while elderly were standing upright on a platform and head in the Frankfort plane. Weight was measured to the nearest 100 g using a digital scale (Tanita corp.). Subscapular, suprailiac, biceps and triceps skinfold thickness was measured to the nearest mm using a Harpenden® type calliper with the average of two measurements at each site being used for analysis. The body mass index (BMI) (Wt (kg)/ Ht^2 (m)) was also calculated as a measure of the body composition to support skinfold data. The body composition was represented by percentage of fat and fat free mass. Anthropometric data of all subjects were collected by the same person. All the subjects were measured in underwear without shoes.

Body Composition

Calculation of Body Density According to the method of Durnin & Womersley [16] (Biceps, Triceps, Subscapula, and Suprailiac)

Bodyfat [%] = 495 / body density – 450
Equation for Males; body density (50+) = 1.1715–0.0779 x (log Σ)
Equation for Females; body density (50+) = 1.1339–0.0645 x (log Σ)
Upper arm fat area (UAFA); UAFA = [(TRSF ×MUAC)/2] – [($\pi \times$ TRSF2)/4]
(MUAC: midupper arm circumference,TRSF:triceps skinfold)

Statistical analysis

Descriptive statistics were made according to age and sex using the Statistical Package for the Social Sciences (SPSS) version 13.0. The student t test was used to evaluate differences between sexes according to age. To show the obesity rate, the body mass index (BMI) and the BMI categories recommended by the WHO (5) (BMI < 18.50: underweight; BMI 18.50–24.99: normal weight; BMI 25.00–29.99: overweight; BMI 30.00–39.99: obese; BMI > 40.00 morbid obese) were used. The pearson correlation coefficients were calculated to determine the correlations between the anthropometric measurements and body composition values.

RESULTS

The sample, representing aged 65 years and older, consisted of 164 subjects (91 females, 73 males) and physical characteristics of the subjects are summarized in Table 1. From these records, 10 of them were excluded because of lack of important demographic data such as the date of birth. Males were taller than females (163.73 cm (SD 6.5) and 149.37 (SD 6.6) cm, respectively) and the difference was statistically significant ($p<0.01$). Gender-related differences showed that males had significantly greater weights ($p < 0.01$) than females.

The results show that the body mass index was 26.60 kg/m^2 and 26.02 kg/m^2 for females and males respectively. The body mass index of female elderly reduces with age (Figure 2). There was significant difference in the BMI or fat mass when comparing males to females. Males had significantly greater fat free mass ($P < 0.001$) than females, while females had significantly greater ($P < 0.001$) body fat as the percentage of body weight (Table 1, Figures 2–4).

Upper arm circumferences, fat mass, arm fat area (Figure 3) and skinfold thickness were greater in females (Table 1).

The mean values of all anthropometric measurements significantly differed between sexes, except for arm circumferences (Table 1). The slopes for decline with age in average values of all anthropometric variables were of greater magnitude in females than in males (Figures 2–4).

Table 2 also shows the Pearson correlation coefficients between the anthropometric measurements and body composition values. High correlation were found between BMI and arm fat area, fat mass and fat free mass both for males and females.

Table 1. Physical characteristics of the subjects

	Female			Male			
	N	**Mean**	**SS**	**N**	**Mean**	**SS**	**p**
Age (year)	91	78.38	6.5	73	76.17	6.5	0.036
Weight (kg)	91	66.03	12.99	73	69.67	11.80	0.065
Height (cm)	91	149.37	6.61	73	163.72	6.51	0.000
BMI (kg/cm^2)	91	29.60	5.55	73	26.02	4.39	0.000
Triceps (mm)	91	19.20	8.60	73	9.83	5.13	0.000
Biceps (mm)	91	11.10	6.06	73	6.46	3.24	0.000
Subscapular (mm)	91	22.29	10.00	73	15.12	6.58	0.000
Suprailiac (mm)	91	20.27	10.22	73	16.99	8.76	0.057
Upper arm circumference (mm)(UAC)	91	290.71	33.26	73	269.78	36.64	0.001
Arm fat area (cm^2)	91	25.53	13.08	73	12.83	7.79	0.000
Fat mass (kg)	91	24.67	8.14	73	17.82	7.11	0.000
Fat free mass (kg)	91	40.79	5.88	73	51.84	6.05	0.000

P < 0.001 significant difference between males and females

Table 2. Anthropometric Measures and Pearson Correlation Coefficients

		Female										
		Weight	**Height**	**BMI**	**Triceps**	**Biceps**	**Sub-scapular**	**Suprailiac**	**UAC**	**AFA**	**Fat mass**	**Fat free mass**
Male	Weight	–	,319**	,897**	,644**	,647**	,655**	,680**	,732**	,502**	,946**	,893**
	Height	,294*	–	–,125	,060	,202	,178	,203	,159	,033	,271*	,323**
	BMI	,875**	–,197	–	,649**	,587**	,606**	,617**	,694**	,511**	,859**	,777**
	Triceps	,579**	–,011	,599**	–	,740**	,663**	,639**	,633**	,957**	,765**	,309**
	Biceps	,640**	,074	,609**	,675**	–	,685**	,810**	,696**	,620**	,794**	,294**
	Subscapular	,698**	,162	,607**	,542**	,694**	–	,778**	,531**	,600**	,805**	,293**
	Suprailiac	,692**	,150	,616**	,548**	,664**	,715**	–	,650**	,512**	,840**	,336**
	UAC	,720**	–,073	,763**	,579**	,645**	,606**	,554**	–	,407**	,764**	,556**
	AFA	,423**	,010	,428**	,958**	,558**	,437**	,455**	,373**	–	,631**	,167
	Fat mass	,917**	,206	,826**	,741**	,794**	,841**	,866**	,744**	,612**	–	,699**
	Fat free mass	,884**	,338**	,749**	,276*	,326**	,393**	,340**	,540**	,121	,625**	–

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

In this study, the estimated prevalence of obesity for females were (Table 3); 1.09% underweight, 17.58% normal weight, 37.37% lightly obese, 29.67% type I obesity, 8.79% type II obesity and 5.50% morbidity. Among males: 1.28% underweight, 49.00% normal weight, 30.45% lightly obese, 15.19 % type I obesity and 4.14% type II obesity. The prevalence of underweight was 2.18% in the whole sample and there were no differences between sexes. Obesity was more frequent in women (29.67%) than in men (12.08%). The higher risk of obesity for women was evaluated.

Table 3. Underweight, overweight and obesity prevalence in Turkish elderly.

BMI (kg/m^2)	Status	Female (%)	Male (%)
18.5	Underweight	1.09	1.09
18.5–24.9	Normal	17.58	38.46
25–29.9	Overweight	37.36	24.17
30–34.9	Obese I	29.67	12.08
35–39.9	Obese II	8.79	3.29
40 +	Obese III	5.49	–

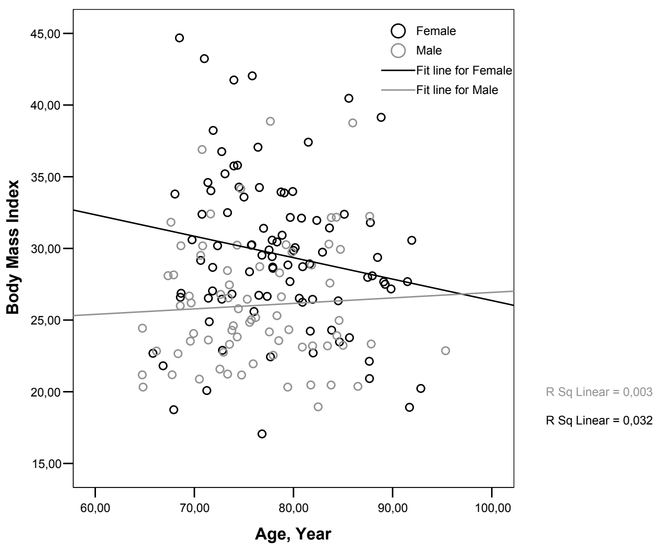

Figure 2. Relationship between Body Mass Index (kg) and age in elderly

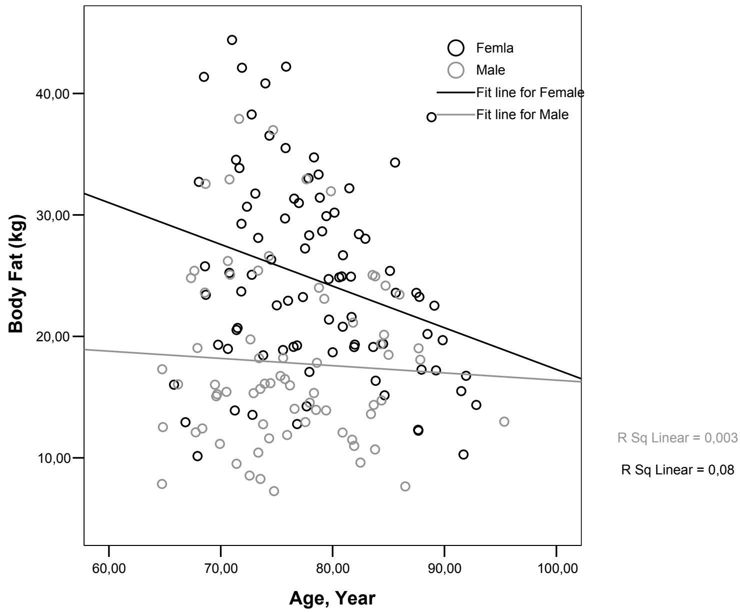

Figure 3. Relationship between Body Fat (kg) and age in elderly

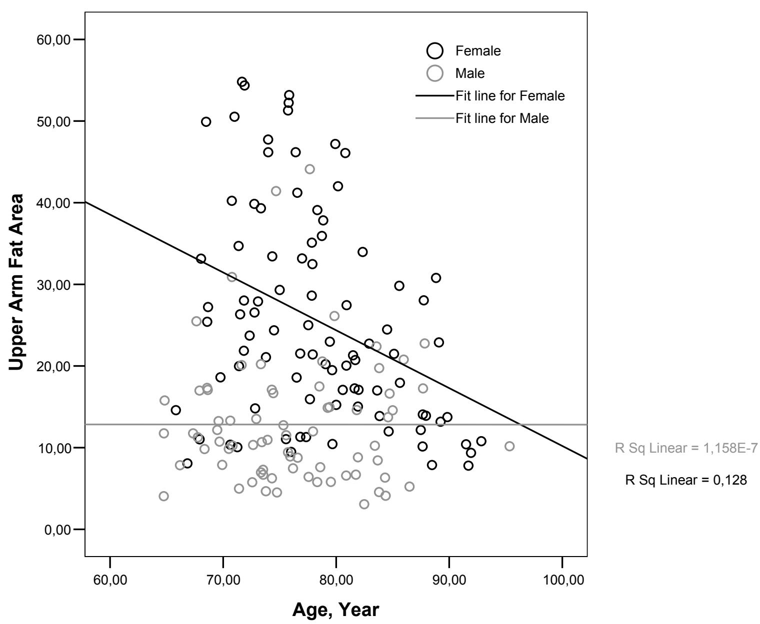

Figure 4. Relationship between Upper Arm Fat Area (kg) and age in elderly

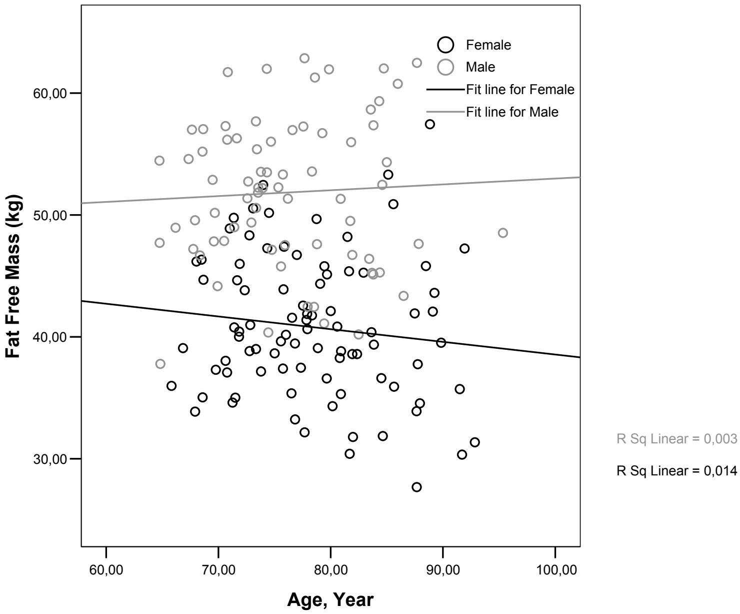

Figure 5. Relationship between Fat Free Mass (kg) and age in elderly

DISCUSSION

The body composition is a good indicator for assessing obesity and the nutritional status of people. The body compositions in elderly have recently been investigated in different countries. But there are only a few studies concerning the prevalence in the Turkish elderly [17, 18].

In the present cross-sectional study we investigated anthropometric measurements in elderly people. The lack of anthropometric cross-sectional surveys in Turkish populations limits the comparison of our sex and age-specific results with those produced by other studies. The results of our study provided useful information, even if preliminary, on the anthropometric characteristics of the elderly people living in nursing homes in Ankara.

The body composition changes occur differently in males and females, and in the various phases of ageing, influencing anthropometry. Consequently, the anthropometric standard values derived from adult populations may not be applicable to the elderly [19]. The ageing process involves modifications in nutritional and physiological status, such as a decrease in the body weight and height [20], and a reduction in fat-free mass associated with an increase in the fat mass. Moreover, a redistribution of adipose tissue occurs with accumulation in the trunk and visceral sites [21, 22]. This study results show that males had a significantly greater fat free mass ($P < 0.001$) than females, while females had a significantly greater ($P < 0.001$) body fat as the percentage of body weight (Table 1, Figures 2–4), as expected and reported by others [23, 24].

Recent studies report high prevalence rates of obesity and overweight among adults in Turkey and higher obesity rate for females than males [25, 26, 27]. This study also provides valuable descriptive information on the current prevalence of overweight and the body composition in Turkish elderly. In elderly (over 65 years and older), the health risk of overweight is unclear; in fact, population data indicate that moderate overweight at older ages is associated with lower mortality. Among those older than 80 years, thinness and loss of lean body mass may be a more significant problem than overweight. It is known that both lean and fat body mass play a role in determining the health status and outcomes [10]. Low body mass index (BMI), indicative of chronic energy deficiency (CED) and malnutrition, is associated with compromised immune function, increased susceptibility to infectious illnesses, and reduced survival among elderly [28].

The pattern of sex differences in anthropometric characteristics of the elderly, as observed in this study, was similar to patterns reported from the other developed [29, 30] and developing countries [31, 32, 33, 34].

Anthropometric and nutritional characteristics are related to environmental factors, socio-economic structure, habits, educational status, climate, nutritional regime as well together with genetic factors. This makes it difficult to give a standard interpretation of their values. But it has been known that anthropometry is an essential tool in geriatric nutritional assessment to evaluate body compositions, which are both important risk factors for severe diseases and disability in the elderly.

The present study did not aim to establish recommended standards for the BMI and the body composition value among the elderly living in nursing house in Turkey, as these values should provide baseline information on the body composition for elderly. It is important to highlight the high prevalence of overweight and obesity ratios among females in nursing homes, and public preventions must be considered. The results of this study identify the elderly participants, who are particularly at risk, and will allow health care workers to focus their attention on the elderly living in nursing houses.

REFERENCES

1. Kinsella, K., Victoria A. Velkoff. U. S. Census Bureau. Series P95/01-1, An Aging World 2001; U.S. Government Printing Office, Washington, DC.
2. Türkiye İstatistik Kurumu (TÜİK). Nüfus ve kalkınma göstergeleri. Türkiye İstatistik Kurumu, 2007; http://www.tuik.gov.tr. http://tuikapp.tuik.gov.tr/adnks-dagitapp/adnks.zul.(18.06.2011)
3. Buken N. Aged Population From Ethical Perspective, in An Ethical Look to Life. Ankara Medical Association Publications 2002, 133–156.
4. Janssen I. (2006). Influence of Sarcopenia on the Development of Physical Disability: The Cardiovascular Health Study. J Am Geriatr Soc, 54, (1): 56–62.
5. WHO 1995. Physical status the use and interpretation of anthropometry. WHO technical Reports Series 854, Geneva.
6. Visser M., Langlois J., Guralnik J. M., Cauley J. A., Kronmal R. A., Robbins J., Williamson J. D., Harris T. B. (1998). High body fatness, but not low fat-free mass, predicts disability in older men and women: the Cardiovascular Health Study. American Journal of Clinical Nutrition, 68, 584–590.
7. Chumlea W. C. Baumgartner R. N. (1989). Status of anthropometry and body composition data in elderly subjects. Am. J. Clin. Nutr, 50, 1158–1166.
8. Forbes G. B. (1999). Body Composition: Overview. The journal of Nutrition, vol. 129, 1, 270–272.
9. de Onis M., Habicht J. P. (1996). Anthropometric reference data for international use: recommendations from a World Health Organization Expert Committee. American Journal of Clinical Nutrition, 64, 650–658.
10. Bosi T. B. (2003). Anthropomethry in elderly. Turkish Journal of Geriatrics, 6, 147–151.
11. Pekcan G., Yücecan S., Tayfur M. (1992). Dietary Intakes and Nutritional Status of Non-Institutionalized Elderly. Age and Nutrition (abstract), 3:139.
12. Atamtürk D., Mas N. Elli Yaş ve Üzerindeki Bireylerde Malnütrisyon ve Obezite Sıklığı. (2010). Journal of Geriatrics and Geriatric Neuropsychiatry, 2, Sayı,1.
13. Gültekin T., Akın G. (2005). Yaşlanmayla Birlikte Boy Uzunluğu ve Oturma (Büst) Yüksekliğinde Meydana Gelen Değişimler. Türk Geriatri Dergisi, 8, 123–128.
14. Başıbüyük G. Ö., Akın G. (2007)Sivas İl Merkezinde Yetişkin Kadın ve Erkeklerde Obezite Değerleri. Turkish Studies, 2,1239–1261.
15. Wang Z. M., Pierson R. N., Heymsfield S. B. (1992). The five-level model: a new approach to organizing body composition research. Am J Clin Nutr, 56, 19.
16. Durnin J. V. G. A., Womersley J. (1974). Body fat assessed from total body density and its estimation from skinfold thickness: measurements on 481 men and women aged from 16 to 72 years. Br J Nutrition, 32, 77–97.
17. Aslan D., Ozcebe H., Takmaz S., Toptan S., Sahın A., Arıkan M., Tanviverdi B. (2000). Anthropometric assessment of 65 years and older people living in the

catchment area of a primary health care unit in Ankara, Turkish Journal of Geriatrics, Cilt 9, Sayı 2, Sayfa(lar) 065–069.
18. Onat A, Sansoy V, Uysal O. (1999). Waist circumference and waist to hip ratio in Turkish adults: interrelation with other risk factors and association with cardiovascular disease. Int J Cardiol, 70, 43–50.
19. Perissinotto E., Pisent C., Sergi G., Grigoletto F., Enzi G. (2002). Anthropometric measurements in the elderly: age and gender differences, British Journal of Nutrition, 87, 177–186.
20. Dey D. K., Rothenberg E., Sundh V., Bosaeus I., Steen B. (1999). Height and body weight in the elderly. I. A 25 year longitudinal study of a population aged 70 to 95 years. European Journal of Clinical Nutrition, 53, 905–914.
21. Steen B. Body composition and aging. (1998). Nutrition Reviews, 46, 45–51.
22. Schwartz R. (1998). Obesity in the elderly. In Handbook of Obesity, 103–114. [GA Bray, C Bouchard and WPT James, editors]. New York: M Dekker.
23. Kuczmarksi M. F., Kuczmarksi R. J., Najjar M. (2000). Descriptive anthropometric reference data for older Americans. Journal of the American Dietetic Association, 100, 59–66.
24. National Center for Health Statistics: National Health and Nutrition Examination Survey, AnthropometricReference Data,United States, 1988–1994. http://www.cdc.gov/nchs/about/major/nhanes/Anthropometric%20Measures.htm (accessed 11/07/2010).
25. Gültekin T., Ozer B. K, Akin G., Bektas Y., Sagir M., Gülec, E. (2009). Prevalence of overweight and obesity in Turkish adults. Anthropologischer Anzeiger, 6, 205–212.
26. Oguz A., Temizhan A., Abaci A., Kozan O., Erol C., Ongen, Celik S. (2008). Obesity and abdominal obesity; an alarming challenge for cardiovascular risk in Turkish adults. Anadolu Kardiyolu Derg, 8, 401–406.
27. Dinc G., Eser E., Saatli G. L., Cihan U. A, Oral A., Baydur H., Ozcan C. (2006). The relationship between obesity and health related quality of life of women in a Turkish city with a high prevalence of obesity. Asia Pacific Journal of Clinical Nutrition, 15, 508–515.
28. Dangour A. D., Ismail S. J. (2003). Ageing and nutrition in developing countries. Trop Med Int Health, 8, 287–9.
29. Lehmann A. B., Bassey E. J. (1996). Longitudinal weight changes over four years and associated health factors in 629 men and women aged over 65. Eur J Clin Nutr, 50, 6–11.
30. Rea I. M., Gillen S., Clarke E. (1997). Anthropometric measurements from a cross-sectional survey of community dwelling subjects aged over 90 years of age. Eur J Clin Nut, 51,102–6.
31. Strickland S. S., Ulijaszek S. J. (1993). Body mass index, aging and differential reported morbidity in rural Sarawak. Eur J Clin Nutr, 47, 9–19.

32. Chilima D. M., Ismail S. J. (1998). Anthropometric characteristics of older people in rural Malawai. Eur J Clin Nutr, 52, 643–9.
33. Suzana S., Earland J., Suriah A. R., Warnes A. M. (2002). Social and health factors influencing poor nutritional status among rural elderly Malays. J Nutr Health Ageing, 6, 363–9.
34. Muñoz A. M., Madrid L. F., Zambrano R. C., Maestre G. E. (2010). Basic Anthropometry and Health Status of Elderly: Findings of the Maracaibo Aging Study. Journal of Aging and Health, 22, 242– 261.

Corresponding author:
Timur Gültekin
Ankara University, Faculty of Languages
History and Geography, Department of Anthropology
Sihhiye, 06100 Ankara Turkey
E-mail: tgultekin@ankara.edu.tr