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Body Mass Index, Waist, Waist to Hip Ratio and Lipid Profile in Elderly Subjects Living in a Nursing Home

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In the present study, lipid profile and indices of obesity in elderly residents living in the Riyadh-nursing home, Kingdom of Saudi Arabia was assessed. All elderly males (n = 48) living in the nursing home were included in the study. Body mass index, waist circumference and waist to hip ratio were measured. In addition, total cholesterol, low density lipoprotein-cholesterol, high density lipoprotein-cholesterol and triglyceride concentrations were measured in serum. The results show that 43.8% of the elderly were considered to be either overweight or obese. The results show that 29.2 and 33.3% of the subjects were having central obesity, as measured by waist circumference and waist to hip ratio, respectively. Twenty five percent and 20.8% of the subjects had high total cholesterol and high low-density lipoprotein-cholesterol, respectively. About 42% of the elderly classified as having low high-density lipoprotein-cholesterol and 10.4% classified as having high triglyceride. Waist circumference was strongly correlated with body mass index (r = 90), whereas waist-to-hip ratio was less correlated (r = 0.64). Body mass index, waist circumference and wait-to-hip ratio were positively associated with triglyceride, whereas waist circumference and waist-to-hip ratio were negatively associated with high density lipoprotein-cholesterol. To conclude, the prevalence of central obesity was appreciable. Early detection of obesity, upon admission to nursing homes, would lead to early nutritional intervention, thus, help in preventing obesity-related complications and reducing medical-treatment costs.

Key words: Anthropometric, geriatric, cholesterol, triglyceride, elderly institute

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INTRODUCTION

Obesity, Particularly central obesity, has been associated with dyslipidemia and many metabolic-syndrome conditions, such as glucose intolerance, hyperinsulenemia, type-2 diabetes, high blood pressure and cardiovascular disease (Kannel *et al*., 1991; Eckel and Krauss, 1998; Calle *et al*., 1999; Di Pietro *et al*., 1999; Must *et al*., 1999; Elisaf, 2001; Shirai, 2004). The Royal College of Physicians of London stated that overweight and obesity are serious clinical problems, which requires appropriate and effective management by multi disciplinary professionals (Royal College of Physicians, 1998).

Although Body Mass Index (BMI) is used as a clinical measure to identify overweight and obese patients, however, it does not account for the wide variation in body fat distribution. Fat accumulated in the abdominal area (Visceral tissues) is an independent risk factor for hypertension, diabetes, dyslipidemia and cardiovascular disease and has greater health risk than fat distributed around the hips and thigh (Carson *et al*., 2004), thus, estimating fat in the visceral tissues (abdominal region), by measuring Waist Circumference (WC) and/or Waist to Hip Ratio (WHR), becomes a necessary measurements to identify individuals at risk of obesity-health complications (WHO, 2000). It has been shown that WHR and those with larger waist, but smaller hip are positively related to total cholesterol (TC) and low density lipoprotein-cholesterol (LDL-C) and negatively associated with high density lipoprotein-cholesterol (HDL-C), independent of BMI (Canoy *et al*., 2006).

According to our knowledge, no data has been published to determine the prevalence of overweight and obesity and the relationship between BMI, fat distribution and lipid profile in elderly living in nursing homes in the Kingdom of Saudi Arabia (KSA).

In the present study, BMI, WC, WHR and the correlation of these anthropometric measurements with lipid profile [TC, LDL-C, HDL-C and triglyceride (TG)] were assessed in elderly men living in the nursing Home, Riyadh, KSA.

The nursing home is under the management of the Ministry of Social Affairs. The nursing home accommodates and provides medical, psychological and rehabilitative care for the elderly. Almost all of the people living in the nursing home are without family or financial support.

MATERIALS AND METHODS

All Elderly males (n = 48) ≥60 years living in the nursing home were included in the study. The study was approved by the nursing home ethics committee, after explaining the nature of the study in a written form and consent form was obtained by the subjects. The study was conducted during the year 2007.

All anthropometric measurements were collected by a well-trained nurse. Measurements of weight (to the nearest 0.1 kg) and height (to the nearest 0.1 cm) were made using a portable scale and a portable stadiometer, respectively. Knee height was used to estimate the stature of a person who could not stand, or for a person with an obvious spinal curvature. The following equation was used to estimate the stature from knee height. Stature for men = [(2.02 × knee height) – (0.24 × age)] (Chumlea *et al*., 1987). BMI was calculated by dividing the weight in kilograms by the square of the stature in meters (kg m^{-2}). WC to the nearest 0.1 cm was measured at the med-point between the lower border of the rib cage and the iliac crest using measuring tape that was placed in a horizontal plane around the abdomen at the level of the marked med-point and hip circumference to the nearest 0.1 cm was measured using a similar tape at the widest part of the hip region.

For the BMI, a classification defined by the WHO was used to classify the elderly into categories of underweight [<18.5 kg m^{-2}], normal weight [18.5-24.9 kg m^{-2}], overweight [25-29.9 kg m^{-2}] and obese [>30 kg m^{-2}] (WHO, 2000). The following cutoff points were used to indicate central obesity; WHR >1.0 (Stunkard, 1996) and WC = 94 (Han *et al*., 1995; WHO, 2000) were used to indicate central obesity.

A fasting (8-12 h fast) venous blood sample was taken to analyze lipid profile in serum. Lipid concentrations were analyzed in the Central Laboratory and Blood Bank, Ministry of Health, KSA, by standardized enzymatic methods. Cutoff points corresponding to Adult Panel Treatment III criteria (National Cholesterol Education Program, 2002) for borderline high TC, LDL-C, low HDL-C and TAG levels were used to define high TC (≥200 mg dL^{-1}), high LDL-C (≥130 mg dL^{-1}), low HDL-C (<40 mg dL^{-1}) and high TAG (≥150 mg dL^{-1}).

In addition, a high TC/HDL-C (> 4) was used as a cutoff point, as a risk factor for cardiovascular disease and as adverse serum lipid profile (Morar *et al*., 1998).

Statistical analysis: Results were expressed as mean (M) values±standard deviation (SD) and in number (n) and percentage (%). Spearman correlation coefficients were used to estimate the correlation between BMI, fat distribution and serum lipids.

RESULTS AND DISCUSSION

The mean age of the subjects was 69.4±7.96 years (range 60-98 years). Table 1 shows the mean values of the

Table 1: Body mass index, abdominal to hip circumference ratio and serum lipid concentrations of the elderly residents (N = 48)

Parameters	M±SD
BMI (kg m^{-2})	24.60±5.60
WC (cm)	88.90±15.5
WHR	0.97±0.09
TC (mmol L^{-1})	4.63±1.03
TG ((mmol L^{-1})	1.13±0.63
LDL-C (mmol L^{-1})	2.79±0.90
HDL-C (mmol L^{-1})	1.17±0.42

Results are presented as mean (M)±standard deviation (SD). BMI: Body mass index; WC: Waist circumference; WHR: Waist to hip ratio; TC: Total cholesterol; TG: Triglyceride; LDL-C: Low density lipoprotein-cholesterol; HDL-C: High density lipoprotein-cholesterol

Table 2: Classification of body fatness by body mass index in the elderly residents (N = 48)

Body mass index	N (%)
Underweight	5 (10.4)
Normal weight	22 (45.8)
Overweight	14 (29.2)
Obese	7 (14.6)

Results are presented in number (N) and in percentage (%)

Table 3: Classification of body fatness by measuring waist and waist to hip circumference ratio in the elderly residents (N = 48)

Waist to hip ratio	N (%)	Waist circumference (cm)	N (%)
≤1	32 (66.7)	<94	34 (70.1)
>1	16 (33.3)	≥94	14 (29.2)

Results are presented in number (N) and in percentage (%)

Table 4: Classification of serum lipids in the elderly residents (N = 48)

Lipid profile	N (%)
TC (mg dL^{-1})	
< 5.18 mmol L^{-1} (< 200 mg dL^{-1})	36 (75.0)
≥ 5.18 mmol L^{-1} (≥ 200 mg dL^{-1})	12 (25.0)
LDL-C	
< 3.37 mmol L^{-1} (< 130 mg dL^{-1})	38 (79.2)
≥ 3.37 mmol L^{-1} (≥ 130 mg dL^{-1})	10 (20.8)
HDL-C	
< 1.03 mmol L^{-1} (< 40 mg dL^{-1})	20 (41.7)
≥ 1.03 mmol L^{-1} (≥40 mg dL^{-1})	28 (58.3)
TG	
< 1.7 mmol L^{-1} (<150 mg dL^{-1})	43 (89.6)
≥ 1.7 mmol L^{-1} (≥150 mg dL^{-1})	5 (10.4)
TC/HDL-C	
≤ 4	26 (54.2)
> 4	22 (45.8)

TC: Total cholesterol; LDL-C: Low density lipoprotein-cholesterol; HDL-C: High density lipoprotein-cholesterol; TG: Triglyceride; TC/HDL-C: Total cholesterol/high density lipoprotein-cholesterol ratio

Table 5: Correlation between body mass index, fat distribution and serum lipids (N = 48)

Parameters	TC	HDL-C	LDL-C	TC/ HDL-C ratio	TG	BMI	Waist
BMI	0.11	-0.28	0.10	0.33*	0.38*	------	------
WC	0.16	-0.32*	0.16	0.34*	0.39*	0.90*	-------
WHR	0.17	-0.39*	0.20	0.34*	0.47*	0.64*	0.81*

Spearman correlation coefficients (r) were used to test the correlations between various parameters, * $p<0.05$. BMI: Body mass index; WC: Waist circumference; WHR: Waist to hip ratio; TC: Total cholesterol; LDL-C: Low density lipoprotein-cholesterol; HDL-C: High density lipoprotein-cholesterol; TC/HDL-C: Total cholesterol/high density lipoprotein-cholesterol ratio; TG: Triglyceride

anthropometric measurements and lipid profile in the elderly residents. All mean values were within normal/desirable range, according to the cutoff points used in the study. Table 2 shows the classification of BMI in the elderly. About 44% of the elderly were either overweight or obese and only 10.4% were classified as underweight. Table 3 shows that more than quarter of the subjects their WHR and WC were above the cutoff points, used to indicate subjects with central obesity. Table 4 shows the classification of lipid profile in the elderly residence. Twenty five percent, 20.8 and 10.4% of the subjects were having high TC, LDL-C and TAG, respectively. About 42 and 46% of the subjects were having low HDL-C and high TC/HDL-C ratio, respectively. Table 5 examined the correlation between BMI, fat distribution and lipid profile in the elderly. The correlation between WC and BMI was stronger (r = 0.90) than the correlation between WHR and BMI (r = 0.64). BMI, WC and WHR were all positively associated with TG, while WC and WHR, but not BMI, were negatively associated with HDL-C. The negative correlation between BMI and HDL-C (r = -0.28), did not reach the significant level (p = 0.07). BMI, WC and WHR were all positively associated with TC/HDL-C ratio.

Al-Nozha *et al.* (2004) conducted a community-based national epidemiological health survey in KSA. The results show that the prevalence of coronary artery disease was 5.5% and the overall prevalence of overweight and obesity were 36.9 and 35.6%, respectively in Saudi adults, in which the prevalence of overweight and obesity in the male-Saudi elderly subjects (≥60 years) was 42.4 and 26.4%, respectively (Al-Nozha *et al.*, 2005b). In addition, in the same survey, the overall age-adjusted prevalence of metabolic syndrome was dramatically high, 39.3%, in which low-HDL-C found to be the leading factors contributing to the metabolic syndrome (Al-Nozha *et al.*, 2005a). Aziz *et al.* (2004) have shown that the overall prevalence of overweight and obesity was 40 and 23.3%, respectively, in Iranian subjects (age 20-70 years) in which the highest prevalence was seen in the 50-59 years age group and have shown that high TC:HDL-C ratio and high TC were the most prevalent risk factor for cardiovascular disease in men and women, respectively. In addition, the above study had shown that the prevalence of all risk factors for cardiovascular disease has been shown to be increased with advancing age.

Several studies have shown a significant decrease in lean body mass and a significant increase in body fat in elderly subjects (Gallagher *et al.*, 2000; Jensen *et al.*, 2001). In old age, a redistribution of fat occurs, in which more adipose tissues were deposited in the trunk

(abdomen) and around internal organs than in the extremities (Enzi *et al*., 1986; Baumgartuer *et al*., 1988; De Groot *et al*., 1991). Minten *et al.* (1991) have found a relatively low correlation between body mass index and body fat, when body fat was assessed by biceps and triceps skin-fold thickness in old age. Thus, using peripheral skin fold thickness measurements may not be a good indicator for the estimation of body fat in elderly subjects due to the alteration in fat distribution that occurred with advancing age. Measuring WC and WHR may be a better predictor of fatness in old age (Kuczmarski, 1989; Minten *et al*., 1991).

Lemos-Santos *et al.* (2004) have shown that WC, in both young (20-30 years) and old subjects (31-58 years), was strongly correlated with percentage of body fat, measured by electrical bioimpedance and with BMI, while WHR was less correlated. In addition, they found that triglyceride concentration was significantly correlated with all measurement of fatness (BMI and percentage of body fat) and fat location (WHR and WC). This was consistent with our study, in which the correlation between WC and BMI was stronger (r = 0.90) than the correlation between WHR and BMI (r = 0.64) and that BMI, WC and WHR were positively associated with TG in the elderly residence.

In our study, the results showed that fat location (WC and WHR) were negatively associated with HDL-C and this may indicate the important of reducing fat, located centrally, in improving HDL-C. However, no significant correlation was found between BMI, WC or WHR with TC and LDL-C. When age was adjusted for odds ration, Caroll *et al*. (2000) have shown that WC between 94 and 102 cm had significantly higher odds ration for hypertriglyceridemia (3.38) compared to those with WC below 94 cm and WC = 102 cm had significantly higher odds ratio for hypertriglyceridemia (3.88), low HDL-C (1.78) higher TC:HDL-C ratio (1.86) and diastolic hypertension (2.17) compared to those with WC below 94 cm, in male coronary patients. However, several studies have shown that in young subjects, the associations between anthropometric measurements and lipid concentrations were stronger than in old subjects (Heitmann, 1992a; Heitmann, 1992b; Bonora *et al*., 1996; Lemos-Santos *et al*., 2004).

To conclude, early detection of abnormal BMI, WC and WHR and lipid profile in elderly residents, upon admission to elderly institutes, would lead to early medical-nutritional intervention and thus help in reducing medical-treatment costs and would effectively reduced complications.

The medical and/or dietitian staff, working in nursing homes, should be aware of the nutritional guidelines for preventing and treatment of obesity and should educate the residents about the health complications related to overweight and obesity.

Elderly, in nursing homes, should be encouraged and educated in practicing good eating dietary habits, based on moderation and variety and should follow general guidelines for reducing the risk of chronic diseases.

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