European Journal of Clinical Nutrition (2007) 61, 548–553
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www.nature.com/ejcn

ORIGINAL ARTICLE

Prevalence of the metabolic syndrome among Turkish adults

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Objective: To determine prevalence of the metabolic syndrome (MS) in a sample representing Turkish population using United States Adult Treatment Panel-3 guidelines.
Design: The study included random samples from both urban and rural populations in the seven geographical regions of Turkey. The population for this analysis were 2108 men (1372 in urban and 736 in rural areas) and 2151 women (1423 in urban and 728 in rural areas) with a mean age of 40.9 ± 14.9 years (range 20–90).
Results: The prevalence of the MS diagnosed using the Adult Treatment Panel III criteria was 33.9% (1442 of 4259) and differed significantly in men (28%) and women (39.6%). The prevalence of syndrome increased with age in men, from 10.7% in subjects aged 20–29 years to 49% in those aged over 70 years. The prevalence increased with age in women, from 9.6% in subjects aged 20–29 years to 74.6% in those aged 60–69 years, and decreased to 68.6% in those over 70 years of age. The prevalence of the syndrome was similar in urban (33.8%) and rural (33.9%) population. We found 26.8, 26.4, 19.3, 10.9 and 3.6% of the population had at least 1, 2, 3, 4 or 5 components, respectively. We found 57.2, 32.3 and 10.6% of the subjects with MS had 3, 4 and 5 components, respectively.
Conclusions: The prevalence of the MS in the adult Turkish population is very high, especially in women. Our findings have important implications for public health in Turkey.
European Journal of Clinical Nutrition (2007) **61,** 548–553. doi:10.1038/sj.ejcn.1602554; published online 22 November 2006

Keywords: metabolic; syndrome; prevalence

Introduction

Cardiovascular disease remains the number one cause of morbidity and mortality in many developed or developing countries. Metabolic syndrome (MS) is a very important risk contributor to cardiovascular disease (Isomaa *et al*., 2001). The overall prevalence of MS is increasing globally, and adoption of modern lifestyles with high-calorie and high-fat diets and low levels of physical activity has caused the increase in prevalence rates of MS in developing countries. The MS is closely linked to insulin resistance (Grundy *et al*., 2002). Insulin resistance is influenced by genetic factors (Grundy, 1999; Abate, 2000; Grundy *et al*., 2002), and its frequency considerably varies among different populations (Grundy *et al*., 2002). Although obesity and level of physical activity contribute significantly to the frequency of MS, other factors, such as a genetic predisposition, may play a role (Abate, 2000; Thomas *et al*., 2000; Das, 2002). Studies performed in various ethnic groups have also shown that the frequency of individual components of MS can vary between countries (Ford *et al*., 2002; Onat and Sansoy, 2002; Azizi *et al*., 2003; Ramachandran *et al*., 2003; Chuang *et al*., 2004; Gupta *et al*., 2004; Kim *et al*., 2004; Lee *et al*., 2004; Duc Son *et al*., 2005; Enkhmaaa *et al*., 2005; Thomas *et al*., 2005).

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Contributors: OK, AO, AA, CE, ZO, AT and SC participated in the design and conduct of the study. All the authors contributed to the writing and revision of the paper for which AA is guarantor. The order of the contributors was agreed among the investigators, and the first listed contributor made the greatest contribution to the paper, and then in decreasing order.
Received 14 November 2005; revised 27 July 2006; accepted 27 September 2006; published online 22 November 2006

A better knowledge of the prevalence and components of MS would allow the evaluation of better strategies at both population level and patient level to reduce the burden of MS. Therefore, the assessment of the components of MS in a country should provide important insights in the pathogenesis of MS. Previous studies in Turks have shown a higher prevalence of low high-density lipoprotein-cholesterol (HDL-C) concentrations than Western populations; therefore, Turks may be more susceptible to the MS (Mahley *et al*., 1995; Onat *et al*., 1999b). In addition, obesity is very common in Turkish women (Onat *et al*., 1999a; Satman *et al*., 2002; Hatemi *et al*., 2003). There are still only very crude estimates of the prevalence of MS in Turkey (Onat and Sansoy, 2002; Ozsahin *et al*., 2004). Therefore, the aim of this study is to determine the prevalence of MS and its components in a sample representing Turkish population.

Materials and methods

The study protocol was approved by the Ministry of Health of Turkey. A questionnaire was designed to obtain social characteristics (profession, smoking, alcohol consumption, physical activity, diet) and medical history (medications used, cardiovascular risk factors). Two mobile survey teams were formed, which included three research nurses, a health technician and two supervisors. Before the survey, team members were trained about the completion of the questionnaire, blood pressure and anthropometric measurements, and biochemical analyses. The subjects were interviewed by a nurse at a mobile examination center, including extensive anthropometric, physiological and laboratory testing. Two blood pressure readings, separated by at least 5 min, were recorded on the right arm with the participants sitting, using a mercury sphygmomanometer, after 5 min resting. Systolic and diastolic blood pressure was calculated as the mean of the two measurements. However, one blood pressure readings were obtained in 394 subjects. Height, body weight and waist circumferences of all the participants were measured according to the standard methods.

Biochemical analyses
A fasting blood samples early in the morning after an overnight fast (12 h) were taken for the biochemical analysis. The blood sample was analyzed immediately. Total plasma cholesterol, triglyceride (TG), HDL-C and glucose levels were measured using a Vitros multianalyzer and respective reagents (Ortho-Clinical Diagnostics Inc., Rochester, NY, USA). The analyzer was checked every morning with standard solutions, and after every 20 measurements with check strips. All control values were within recommended ranges.

Definition of MS
Based on criteria suggested by the Third Report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation and treatment of High Blood Cholesterol in Adults (Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults, 2001), the MS was defined as the presence of three or more of the following five factors: (1) HDL-C <40 mg/dl; (2) TGs $\geqslant 150$ mg/dl; (3) fasting glucose $\geqslant 110$ mg/dl or the presence of diabetes mellitus; (4) resting blood pressure $\geqslant 130/85$ mm Hg or use of antihypertensive treatment and (5) waist circumference >102 cm in men, >88 cm in women.

Sample size
Our sample size calculation was based on the assumption – from results of previous trials of MS – that the rural/urban frequency of MS in Turkey is 24 and 32%, and men/women frequency is 20 and 34%. The sample size was selected to achieve 80% power to detect a difference in the prevalence of MS between the rural/urban and between men/women at a 5% alpha level. A total of 3600 subjects was calculated as necessary to provide the study with 80% power to detect a difference between rural/urban or men/women with a type I error of 5%. In order to account for possible dropouts, a sample equivalent to $\sim 125\%$ of the required sample size was invited.

The study was conducted in 87 centers across the nation, and included samples from both urban and rural populations in the seven geographical regions of Turkey. Urban districts (towns and city centers) and rural villages (population <2000) near each town were randomly selected in each region of the country according to the number of inhabitants. The number of subjects to be invited from each center was calculated on the basis of age and sex distributions of the urban and rural populations in Turkey. The study was preceded by meetings with the civil authorities who cooperated in identifying and ensuring participation of selected subjects. The subjects were randomly chosen according to the gender and age from the census records of the each center. A member of the survey team visited subjects in their homes and invited to participate to the survey.

Statistical analysis
Continuous variables were shown as mean $\pm$ s.d., and categorical variables as percentage. Student's *t*-test was used to compare continuous variables and χ^2 test was used to compare categorical variables. Statistical analyses were performed using SPSS software (version 11.0). $P<0.05$ was considered significant.

Results

This study included the subjects aged 20+ years, similar to many surveys. Of the 4264 subjects included in the survey, five subjects were excluded because the HDL-C, TG or blood glucose levels were not specified in the records; the

remaining 4259 subjects were included in the analysis. The final population for this analysis was 2108 men (1372 in urban and 736 in rural areas) and 2151 women (1423 in urban and 728 in rural areas) with a mean age of 40.9±14.9 years (range 20–90).

The characteristics of subjects are shown in Table 1. Women had higher body mass index (BMI), overweight and obesity; men had higher waist circumference. Smoking and alcohol consumption were more common in men than in women. As expected, HDL-C levels were higher in the females. Total cholesterol levels were also slightly but significantly higher in the females. Whereas, TG levels were higher in the males.

The prevalence of the MS diagnosed using the Adult Treatment Panel III (ATP III) criteria was 33.9% (1442 of 4259) and differed significantly in men (28%) and women (39.6%). The prevalence of the MS increased with age in men, from 10.7% in subjects aged 20–29 years to 49% in those aged over 70 years (Table 2). The prevalence in women also increased with age in women, from 9.6% in subjects aged 20–29 years to 74.6% in those aged 60–69 years. However, the prevalence decreased in women (68.6%) over 70 years of age.

The proportions of the subjects with the MS components are described in Table 3. High blood pressure and abdominal obesity were most frequent components of the MS. There were significant differences in the prevalence of individual components of MS among men and women. High blood pressure was the most common metabolic disorder in male subjects, whereas, in female subjects, it was abdominal obesity. In male subjects, abdominal obesity was observed as the lowest component, whereas, in female, it was hyperglycemia.

We found 26.8, 26.4, 19.3, 10.9 and 3.6% of the population had at least 1, 2, 3, 4 or 5 components, respectively (Figure 1). Among MS subjects, 57.2% had three components of the syndrome, 32.3% with four components and 10.6% with five components.

The prevalence of the syndrome was similar in urban (33.8%) and rural (33.9%) areas. It was highest in the Black Sea region (37.2%), which was followed by the East Anatolian (36.2%), Aegean (35.8%), Mediterranean

Table 1 Anthropometric, blood pressure and plasma biochemical characteristics in the study subjects

Cohort	*Overall*	*Males*	*Females*	P-*value*
Number ($n=2$)	4264 (100)	2110 (49.5)	2154 (50.5)	
Age (years)	40.9±14.9	40.8±15	41±14.9	NS
Smoking (never, %)	2578 (60.5)	872 (41.3)	1706 (79.2)	<0.001
Alcohol consumption (never, %)	3728 (87.4)	1629 (77.2)	2099 (97.4)	<0.001
Systolic blood pressure (mm Hg)	127.9±19.9	127.8±18.7	128.0±20.9	NS
Diastolic blood pressure (mm Hg)	82.9±13.2	83.0±12.6	82.8±13.8	NS
Mean blood pressure (mm Hg)	97.9±14.5	98.0±13.6	97.8±15.3	NS
Body mass index (kg/m^2)	27.7±5.7	26.6±4.7	28.8±6.3	<0.001
Overweight (%)	2828 (66.3)	1310 (62.1)	1518 (70.5)	<0.001
Obesity (%)	1294 (30.3)	435 (20.6)	859 (39.9)	<0.001
Waist circumference (cm)	90.9±13.6	91.7±12.2	90.1±14.8	<0.001
Total cholesterol (mg/dl)	176.6±41.3	173.6±40.9	179.6±41.4	<0.001
HDL-cholesterol (mg/dl)	49.2±16.7	46.3±16.6	52.0±16.3	<0.001
Triglyceride (mg/dl)	138.9±80.8	148.3±85.7	129.7±74.4	<0.001
Fasting glucose (mg/dl)	108.5±40.8	109.5±41.5	107.5±40.0	NS

Abbreviations: HDL, high-density lipoprotein; NS, nonsignificant.
Values are given as mean±s.d. (range) or number (%).

Table 2 Prevalence of metabolic syndrome according to age strata

Age groups	*Men*		*Women*		*All*	
	Total	*Prevalence (%)*	*Total*	*Prevalence (%)*	*Total*	*Prevalence*
20–29	617 (29.3)	66 (10.7)	613 (28.5)	59 (9.6)	1230 (28.9)	125 (10.2)
30–39	527 (25)	126 (23.9)*	532 (24.7)	158 (29.7)	1059 (24.9)	284 (26.8)
40–49	373 (17.7)	137 (36.7)**	395 (18.4)	204 (51.6)	768 (18)	341 (44.4)
50–59	287 (13.6)	118 (41.1)**	296 (13.8)	201 (67.9)	583 (13.7)	319 (54.7)
60–69	208 (9.9)	97 (46.6)**	213 (9.9)	159 (74.6)	421 (9.9)	256 (60.8)
70+	96 (4.6)	47 (49)*	102 (4,7)	70 (68.6)	198 (4.6)	117 (59.1)
Total	2108 (100)	591 (28)	2151 (100)	851 (39.6)	4259 (100)	1442 (33.9)

Men vs women; *$P<0.05$, **$P<0.001$.

Table 3 Prevalence of individual components of the MS

MS components	*All Subjects*			
	Overall (n = *4259*)	*Male* (n = *2108*)	*Female* (n = *2151*)	P-*value*
Hyperglycemia	27.6	29.6	25.7	<0.001
Hypertriglyceridemia	35.8	39.9	31.8	<0.001
Abdominal obesity	36.2	17.2	54.8	<0.001
Low HDL cholesterol	44.1	38.3	49.7	<0.001
High blood pressure	55.7	58.6	52.7	<0.001
		Subjects with MS		
	Overall (n = *1442*)	*Male* (n = *591*)	*Female* (n = *851*)	
Hyperglycemia	57.4	63.2	53.3	0.001
Hypertriglyceridemia	69.1	77.7	63.1	<0.001
Abdominal obesity	75	49.9	92.5	<0.001
Low HDL cholesterol	63.5	61	65.3	NS
High blood pressure	88.6	90.5	87.2	NS

Abbreviations: HDL, high-density lipoprotein; MS, metabolic syndrome; NS, nonsignificant.

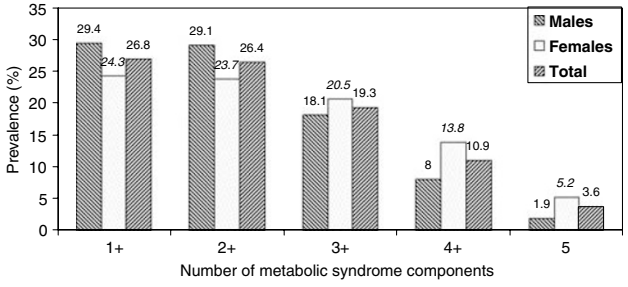


Figure 1 Gender-specific prevalence of components of the MS.

(34.3%), Central Anatolian (32.8%), Marmara (32.4%) and southeastern Anatolian (29.2%). Regional differences were more prominent among men than among women (data not shown).

Discussion

We reported the nationwide prevalence of MS under the ATP III definition in Turkish population. Turkey has undergone rapid socioeconomic transition since 1980 that has resulted in a dramatic change in lifestyles. This urbanization and the attendant relatively unhealthy lifestyle may have contributed to the remarkable high prevalence of MS, especially in women. The Turkish Adult Risk Factor Study examined the prevalence of MS in a cohort of 2455 subjects aged 30–79 and showed a prevalence of 27% in men and 45.2% in women (Onat and Sansoy, 2002). However, the age of the subjects in the Turkish Adult Risk factor study is 10 years higher than that in our study. Ozsahin *et al*. (2004) have determined the prevalence of the MS in 1637 adults aged 20–79 years using ATP III criteria in Adana, a southern province of Turkey. Similar to our results, they reported the prevalence of the MS was 33.4% and was more common in women than in men (39.1 vs 23.7). Sanisoglu *et al*. (2006) recently reported a prevalence of 27.38% for MS that is apparently low for our country. However, their study was designed to investigate the nutrition status of the population, not the prevalence of MS. Indeed, waist circumference was not determined in this study, they defined the MS using BMI instead of waist circumference.

We hypothesized that prevalence of MS is higher in urban than in rural regions, because the subjects in rural regions might be physically more active and consume healthier diet. However, our results did not support this hypothesis. High prevalence of low HDL-C has been previously reported in Turkey (Mahley *et al*., 1995; Onat *et al*., 1999b). In these studies, HDL-C level was about 37 mg/dl in men and 45 mg/dl in women. However, HDL-C level is significantly higher in our study than in these studies. The frequency of low HDL component of MS is not higher in Turkish population than those in the USA population (Jacobson *et al*., 2004). In the past few years, several studies have consistently provided higher concentrations of HDL-C in Turkish adults that is similar to our results (Ilerigelen *et al*., 2005; Uzunlulu *et al*., 2005). The causes of this discrepancy between previous and current studies are not exactly known. However, it may be due to use of different measurement methods for HDL-C. In previous studies, conventional precipitation technique was used for measuring HDL-C. It has been demonstrated that the precipitation method for HDL-C correlated well with the ultracentrifugation method but that the precipitation method exhibited a negative bias for HDL-C (Jensen *et al*., 2002).

Ethnic and country differences in MS prevalence

The prevalence of MS varies dramatically between countries and ethnic groups. However, comparisons between these studies are difficult because of important differences in methods, population characteristics, age ranges and diagnostic criteria. Therefore, the differences may in part be due

to different criteria used to define the MS or populations studied between the studies.

Our results demonstrate a remarkably higher prevalence of MS in Turkish population when using the ATP III definition. The prevalence is higher when compared with Americans, Koreans, Chinese, Japanese, Mongolians (Ford *et al*., 2002; Kim *et al*., 2004; Lee *et al*., 2004; Duc Son *et al*., 2005; Enkhmaaa *et al*., 2005; Thomas *et al*., 2005) and comparable to that of Mexican Americans, South Asians and Persians (Ford *et al*., 2002; Azizi *et al*., 2003; Ramachandran *et al*., 2003; Gupta *et al*., 2004). Turkish population has one of the world's highest prevalences of MS, comparable to that of the South Asians. This suggests a greater burden of MS in our population compared with most of the developed countries. Although obesity and level of physical activity contribute significantly to the frequency of MS, other factors, such as a genetic predisposition, may play a role (Abate, 2000; Thomas *et al*., 2000; Das, 2002). For example, south Asians are highly likely to develop the MS, and genetics may play a role in the high prevalence of MS in South Asians (Das, 2002).

In some countries, MS is more prevalent among women (Ramachandran *et al*., 2003; Gupta *et al*., 2004; Kim *et al*., 2004; Lee *et al*., 2004), in others, the prevalence of the syndrome is similar in two sexes (Chuang *et al*., 2004; Duc Son *et al*., 2005; Enkhmaaa *et al*., 2005; Thomas *et al*., 2005). The prevalence differed little among men and women in the USA. However, among African Americans and Mexican Americans, women had higher prevalence than men. Higher prevalence of MS in women appears to be due to a disproportionately high prevalence of abdominal obesity in women as compared with men. For example, the rates of abdominal obesity in Koreans were only 0.2% in men, but they were 27.3% in women (Kim *et al*., 2004). In our study, abdominal obesity was 17.2% in men and 54.8% in women. Mean values of BMI for the Turkish population have been reported in several population-based investigations in Turkey (Onat *et al*., 1999a; Satman *et al*., 2002; Hatemi *et al*., 2003). In line with our results, these studies showed that BMI was significantly higher in women than in men. In addition, abdominal obesity is very common in Turkish women (Onat *et al*., 1999a; Satman *et al*., 2002; Hatemi *et al*., 2003). It appears that, in Turkey, obesity is an important problem in women than in men. In a recent survey in Turkey, 29% of Turkish women are obese and an additional 27% are overweight (Satman *et al*., 2002). Higher frequency of obesity can be explained by the lack of employment outside the home among Turkish women and limited physical activity (Satman *et al*., 2002).

Components of MS

Studies performed in various ethnic groups have also shown that the frequency of individual components of MS can vary between countries and ethnic groups (Ford *et al*., 2002; Onat and Sansoy, 2002; Azizi *et al*., 2003; Ramachandran *et al*., 2003; Chuang *et al*., 2004; Gupta *et al*., 2004; Kim *et al*., 2004; Lee *et al*., 2004; Duc Son *et al*., 2005; Enkhmaaa *et al*., 2005; Thomas *et al*., 2005). Genetic factors may also have a role in determining the different clustering of various components of the MS in various individuals and ethnic groups (Abate, 2000; Thomas *et al*., 2000). Therefore, the assessment of the components of MS in a country should provide important insights in the pathogenesis of MS. For example, abdominal obesity is more prominent in the South Asians than in the Western population (Das, 2002).

The most frequent component in our study is high blood pressure, followed by low HDL, abdominal obesity, high TG and high fasting blood glucose. The most frequent component of MS is abdominal obesity, followed by low HDL-C, high blood pressure, high TG and high fasting blood glucose in the USA (Ford *et al*., 2002). Among the subjects with MS, the prevalence of high blood pressure and hyperglycemia were higher in Turkey than in the USA. In contrast, the prevalence of abdominal obesity, low HDL and hypertriglyceridemia were lower in our population compared with population of the USA (Sanisoglu *et al*., 2006). Prevalence of other components of MS in Turkish population and US subjects was not much different.

Individual components of MS also vary between men and women in most of the populations. In general, the prevalence of obesity, low HDL and hyperglycemia were higher in women, and high blood pressure and hypertriglyceridemai were higher in men (Ford *et al*., 2002; Gupta *et al*., 2004; Thomas *et al*., 2005). The most striking gender difference among components of MS in our population was the frequency of abdominal obesity. Hypertension was the most prevelant MS component in men; however, abdominal obesity was found to be the most frequent component of the MS in women. Body build is different among populations and, therefore, MS definition according to the ATP III may be inappropriate for the comparisons of MS among some ethnic groups (Ramachandran *et al*., 2003; Lee *et al*., 2004). However, waist circumference values of our population are similar to that of Caucasians. Therefore, the National Cholesterol Education Program critical waist circumference values of 102 cm for men and 88 cm for women seem to be applicable in Turkish population.

In conclusion, the prevalence of the MS in the adult Turkish population is very high, especially in women. Greater emphasis should be laid on the women in terms of MS management. A high prevalence of the MS in Turkey will lead to an increase in coronary artery disease and diabetes, which are already high compared with most of the developed or developing countries. These results may provide a rationale and the basis for the development of prevention programs for the MS.

Acknowledgements

This study was supported by an unrestricted grant from the Abdi İbrahim Pharmaceuticals.

References

Abate N (2000). Obesity and cardiovascular disease. Pathogenetic role of the metabolic syndrome and therapeutic implications. *J Diabet Complicat* **14**, 154–174.

Azizi F, Salehi P, Etemadi A, Zahedi-Asl S (2003). Prevalence of metabolic syndrome in an urban population: Tehran lipid and glucose study. *Diab Res Clin Pract* **61**, 29–37.

Chuang SY, Chen CH, Chou P (2004). Prevalence of metabolic syndrome in a large health check-up population in Taiwan. *J Chin Med Assoc* **67**, 611–620.

Das UND (2002). Metabolic syndrome X is common in South Asians, but why and how? *Nutrition* **18**, 774–776.

Duc Son LNT, Kunii D, Hung NT, Sakai T, Yamamoto S (2005). The metabolic syndrome: prevalence and risk factors in the urban population of Ho Chi Minh City. *Diabet Res Clin Pract* **67**, 243–250.

Enkhmaaa B, Shiwakua K, Anuurada E, Nogib A, Kitajimaa K, Yamasakia M *et al*. (2005). Prevalence of the metabolic syndrome using the Third Report of the National Cholesterol Educational Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (ATP III) and the modified ATP III definitions for Japanese and Mongolians. *Clin Chim Acta* **352**, 105–113.

Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (2001). Executive summary of the third report of the National Cholesterol Education Program (NCEP) expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (Adult Treatment Panel III). *JAMA* **285**, 2486–2497.

Ford ES, Giles WH, Dietz WH (2002). Prevalence of metabolic syndrome among US adults: findings from the Third National Health and Nutrition Examination Survey. *JAMA* **287**, 356–359.

Grundy SM (1999). Hypertriglyceridemia, insulin resistance, and the metabolic syndrome. *Am J Cardiol* **83**, 25F–29F.

Grundy SM, Abate N, Chandalia M (2002). Diet composition and the metabolic syndrome: what is the optimal fat intake? *Am J Med* **113**, 25S–29S.

Gupta R, Deedwania PC, Gupta A, Rastogi S, Panwar RB, Kothari K (2004). Prevalence of metabolic syndrome in an Indian urban population. *Int J Cardiol* **97**, 257–261.

Hatemi H, Yumuk VD, Turan N, Arık N (2003). Prevalence of overweight and obesity in Turkey. *Metab Syndr Relat Disord* **1**, 285–290.

Ilerigelen B, Kabakci G, Koylan N, Kozan O, Buyukozturk K (2005). Coexisting dyslipidemia in hypertensive patients (Abstract). *Atherosclerosis* **6** (Suppl), 156.

Isomaa B, Almgren P, Tuomi T, Forsen B, Lahti K, Nissen M *et al*. (2001). Cardiovascular morbidity and mortality associated with the metabolic syndrome. *Diabet Care* **24**, 683–689.

Jacobson TA, Case CC, Roberts S, Buckley A, Murtaugh KM, Sung JCY *et al*. (2004). Characteristics of US adults with the metabolic syndrome and therapeutic implications. *Diabet Obes Metab* **6**, 353–362.

Jensen T, Truong Q, Frandsen M, Dinesen B, Stender S (2002). Comparison of a homogeneous assay with a precipitation method for the measurement of HDL cholesterol in diabetic patients. *Diabet Care* **25**, 1914–1918.

Kim ES, Han SM, Kim YI, Song KH, Kim MS, Kim WB *et al*. (2004). Prevalence and clinical characteristics of metabolic syndrome in a rural population of South Korea. *Diabet Med* **21**, 1141–1143.

Lee WY, Park JS, Noh SY, Rhee EJ, Kim SW, Zimmet PZ (2004). Prevalence of the metabolic syndrome among 40 698 Korean metropolitan subjects. *Diabet Res Clin Pract* **65**, 143–149.

Mahley RWW, Palaoglu KE, Atak Z, Dawson-Pepin J, Langlois AM, Cheung V *et al*. (1995). Turkish Heart Study: lipids, lipoproteins, and apolipoproteins. *J Lipid Res* **36**, 839–859.

Onat A, Sansoy V (2002). Metabolic syndrome, major culprit of coronary disease among turks: its prevalence and impact on coronary risk. *Arch Turk Soc Cardiol* **30**, 8–15.

Onat A, Yildirim B, Cetinkaya A, Aksu H, Keles I, Uslu N *et al*. (1999a). Indices of obesity and central obesity in Turkish Adults: distinct rise in obesity in 1990–98 more pronounced among men. *Arch Turk Soc Cardiol* **27**, 209–217.

Onat A, Yıldırım AB, Uslu N, Gürbüz N, Keles I, Çetinkaya A *et al*. (1999b). Plasma lipoproteins and apolipoproteins in Turkish adults: overall levels, associations with other risk parameters and HDL's role as a marker of coronary risk in women. *Arch Turk Soc Cardiol* **27**, 72–79.

Ozsahin AK, Gokcel A, Sezgin N, Akbaba M, Guvener N, Ozisik L *et al*. (2004). Prevalence of the metabolic syndrome in a Turkish adult population. *Diabet Nutr Metab* **17**, 230–234.

Ramachandran A, Snehalatha C, Satyavani K, Sivasankari S, Vijay V *et al*. (2003). Metabolic syndrome in urban Asian Indian adults – a population study using modified ATP III criteria. *Diabet Res Clin Pract* **60**, 199–204.

Sanisoglu SY, Oktenli C, Hasimi A, Yokusoglu M, Ugurlu M (2006). Prevalence of metabolic syndrome-related disorders in a large adult population in Turkey. *BMC Public Health* **6**, 92.

Satman I, Yilmaz MT, Sengul A, Salman S, Salman F, Uygur S *et al*. (2002). Population based study of diabetes and risk characteristics in Turkey. Results of the Turkish Diabetes Epidemiology Study (TURDEP). *Diabet Care* **25**, 1551–1556.

Thomas GN, Ho SY, Janus ED, Lam KSL, Hedley AJ, Lam TH (2005). The US National Cholesterol Education Programme Adult Treatment Panel III (NCEP ATP III) prevalence of the metabolic syndrome in a Chinese population. *Diabet Res Clin Practice* **67**, 251–257.

Thomas GN, Tomlinson B, Chan JCN, Lee ZSK, Cockram CS, Critchley JAJH (2000). An insulin receptor gene polymorphism is associated with diastolic blood pressure in Chinese subjects with components of the metabolic syndrome. *Am J Hypertens* **13**, 745–752.

Uzunlulu M, Oguz A, Tigen K (2005). High-density lipoprotein cholesterol in coronary artery disease patients: is it as low as expected? *Anadolu Kardiyol Derg* **5**, 268–270.