Original Article

Serum lipid and lipoprotein levels, dyslipidemia prevalence, and the factors that influence these parameters in a Turkish population living in the province of Tokat*

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Aim: To determine the mean total LDL and HDL cholesterol values and trigliseride levels as well as dyslipidemia and the factors that influence the parameters mentioned above in the population living in the province of Tokat located in the Middle Black Sea (Northeastern) region of Turkey.

Materials and methods: The study was performed in 58 rural and 12 urban residential areas. The 58 rural regions were selected using a cluster sampling method. A total of 1095 subjects were selected through a random sampling method.

Results: The total serum cholesterol level was 186 ± 42 mg/dL with 33.7% of the participants having hypercholesterolemia (≥200 mg/dL). The HDL-cholesterol level was 42 ± 11 mg/dL with 50.9% of the participants having low HDL-cholesterol levels (<40 mg/dL). The LDL cholesterol level was 119 ± 37 mg/dL with 36.2% of the participants having high LDL-cholesterol levels (≥130 mg/dl). The Triglyceride level was 142±82 mg/dL with 36.1% of the participants having high triglycerides levels (≥150 mg/dL). The TC/HDL ratio was 4.7 ± 1.4 with 36.3% of the participants having high TC/HDL ratio levels (≥5).

Conclusion: In agreement with previous studies, we found Turkish people have low HDL-C levels despite normal or near normal levels of TC and LDL-C.

Key words: Dyslipidemia, prevalence, Tokat, Turkey

Tokat ilinde yaşayan Türk toplumunda serum lipid, lipoprotein seviyeleri ve dislipidemi prevalansı ile bu parametreleri etkileyen faktörler

Amaç: Çalışmamızda Orta Karadeniz bölgesinde yer alan Tokat ili genelinde yaşayan kişilerde toplam,LDLve HDL kolesterol , Trigliserid miktarları ile dislipidemi prevalansı ve bunları etkileyen faktörler araştırılmıştır.

Yöntem ve gereç: Çalışma 58 kırsal ve 12 kentsel yerleşim yerinde gerçekleştirilmiştir. Araştırmanın yapıldığı yerleşim yerleri tabakalı örnekleme yöntemiyle seçilmiştir. Araştırmaya katılan toplam 1.095 kişi ise yerleşim yerlerinden rastgele örneklem yöntemiyle seçilmiştir.

Bulgular: Araştırmaya katılan kişilerin ortalama kolesterol miktarı 186 ± 42 mg/dL olup bu kişilerin % 33,7'sinde hiperkolesterolemi (≥200 mg/dL) mevcuttu. Ortalama HDL- kolesterol miktarı 42 ± 11 mg/dL olup katılımcıların % 50,9'u düşük HDL- kolesterol seviyesine (<40 mg/dL) sahipti. Ortalama LDL kolesterol miktarı 119 ± 37 mg/dL olup katılımcıların % 36,2'si yüksek LDL- kolesterol seviyesine (≥130 mg/dL) sahipti. Ortlama trigliserid miktarı 142 ± 82 mg/dL olup kişilerin % 36,1'i yüksek trigliserid seviyesine (≥150 mg/dL) sahipti. Toplam kolesterol /HDL kolesterol oranı ise 4,7 ± 1,4 olup katılımcıların % 36,3'ü yüksek toplam kolesterol /HDL kolesterol oranına (≥5) sahipti.

Sonuç: Türk milletinde daha önceden de yapılmış araştırmaların önemli bir kısmında belirtiltildiği gibi Tokat ili genelinde yaşayan insanlarda normal veya normale yakın toplam kolesterol ve LDL kolesterol seviyesine rağmen, HDL- kolesterol seviyesi düşük bulunmuş olup araştırma yapılan kişilerde dislipidemi sıklığı yüksek bulunmuştur.

Anahtar sözcükler: Dislipidemi, prevalans, Tokat, Turkey

Introduction

Coronary heart disease (CHD) is the leading cause of morbidity and fatality in developing and developed countries (1-3). Dyslipidemia, hypertension, and cigarette smoking are three well known major, but modifiable, risk factors of CHD (1-5). Control of major coronary heart disease risk factors has been revealed to definitively decrease the risk of CHD (4-5). Dyslipidemia is constituted as high level serum total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), triglycerides (TGs), and low level high-density lipoprotein cholesterol (HDL-C) (6, 7). The prevalence of dyslipidemia can vary across population groups according to nationality, ethnicity, genetics, and socio-cultural and economic factors. Also, changes in lifestyle and diet have proven to be influential (8). Dyslipidemia has clearly been shown to increase with age and is especially high among individuals worldwide between ages 40-60 (3-5, 8 ,9).

The 2002 World Health Report indicated that high plasma cholesterol levels are responsible for 56% of CHD and 18% of nonfatal cerebrovascular diseases worldwide (2). In Turkey, the prevalence of cardiovascular and cerebrovascular disease and risk of death is higher than the worlwide average. In Turkey, concerning deaths of those over age 20, 42% are of cardiovascular origin and 11% are of cerebrovascular origin (10).

Turkey is a developing country that has undergone rapid economic development and changes over the last 20 years. These changes have influenced the nation's overall lifestyle, including behaviors linked to CHD such as eating habits and physical activity (1, 3, 8). In addition, studies carried out in different regions of Turkey demonstrated that Turks have normal or near normal total and HDL cholesterol levels and one of the lowest levels of HDL-C in the world. The mean level of HDL-C is around 10-15 mg/dl lower in Turkish society than in Western societies (3). It has also been reported that lower HDL-K levels are proatherogenic, irrespective of normal total and LDL cholesterol levels, and are associated with higher incidents of CHD (11).

Although a few Turkish studies on the prevalence of and factors influencing dyslipidemia exist, it is obviously necessary to carry out further regional studies and differentiate between lifestyles (1,3). Therefore, in accordance with "The Third Report of the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) diagnostic criteria," the aim of this study was to investigate total and LDL cholesterol levels, mean values of triglycerides and HDL-C, and the prevalence of and factors influencing dyslipidemia in the people living in Tokat (12).

Materials and methods

This study was carried out in the province of Tokat, Turkey. Tokat is in the Middle Black Sea region of northeastern Turkey and has a population of 828,000 (about 530,000 inhabitants aged 18 years and older). The study was performed in all of Tokat's 12 urban residential areas. Further, 58 rural of 686 total regions were selected through cluster sampling. Then random sampling produced a total of 1095 subjects (541 male and 554 female; 555 urban and 540 rural). All subjects gave informed consent and the study protocol was approved by the ethics board of Gaziosmanpaşa University. Demographic data (sex, age, education, occupation, marital status, monthly household income, physical activity, alcohol and tobacco consumption, and personal and family history of disease) were obtained from each subject by way of face-to-face interview. BMI was calculated as weight in kilograms (kg) divided by height in square meters (m^2). The BMI was stratified in six parts (<18.5, 18.5-24.9, 25.0-29.9, 30.0-34.9, 35.0-39.9, ≥40). With subjects standing in a relaxed position in only their undergarments, WC was measured at the narrowest horizontal point between the costal margin

and iliac crests and at the end of normal expiration to the nearest 0.1 cm. Central obesity was defined as WC >88 cm in women and >102 cm in men. For physical activity, we considered four categories of physical activity for at least 20 minutes daily (less than once a day =Scarce, once a day=Mild, at least once a day=Intensive, competitive activities in physical sports=Competitive). Alcohol intake was recorded on a validated questionnaire and expressed as weekly (g/wk) consumption.

Blood samples were drawn from each subject after 8–12 h of fasting. Plasma levels, total cholesterol, triglycerides, HDL-C, and LDL-C were measured using Dimension Clinical Chemistry System (Dade Behring Inc. Newark, DE 19714, U.S.A), Roche Elecsys 2010, and Modular Analytics E170 (Elecsys module) immunoassay analyzers (Roche Diagnostics GmbH, D-68298 Mannheim).

Dyslipidemia was defined according to NCEP ATP III criteria. According to this criteria, TC <200 mg/dL is normal and ³200 mg/dL is high; LDL-C <130 mg/dL is normal and ≥130 mg/dL is high; HDL-C <40 mg/dL is normal and ≥40 mg/dL is high; and TG <150 mg/dL is normal and ≥150mg/dL is high (12).

Statistical Analysis

Data were expressed as the arithmetic mean ± standard deviation (SD) for quantitative data and as percentages (%) for qualitative data. Data normality was determined by the One–Sample Kolmogorov-Smirnov test. Statistical comparisons among groups were done with the Two-Independent Samples Test (Mann-Whitney U Test) and Several Independent Samples (Kruskal Wallis test with Bonferroni correction as post hoc). A Chi-Square Test (c^2) was performed to compare quantitative groups of dyslipidemia. Univariate and multivariate logistic regression analyses were performed to determine association among dyslipidemia and its risk factors. Logistic regression analysis results were shown using an Odds Ratio (OR) and Confidence Interval (95% CI) and P < 0.05 was considered as significant.

Statistical analyses were performed using the SPSS/PC statistical program (version 11.5 for Windows; SPSS, Inc., Chicago, IL).

Results

Of the 1095 subjects in the study population, 541 (49.4%) were male and 554 (50.6%) were female. The mean age of study participants was 41.4 ± 17.0 years (41.2 ± 17.7 years in men and 41.6 ± 16.3 years in women, p=0.343).

The total serum cholesterol level was 186 ± 42 mg/dL (182 ± 40 mg/dL in men and 190 ± 43mg/dL in women, P = 0.005) and 33.7% of the participants had hypercholesterolemia [≥200 mg/dL (28.5% of men and 35.9% of women, P = 0.007)]. The HDL-C level was 42 ± 11 mg/dL (39 ± 10 mg/dL in men and 44 ± 10 mg/dL in women, P < 0.0001). In addition, we observed that 50.9% of the participants had low HDL-C levels [<40 mg/dL (63% of men and 38.1% of women, P < 0.0001)]. The LDL-C level was 119 ± 37 mg/dL (116 ± 34 in men and 121 ± 39 mg/dL in women, P = 0.03). Of the participants, 36.2% had high LDL-C levels [≥130 mg/dL (31.2% of men and 37.4% of women, P = 0.03)] and 142 ± 82 mg/dL triglyceride levels [150 ± 87 mg/dL in men and 134 ± 75 mg/dL in women (P = 0.001)]. Of the participants, 36.1% had high triglycerides levels [≥150 mg/dL (38.1% of men and 32.1% of women, P = 0.04)]. The TC/HDL-C ratio was 4.7 ± 1.4 [4.9 ± 1.4 in men and 4.5 ± 1.3 in women (P < 0.0001)]. Of the participants, 36.3% (398 individuals) had high TC/HDL-C ratio levels [≥5 (42.5% of men and 30.3% of women, P < 0.0001)] (Table 2). Of the study participants, the rate of those with high levels of TC, LDL-C, TG, or low levels of HDL-C was 23.7%. This rate was 16.5% in males and 30.7% in females (P < 0.0001). Of the 398 subjects determined to have dyslipidemia according to TC/HDL-C ratio, only 17 (4.3%) stated that they had dyslipidemia when asked and 65% lived in urban areas. Of the participants with dyslipidemia, 8 (2%) were undergoing treatment (Table 1,2).

Table 1. Mean values of total, LDL, and HDL cholesterols, trigliseride, and the ratio TC/HDL-D by gender.

	Male	Female	Total	P value
Total Cholesterol	182 ± 40	190 ± 43	186 ± 42	0.005
LDL Cholesterol	116 ± 34	121 ± 39	119 ± 37	0.029
TG Cholesterol	150 ± 87	134 ± 75	142 ± 82	0.001
HDL Cholesterol	39 ± 10	44 ± 10	42 ± 11	<0.0001
TC/HDL-C	4.9 ± 1.4	4.5 ± 1.3	4.7 ± 1.4	<0.0001

Table 2. Mean values of plasma TC, LDL-C, TG, and HDL-C in people living in the province of Tokat by gender, age group, WC, WHR, BMI, fasting serum glucose, blood pressure, cigarette use, alcohol consumption, levels of physical activity, place of residence, and monthly household income (mean ± SD).

	TC(mg/dL)	LDL-C(mg/dL)	TG (mg/dL)	HDL-C (mg/dL)	TC/ HDL-C
Gender	P = 0.005	P = 0.03	P = 0.001	P < 0.0001	P < 0.0001
Male	182 ± 40	116 ± 34	150 ± 87	39 ± 10	4.9 ± 1.4
Female	190 ± 43	121 ± 39	134 ± 75	44 ± 10	4.5 ± 1.3
Age groups	P < 0.0001	P < 0.0001	P < 0.0001	P = 0.23	P < 0.0001
18-29	166 ± 39	104 ± 38	120 ± 70	42 ± 11	4.2 ± 1.2
30-39	186 ± 38	117 ± 32	140 ± 83	42 ± 10	4.6 ± 1.3
40-49	197 ± 37	128 ± 32	152 ± 77	41 ± 10	5.0 ± 1.3
50-59	208 ± 42	135 ± 36	170 ± 89	43 ± 10	5.1 ± 1.4
≥60	198 ± 37	128 ± 32	154 ± 88	41 ± 10	5.1 ± 1.3
WC P < 0.0001	P < 0.0001	P < 0.0001	P = 0.31	P < 0.0001	
Normal	176 ± 39	112 ± 36	130 ± 74	42 ± 11	4.5 ± 1.3
High	203 ± 41	131 ± 35	162 ± 90	42 ± 10	5.0 ± 1.3
WHR	P < 0.0001	P < 0.0001	P < 0.0001	P = 0.14	P < 0.0001
Normal	178 ± 40	113 ± 37	130 ± 72	42 ± 11	4.5 ± 1.4
High	200 ± 41	128 ± 35	163 ± 63	42 ± 10	5.0 ± 1.3
BMI(kg/m^2)	P < 0.0001	P < 0.0001	P < 0.0001	P = 0.10	P < 0.0001
<18.5	156 ± 39	96 ± 33	94 ± 48	44 ± 15	4.0 ± 1.4
18.5-24.9	171 ± 38	107 ± 33	118 ± 57	43 ± 11	4.3 ± 1.2
25.0-29.9	192 ± 40	124 ± 38	152 ± 89	41 ± 10	5.0 ± 1.4
30.0-34.9	204 ± 41	132 ± 36	171 ± 95	41 ± 9	5.1 ± 1.2
35.0-39.9	203 ± 38	132 ± 32	163 ± 94	42 ± 12	5.0 ± 1.5
≥40	217 ± 41	136 ± 31	178 ± 78	45 ± 13	5.2 ± 1.2
Fasting Serum Glucose	P < 0.0001	P < 0.0001	P < 0.0001	P = 0.32	P < 0.0001
Normal	185 ± 42	118 ± 37	139 ± 79	42 ± 11	4.7 ± 1.3
High	208 ± 41	134 ± 34	199 ± 112	40 ± 10	5.4 ± 1.4
Blood Pressure	P < 0.0001	P < 0.0001	P < 0.0001	P = 0.2	P < 0.0001
Normal	182 ± 42	116 ± 37	136 ± 78	42 ± 10	4.6 ± 1.3
High	199 ± 40	128 ± 33	162 ± 89	41 ± 11	5.1 ± 1.4
Cigarette use	P < 0.0001	P < 0.0001	P = 0.03	P < 0.0001	P = 0.001
Nonsmoker	189 ± 43	121 ± 39	136 ± 76	43 ± 11	4.6 ± 1.3
Smoker	178 ± 40	113 ± 35	144 ± 81	39 ± 11	4.7 ± 1.4
Ex-smoker	190 ± 38	121 ± 30	164 ± 101	39 ± 8	5.1 ± 1.4
Alcohol consumption	P = 0.11	P = 0.49	P = 0.11	P = 0.02	P = 0.08
Abstainers	186 ± 42	119 ± 37	141 ± 82	42 ± 11	4.7 ± 1.4
<40 g/wk of ethanol	176 ± 35	113 ± 29	132 ± 65	39 ± 9	4.8 ± 1.2
≥40 g/wk of ethanol	190 ± 36	120 ± 32	168 ± 91	39 ± 7	5.1 ± 1.2
Physical activity	P = 0.74	P = 0.54	P = 0.32	P < 0.0001	P = 0.004
Low	188 ± 36	123 ± 29	140 ± 66	40 ± 11	5.1 ± 1.5
Moderate	186 ± 43	119 ± 38	138 ± 77	43 ± 10	4.6 ± 1.3
High	184 ± 40	117 ± 35	154 ± 99	40 ± 10	4.9 ± 1.4
Competitive	181 ± 43	117 ± 32	138 ± 79	40 ± 9	4.7 ± 1.5
Place of Residence	P = 0.31	P = 0.34	P = 0.77	P = 0.87	P = 0.59
Urban	185 ± 43	119 ± 40	141 ± 80	41 ± 10	4.7 ± 1.3
Rural	187 ± 40	119 ± 34	142 ± 83	42 ± 11	4.7 ± 1.4
Monthly Household Income	P = 0.70	P = 0.78	P = 0.21	P = 0.90	P = 0.69
<MW*	185 ± 41	117 ± 34	144 ± 86	42 ± 11	4.6 ± 1.3
MW – 2xMW	188 ± 44	121 ± 42	144 ± 85	41 ± 10	4.8 ± 1.5
2xMW – 4xMW	184 ± 40	117 ± 33	140 ± 77	42 ± 10	4.6 ± 1.3
>4xAU	188 ± 45	122 ± 38	119 ± 55	43 ± 11	4.6 ± 1.4
Total	186 ± 42	119 ± 37	142 ± 82	42 ± 11	4.7 ± 1.4

*MW = minimum wage

Mean values of TC, LDL-C, and HDL-C were higher in males than in females, although the mean level of TG was higher in women than in men. The TC, LDL-C, and TG mean levels were highest among the 50-59 age group. Mean levels of TC, LDL-C, and TG increased progressively with age, while these mean values declined slightly in the ≥60 age group. The TC, LDL-C, and TG mean levels were higher in the WC high group than the WC normal group. These mean values also increased with BMI levels. The TC and LDL-C mean levels were lower in the smoker group than in the nonsmoker and former smoker groups (Table 2).

The prevalence of dyslipidemia is shown (Table 3) by gender, age group, WC, WHR, BMI, BG, blood pressure, cigarette usage, alcohol consumption, level of physical activity, place of residence, and monthly household income. There was greater prevalence of high level TC and high LDL-C in females. Furthermore, our study suggests that 33.7% of the study participants have high TC (≥200 mg/dL), whereas 36.2% have high levels of LDL-C (≥130 mg/dL) and 36.1% have high levels of TG (≥150 mg/dL). Additonally, we found 50.9% have a low level of HDL-C (<40 mg/dL) and 36.3% a high level of TC/HDL-C (≥5). The prevalence of high level TG and low level HDL-C was more pronounced in males. The prevalence of high TC, LDL-C, and TG increased with age with the greatest numbers observed in the 50-59 age group. This prevalence declined slightly in the ≥60 age group. The prevalence of high level TC, LDL-C, and TG increased steadily in line with WC and BMI; however, prevalences of high level TC and LDL-C declined in the last BMI group.

The mean TC/HDL-C ratio and high values (>-5) were found to be significantly high, especially in males over the age of 40 compared to those with high WC, those with high WHR, with a BMI of 25 or greater, a BG level of 126 mg/dL or over, those with high blood pressure, and particularly in former smokers and in those with a sedentary lifestyle (Table 2, 3).

We found the prevalence of high level TC and LDL-C lowest in the smoker group, whereas the prevalence of low level HDL-C highest among smokers. No significant relation was found between the prevalence of high level TC, LDL-C, TG, and low level HDL-C and alcohol consumption, level of physical activity (except for HDL-C), and place of residence.

Univariate and multivariate logistic regression analysis results are presented in Table 4 and 5. According to multivariate logistic regression analysis results, TC was significantly associated with age group, WC, and WHR. TG was significantly associated with gender, blood pressure, BG, BMI, and WHR. LDL-C was significantly associated with age group and WC. HDL-C appeared different according to gender and WC. The TC/HDL-C ratio was significantly associated with gender, age group, WC, WHR, blood pressure, and BG.

Discussion

Previous studies performed in various regions of Turkey indicate that Turks, although they have a normal level of LDL-C, have one of the lowest levels of HDL-C in the world. It has also been reported that genetic factors account for 40-80% of low levels of HDL-C and that an increase of 25-30% in hepatic lipase activity in Turks may have an impact on HDL-C levels being low. In addition, environmental conditions, lifestyle, and nutritional habits have an important influence on TC, LDL-C, TG, and HDL-C levels (1,3,5,13). The findings obtained in the present study were consistent with the aforementioned ones. Our results were also quite similar to the 13 year follow-up results (1990-2003) of the TEKHARF study involving all regions of Turkey (1,10). When our results are compared with the results of a Turkish heart study covering six regions of Turkey, it can be seen that mean TC and LDL-C values in men were lower in our study, while mean TG values were higher and HDL-C values were similar. In addition, mean values of TC, LDL-C, and TG in women were found to be higher in our study, while HDL-C values were similar (3,13). The results found in Ayvalık in the Turkish Heart Study were as follows: mean TC, LDL-C, and TG values were lower than in this study, but HDL-C values were similar (3). The results from this study were higher in all parameters when compared to the results of another study carried out in the Middle Black Sea region that did not include Tokat (14). In all of the above mentioned studies, HDL-C levels were low compared to other countries in spite of near

Table 3. The prevalence of dyslipidemia in people living in the province of Tokat. Adult individuals by gender, age group, WC, WHR, BMI, fasting serum glucose, blood pressure, cigarette use, alcohol consumption, physical activity, place of residence, and monthly household income (%).

	TC (≥200 mg/dL)	LDL-C (≥130mg/dL)	TG (≥150mg/dL)	HDL-C (<40mg/dL)	TC/HDL-C Ratio (≥5)
Gender	$X^2 = 7.3$, P = 0.007	$X^2 = 4.8$, P = 0.03	$X^2 = 4.3$, P = 0.04	$X^2 = 69.1$, P < 0.0001	$X^2 = 17.6$, P < 0.0001
Male	28.5	31.2	38.1	63.0	42.5
Female	35.9	37.4	32.1	38.1	30.3
Age groups	$X^2 = 69.5$, P < 0.0001	$X^2 = 74.7$, P < 0.0001	$X^2 = 30.6$, P < 0.0001	$X^2 = 3.2$, P = 0.5	$X^2 = 64.7$, P < 0.0001
18-29	16.1	17.9	24.1	51.1	20.4
30-39	30.3	31.1	34.0	46.2	32.4
40-49	40.8	47.1	42.5	54.0	49.4
50-59	48.6	48.6	47.2	51.4	47.9
≥60	45.3	48.2	41.3	53.2	48.8
WC	$X^2 = 68.3$, P < 0.0001	$X^2 = 53.3$, P < 0.0001	$X^2 = 28.3$, P < 0.0001	$X^2 = 0.002$, P = 0.97	$X^2 = 27.9$, P < 0.0001
Normal	23.3	26.3	29.3	50.6	30.6
High	47.7	48.2	45.4	50.5	46.7
WHR	$X^2 = 54.9$, P < 0.0001	$X^2 = 35.6$, P < 0.0001	$X^2 = 19.4$, P < 0.0001	$X^2 = 1.9$, P = 0.17	$X^2 = 21.8$, P < 0.0001
Normal	24.5	28.0	30.5	52.1	31.5
High	46.6	46.1	43.9	47.7	45.8
BMI(kg/m^2)	$X^2 = 85.8$, P < 0.0001	$X^2 = 80.1$, P < 0.0001	$X^2 = 60.1$, P < 0.0001	$X^2 = 9.1$, P = 0.1	$X^2 = 62.6$, P < 0.0001
< 18.5	8.8	14.7	17.6	35.3	20.6
18.5-24.9	18.0	19.5	24.1	47.1	22.7
25.0-29.9	37.7	41.8	38.0	55.2	44.8
30.0-34.9	48.9	48.3	52.2	52.2	46.1
35.0-39.9	50.9	52.6	38.6	47.4	49.1
≥40	47.6	42.9	66.7	47.6	54.4
Fasting Serum Glucose	$X^2 = 10.8$, P = 0.001	$X^2 = 11.9$, P = 0.001	$X^2 = 21.2$, P < 0.0001	$X^2 = 2.4$, P = 0.1	$X^2 = 19.9$, P < 0.0001
Normal	31.1	33.1	33.7	50.0	34.8
High	51.7	55.2	60.3	60.4	63.8
Blood Pressure	$X^2 = 21.2$, P < 0.0001	$X^2 = 25.6$, P < 0.0001	$X^2 = 17.2$, P < 0.0001	$X^2 = 1.4$, P = 0.2	$X^2 = 30.3$, P < 0.0001
Normal	28.5	30.2	31.4	49.6	31.9
High	43.8	47.3	47.7	53.8	50.8
Cigarette use	$X^2 = 23.4$, P < 0.0001	$X^2 = 13.1$, P = 0.001	$X^2 = 0.17$, P = 0.91	$X^2 = 29.7$, P < 0.0001	$X^2 = 6.4$, P = 0.04
Nonsmoker Nonsmoker	34.9	36.3	33.8	42.9	34.2
Smoker	24.8	28.8	36.8	63.2	37.2
Former smoker	37.7	38.6	37.7	57.9	46.5
Alcohol consumption consumption	$X^2 = 2.6$, P = 0.27	$X^2 = 1.7$, P = 0.42	$X^2 = 3.5$, P = 0.18	$X^2 = 3.5$, P = 0.17	$X^2 = 3.9$, P = 0.14
Abstainers	32.7	34.2	34.8	49.7	35.4
< 40 g/wk of ethanol	23.6	30.6	31.9	54.2	44.4
≥40 g/wk of ethanol	34.4	43.8	50.0	65.6	46.9
Level of physical activity	$X^2 = 1.4$, P = 0.71	$X^2 = 2.5$, P = 0.47	$X^2 = 3.0$, P = 0.4	$X^2 = 22.5$, P < 0.0001	$X^2 = 9.7$, P = 0.02
Low	33.8	40.0	32.5	60.0	46.8
Moderate	33.0	35.0	34.2	45.7	33.5
High	30.3	31.1	39.4	61.8	41.9
Competitive	24.0	28.0	28.0	52.0	36.0
Place of Residence	$X^2 = 1.5$, P = 0.22	$X^2 = 0.4$, P = 0.5	$X^2 = 0.002$, P = 0.96	$X^2 = 0.41$, P = 0.52	$X^2 = 1.2$, P = 0.3
Urban	30.5	33.3	35.1	49.5	34.8
Rural	33.9	35.2	35.0	51.5	38.0
Monthly Household Income	$X^2 = 1.9$, P = 0.58	$X^2 = 0.3$, P = 0.97	$X^2 = 6.1$, P = 0.1	$X^2 = 0.4$, P = 0.9	$X^2 = 1.9$, P = 0.6
< MW*	29.9	34.1	37.0	50.8	36.8
MW – 2xMW	34.3	34.0	37.0	51.6	38.7
2xMW – 4xMW	31.9	34.1	33.1	49.2	33.8
>4xAU	35.6	37.3	22.0	49.1	33.9
Total	33.7	36.2	36.1	50.9	36.3

*MW = minimum wage

Table 4. Odds ratios(95% CI) and P values for dyslipidemia for selected demographic and lifestyle factors (univariate logistic regression analysis).

	TC(≥200 mg/dL)		LDL-C(≥130 mg/dL)		TG(≥150 mg/dL)		HDL-C(< 40 mg/dL)		TC/ HDL-C Ratio(≥5)	
	P value	OR(95% CI)	P value	OR(95% CI)	P value	OR(95% CI)	P value	OR(95% CI)	P value	OR(95% CI)
Gender										
Female		1		1		1		1		1
Male	0.007	0.7(0.5-0.9)	0.028	0.8(0.6-0.9)	0.04	1.3(1.1-1.7)	0.0001	2.8(2.2-3.6)	0.0001	1.7(1.3-2.2)
Age groups										
18-29		1		1		1		1		1
30-39	0.0001	2.3(1.5-3.5)	0.0001	0.5(0.3-0.7)	0.001	2.1(1.4-3.1)	0.271	0.8(0.6-1.2)	0.002	1.9(1.2-2.8)
40-49	0.0001	3.6(2.3-5.7)	0.118	0.7(0.5-1.1)	0.0001	4.1(2.7-6.4)	0.583	1.1(0.8-1.6)	0.0001	3.8(2.5-5.8)
50-59	0.0001	4.9(3.1-7.8)	0.772	1.1(0.7-1.6)	0.0001	4.3(2.8-6.8)	0.952	1.0(0.7-1.5)	0.0001	3.6(2.3-5.6)
≥60	0.0001	4.3(2.8-6.6)	0.279	1.3(0.8-2.0)	0.0001	4.4(2.9-6.6)	0.645	1.1(0.8-1.6)	0.0001	3.7(2.5-5.5)
WC										
Normal		1		1		1		1		1
High	0.0001	3.0(2.3-3.9)	0.0001	2.0(1.5-2.6)	0.0001	2.6(2.0-3.4)	0.985	1.0(0.8-1.3)	0.0001	2.0(1.5-2.6)
Waist to Hip										
Normal		1		1		1		1		1
High	0.0001	2.7(2.1-3.5)	0.0001	2.2(1.7-2.9)	0.0001	1.8(1.4-2.3)	0.2	0.8(0.7-1.0)	0.0001	1.8(1.4-2.4)
BMI(kg/m²)										
< 18.5		1		1		1		1		1
18.5-24.9	0.182	2.3(0.7-7.7)	0.390	1.5(0.6-3.7)	0.492	1.4(0.5-3.8)	0.194	1.6(0.8-3.4)	0.779	1.1(0.5-2.7)
25.0-29.9	0.003	6.3(1.9-20.8)	0.023	2.9(1.2-7.1)	0.004	4.2(1.6-11.0)	0.029	2.3(1.1-4.7)	0.009	3.1(1.3-7.4)
30.0-34.9	0.0001	9.9(2.9-33.5)	0.001	5.1(2.0-12.9)	0.001	5.4(2.0-14.6)	0.074	2.0(0.9-4.3)	0.008	1.4(0.9-8.0)
35.0-39.9	0.0001	10.7(2.9-39.0)	0.041	2.9(1.0-8.2)	0.001	6.4(2.2-19.0)	0.262	1.7(0.7-4.0)	0.009	3.7(1.4-9.9)
≥40	0.003	9.4(2.2-40.5)	0.001	9.3(2.6-33.1)	0.025	4.4(1.2-15.7)	0.366	1.7(0.6-5.0)	0.018	4.2(1.3-14.0)
Fasting Serum Glucose										
Normal		1		1		1		1		1
High	0.001	2.4(1.4-4.1)	0.001	2.5(1.5-4.2)	0.0001	3.0(1.7-5.2)	0.1	1.5(0.9-2.6)	0.0001	3.3(1.9-5.7)
Blood Pressure										
Normal		1		1		1		1		1
High	0.0001	2.0(1.5-2.6)	0.0001	2.1(1.6-2.8)	0.0001	2.0(1.5-2.6)	0.2	1.2(0.9-1.6)	0.0001	2.2(1.7-2.9)
Cigarette use										
Nonsmoker		1		1		1		1		1
Current Smoker	0.001	2.3(1.4-3.6)	0.737	1.1(0.7-1.7)	0.009	1.8(1.2-2.9)	0.819	1.0(0.6-1.5)	0.8	1.5(0.9-2.3)
Ex smoker	0.0001	2.0(1.5-2.8)	0.942	1.0(0.7-1.3)	0.001	1.7(1.2-2.2)	0.0001	0.5(0.4-0.7)	0.37	0.9(0.7-1.2)
Physical activity										
Low		1		1		1		1		1
Moderate	0.991	1.0(0.6-1.6)	0.821	1.1(0.6-1.7)	0.452	0.8(0.5-1.3)	0.011	0.5(0.3-0.9)	0.02	0.6(0.4-0.9)
High	0.662	0.9(0.5-1.5)	0.301	1.3(0.8-2.3)	0.184	0.7(0.4-1.2)	0.866	1.0(0.6-1.8)	0.4	0.8(0.5-1.4)
Competitive	0.402	0.6(0.2-1.8)	0.646	0.8(0.3-2.1)	0.312	0.6(0.2-1.6)	0.439	0.7(0.3-1.7)	0.6	0.7(0.3-1.7)
Place of Residence										
Urban		1		1		1		1		1
Rural	0.273	1.1(0.9-1.5)	0.523	1.1(0.8-1.4)	0.963	1.0(0.8-1.3)	0.519	1.1(0.9-1.4)	0.22	1.2(0.9-1.5)
Monthly Household Income										
< MW*		1		1		1		1		1
MW – 2 x MW	0.2	1.2(0.9-1.7)	0.98	1.0(0.7-1.4)	0.982	1.0(0.7-1.4)	0.83	1.0(0.8-1.4)	0.6	1.0(0.8-1.5)
2xMW – 4 x MW	0.58	1.1(0.8-1.5)	0.99	1.0(0.7-1.4)	0.284	0.8(0.6-1.2)	0.68	0.9(0.7-1.3)	0.4	0.9(0.6-1.2)
>4 x AU	0.38	1.3(0.7-2.3)	0.64	1.2(0.6-2.0)	0.032	0.5(0.3-0.9)	0.82	0.9(0.5-1.6)	0.7	0.9(0.5-1.6)

*MW = minimum wage

Table 5. Odds ratios (95% CI) and P values for dyslipidemia for some selected demographic and lifestyle factors (multivariate logistic regression analysis).

	P value	OR	95%	CI		P value	OR	95%	CI
TC (≥200 mg/dL)					**WC**				
Age groups					Normal		1		
18-29		1			High	0.0001	1.7	1.3	2.2
30-39	0.001	2.1	1.3	3.2	**HDL-C (< 40 mg/dL)**				
40-49	0.0001	2.8	1.8	4.5	**Gender**				
50-59	0.0001	3.6	2.2	5.8	Male		1		
≥60	0.0001	3.3	2.1	5.2	Female	0.0001	3.6	2.7	4.8
WC					**WC**				
Normal		1			Normal		1		
High	0.005	1.6	1.2	2.3	High	0.0001	1.8	1.4	2.5
Waist to Hip					**TC/HDL-C (≥5)**				
Normal		1			**Gender**				
High	0.049	1.4	1.1	2.0	Male		1		
TG(≥150 mg/dL)					Female	0.0001	3.3	2.3	4.6
Gender					**Age groups**				
Male		1			18-29		1		
Female	0.0001	2.2	1.6	3.0	30-39	0.015	1.7	1.1	2.6
Blood Pressure					40-49	0.0001	2.6	1.7	4.1
Normal		1			50-59	0.003	2.1	1.3	3.4
High	0.007	1.5	1.1	2.1	≥60	0.001	2.1	1.4	3.3
Fasting Serum Glucose					**WC**				
Normal		1			Normal		1		
High	0.032	1.8	1.1	3.3	High	0.004	1.8	1.2	2.6
BMI(kg/m^2)					**Waist to Hip**				
< 18.5		1			Normal		1		
18.5-24.9	0.67	1.2	0.5	3.1	High	0.003	1.8	1.2	2.6
25.0-29.9	0.11	2.1	0.9	5.4	**Blood Pressure**				
30.0-34.9	0.007	3.8	1.5	9.9	Normal		1		
35.0-39.9	0.3	1.8	0.6	5.3	High	0.003	1.6	1.2	2.2
≥40	0.006	6.3	1.7	23.1	**Fasting Serum Glucose**				
Waist to Hip					Normal		1		
Normal		1			High	0.02	2.0	1.1	3.6
High	0.001	1.8	1.3	2.4					
LDL-C (≥130 mg/dL)									
Age groups									
18-29		1							
30-39	0.002	2.0	1.3	2.9					
40-49	0.0001	3.5	2.2	5.5					
50-59	0.0001	3.5	2.2	5.6					
≥60	0.0001	3.7	2.4	5.8					

Table 6. The comparison of mean values of Serum TC, LDL-C, HDL-C, TG (mg/dL), and TC/HDL-C ratio between our study and studies carried out in Turkey and other countries.

	TC(mg/dL)		LDL-C(mg/dL)		HDL-C (mg/dL)		TG (mg/dL)		TC/ HDL-C	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Tokat*	182	190	116	121	39	44	150	134	4.7	4.3
TEKHARF Study (19)	186	195	115	122	37	45	149	126	5.2	4.3
Turkish Heart Study(3)	197	191	126	126	36	42	174	118	5.7	4.8
Turkish Heart Study (Istanbul) (3)	202	181	136	117	38	45	142	90	5.5	4.2
Turkish Heart Study (Ayvalık) (3)	160	162	100	99	38	42	124	112	4.3	3.9
Turks in Central Black Sea (14)	162	175	104	111	34	42	106	93	4.8	4.2
Erem Trabzon study (8)	189	191	129	126	45	54	152	125	4.3	3.6
Turks in Germany (23)	193	174	124	108	38	46	135	88	5.1	3.8
Musul-Iraque(15)	177	180	107	110	40	42	149	140	4.6	4.4
Taheran-Iran(16)	206	213	129	135	39	45	190	162	5.3	4.7
Guadeloupe (9)	188	191	124	127	47	49	87	73	4.3	4.1
Germans in Germany (23)	218	211	144	132	47	60	119	88	4.6	3.5
Americans in USA (17)	206	208	132	126	46	55	149	129	4.5	3.8
Canadian(18)	201	199	125	119	46	55	148	108	4.4	3.6

*Our study

normal levels of LDL-C (1,3,10,13,14). However, there was very little difference between the Erem et al. (2008) study carried out in Trabzon and our study in terms of TC, LDL-C, and TG values. HDL-C levels were 25% higher in their study than in all other Turkish studies including this one (8). The TC/HDL-C ratio found in the Erem et al. study (4.3 in males and 3.6 in females) was the lowest figure in both males and females ever found in any Turkish studies (Table 6).

Also, the mean values obtained in this study were quite similar to the results obtained in a study carried out in Mosul, in Northern Iraq (15). In the Mosul study, the mean TC and LDL-C values in men and women were slightly lower than in our study; however, mean TG and HDL-C values were comparable to our study. According to the Mosul study, the people in that region were also found to have low HDL-C levels and normal LDL-C levels. The results of studies carried out in Tehran were higher than those in this study (mean values of TC, LDL-C and TG), however, HDL-C values were similar (16). In a study carried out in Guadeloupe, Mexico, which has a predominantly black population, TC and LDL-C values were comparable to ours, mean TG values were much lower, and mean HDL-C values were much higher (9). Studies carried out in the USA, Canada and Germany found TC, LDL-C, and HDL-C values were higher than in this study, but TG values were lower (Table 6) (11,17,18).

When the prevalence of dyslipidemia was evaluated, similar rates were found in TEKHARF (1,10) and the Turkish Heart Study (3,13). Our results were similar to these studies. In the TEKHARF study, the TC value was 28% in males and 32% in females; LDL-C was 31% in males and 38% in females; TG 40% in males and 29% in females; low HDL-C prevalence was 64% in males and 36% in females (19). In a study carried out in Ankara, Turkey, with a cohort over age 60, the rate of dyslipidemia was found to be 50.7% (4). In a study conducted in Trabzon, the prevalence of high TC (37.5%) values and LDL-C (44.5%) values was greater than our study; the prevalence of high TG (30.5%) was lower than in ours; and the prevalence of low HDL-C (21.1%) was much lower than in ours (8).

The prevalence of high TC (32.7%), high LDL-C (37.8%), and low HDL-C (49.9%) found in Mosul was comparable to our results, but the prevalence of high TG (41.6%) was slightly greater than in our results (15). An Iran based study found high TC (55%), high LDL-C (50%), and high TG (47%) prevalence, greater than our results, and low HDL-C (19%, <35 mg/dL) that was found to be lower than our values (28.3%, <35 mg/dl) (32). A Chinese study found high TC (32.7%), high LDL-C (24.8%), and low HDL-C prevalence (19.2%), lower than the results we obtained (20).

Low HDL-C values may lead to an increased risk of coronary artery disease and ischemic stroke (carotid atherosclerosis), even though total and LDL cholesterol levels are increased (3,5). The TC/HDL-C ratio in Turks is one of the two best predictors of future coronary artery disease. In Turks, each 2 units of ratio increase corresponds to an increase in the risk of coronary fatality and other negative events at the rate of 68% independent of other factors. We suggest that the TC/HDL-C ratio, rather than total and LDL-C cholesterol levels, be taken into account in the evaluation of the risk of coronary artery disease and treatment plans in Turkey and other societies with similar cholesterol levels (3,5,12,13, 15). In addition, Framingham and PROCAM studies showed a TC/HDL-C ratio of over 5 which brings about a significant difference in the risk of myocardial infarction (21,22)

In the present study, the TC/HDL-C ratio was 4.9 ± 1.4 in men and 4.5 ± 1.3 in women. A high TC/HDL-C ratio (≥5) prevalence was 42.5% in men and 30.3% in women. The TC/HDL-C ratio obtained both in our study and in other Turkish studies (except in the Turkish Heart Study Ayvalık and Erem Trabzon studies) was much higher than the values in western societies. In our literature study, the lowest TC/HDL-C ratio was seen in German females at 3.5 and the highest seen in males from İstanbul, Turkey (3,23).

In a majority of the literature, the TC/HDL-C ratio is higher in men than in women (1,3,8,9,14,23). In the present study, mean HDL-C values were found to be significantly lower in men than in women, and the prevalence of low values were significantly higher in men. Past studies found HDL-C values to be higher in women (1,3,8,9,14,19,23).

The TC/HDL-C ratio and the prevalence of high values increased regularly with age in our study (P < 0.0001). Other studies have found the rate of dyslipidemia increases with age (3,9). In the present study, total and LDL cholesterol levels increased rapidly after age 40 in women compared to men. The decrease in the amount of oestrogens in women after menopause and the decrease in the activity of the LDL-C cholesterol receptor activity may play a part in this (17). In the present study, total and LDL cholesterol, TG levels, and TC/HDL-C ratios were found to increase more rapidly after age 30 in comparison with other age groups. Similar results were obtained in the study carried out in Iran (16). The increase in total cholesterol with age is due to an increase in LDL-C and decrease in LDL-C catabolism due to age and hormonal changes. In addition, the increase in total and LDL cholesterol, TG, and the TC/HDL-C ratio may also be attributed to a shift toward a more sedentary lifestyle and accelerated weight gain (17).

The Turkish rate of obesity is reported as (BMI >30) 19% in men and 39% in women (24). The relation between obesity and dyslipidemia has been shown in many studies (8,9). In 20%-25% of obese subjects, TC and LDL-C levels were found to be high and HDL-C levels low. In various studies, it has been established that obesity and cholesterol level, especially in women, both increase with age (9,13,21,22). There is a correlation between a rise in BMI and low levels of HDL-C (13). Findings show that LDL-C levels decreases by 4 mg/dL and HDL-C increases by 2 mg/dL with the loss of each 4.5 kg (25). In the present study, the TC/HDL-C ratio and the prevalence of high values was found to be high in both in those with high WC, high WHR, and particularly with a BMI of 25 or over (P < 0.0001).

In the present study, the TC/HDL-C ratio was found to be high (P < 0.0001) in those with a BG level of 126 mg/dL or over. Numerous studies have indicated a correlation between high BG levels and dyslipidemia (8,9,11).

The values and prevalence of high values of TC, LDL-C, TG, and TC/HDL-C in the subjects with high blood pressure in the present study were found to be significantly higher than those of subjects with normal blood pressure (P < 0.0001). However, no

relation could be established with HDL-C values. In addition, there is a positive correlation between TC, LDL-C, TG, and TC/HDL-C values and systolic blood pressure and diastolic blood pressure (P < 0.0001). As well, a direct proportion between high systolic blood pressure values and high TC, LDL-C, and TG and low HDL-C was demonstrated in many studies (8). Additionally, Onat et al. found an association of high LDL-C (LDL-C >200 mg/dl) with hypertension at a rate of 9.3%. This association has been stressed to increase the risk of CHD by 2.4 times in comparison to other groups (26). In our study, this association was found to be 11.2%. Blood pressure was found to be related to TC, LDL-C, TG, and TC/HDL-C values, but unrelated to HDL-C values. In the study carried out in Trabzon, similar to our results, blood pressure was found to be related to TC, LDL-C, and TG values but had no relation with HDL-C values (27).

Physical activity was found to be related to both the TC/HDL-C ratio (P = 0.004) and the prevalence of its high values (P = 0.02). The mean TC/ HDL-C ratio and the prevalence of its high values (≥5) was significantly higher in subjects with a very low level of physical activity. The relation between physical activity and dyslipidemia was demonstrated by various studies (8). In the Turkish Heart Study, TC, LDL-C, and TG levels decreased significantly in men and women in relation to the degree of effort required for a particular activity while the HDL-C level remained unchanged in men and increased significantly in women (3).

Of the 398 subjects considered to have dyslipidemia according to TC/HDL-C ratio, only 17 (4.3%) stated they had dyslipidemia when questioned, of which 8 (2%) were undergoing dyslipidemia treatment. In a Chinese study, only 8.8% of men and 7.5% of women with dsylipdemia were aware of their situation with 3.5% of males and 3.4% of females undergoing treatment (20). This indicates that the majority of people living in our region do not have adequate information about dyslipidemia, are not aware of their own condition, and are not receiving necessary treatment.

In Univariate logistic regression analysis, the TC/HDL-C ratio and prevalence of its high value was significantly higher in males, especially in those over the age 40, those with high WC, high WHR, BMI 25 or over, BG 126 mg/dL or over, and high blood pressure (Table 4).

In multivariate logistic analysis, TC (≥200 mg/dL) was found to be related to age group, WC, and WHR. TG (≥150 mg/dL) was found to be related to gender, blood pressure, BG, BMI, and WHR. LDL-C (≥130 mg/dL) was found to be related to age group and WC. HDL-C (<40 mg/dL) was found to be related to gender and WC. TC/HDL-C (≥5) was found to be related to gender, age group, WC, WHR, blood pressure, and BG levels.

In conclusion, the presence of low HDL-C levels in Turkish people, despite normal or near normal TC and LDL-C levels as demonstrated in previous studies, was corroborated by our study. The causes of this phenomenon should be clarified by further studies. People's lack of awareness of their situation creates larger risk. Also, in the region, people's awareness and information level should be increased through workshops and training in health matters.

References

1. Onat A, Surdum-Avci G, Senocak M, Örnek E, Gözükara Y. Plasma lipids and their relationship in Turkish adults. J Epidemiol Community Health 1992; 46: 470-476.

2. World Health Organization: The World Health Report "Reducing risks, Promoting Healthy Life", Quantifying Selected Major Risks to Health. Geneva, World Health Organization, 2002:47-92.

3. Mahley RW, Palaoglu KE, Atak Z, Dawson-Pepin J, Langlois AM, Cheung V et al. Turkish Heart Study: lipids, lipoproteins, and apolipoproteins. J Lipid Res 1995; 36: 839-859.

4. Ozkara A, Turgut F, Kanbay M, Selcoki Y, Akcay A. Population-based cardiovascular risk factors in the elderly in Turkey: a cross-sectional survey. Cent Eur J Med 2008; 3: 173-178.

5. Bersot TP, Palaoglu K E, Mahley R W. Managing Dyslipidemia in Turkey: Suggested Guidelines for a Population Characterized by Low Levels of High Density Lipoprotein Cholesterol. Anadolu Kardiyol Derg. 2002; 4: 315-322.

6. 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): final report. Circulation 2002; 106: 3143-3421.

7. Schaefer EJ. Lipoproteins, nutrition, and heart disease. Am J Clin Nutr 2002; 75: 191-212.

8. Erem C, Hacihasanoglu A, Deger O, Kocak M, Topbas M. Prevalence of dyslipidemia and associated risk factors among Turkish adults: Trabzon lipid study. Endocr 2008; 34: 36–51.

9. Foucan L, Kangambega P, Koumavi Ekouevi D, Rozet J, Bangou-Bredent J. Lipid profile in an adult population in Guadeloupe. Diabetes Metab 2000; 26: 473-480.

10. Onat A: Risk factors and cardiovascular disease in Turkey. Atherosclerosis 2001; 156: 1-10

11. Schaefer EJ, Lamon-Fava S, Ordovas JM, Cohn SD, Schaefer MM, Castelli WP et al. Factors associated with low and elevated plasma high density lipoprotein cholesterol and apolipoprotein A-I levels in the Framingham Offspring Study. J Lipid Res 1994; 35: 871-882.

12. Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. 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 2001; 285: 2486-2497.

13. Mahley RW, Pépin GM, Bersot TP, Palaoğlu KE, Özer K. New Findings of the Turkish Heart Study: Guiding Treatment Suggestions for Levels of Plasma Lipids and Low HDL. Arch Turk Soc Cardiol 2002; 30: 93-103.

14. Adam B, Talu C, Bedir A, Alvur M, Sakan O. The levels of lipids, lipoproteins and apolipoproteins in healthy people in the central region of the Black Sea. Jpn Heart J 1999; 40: 427-434.

15. Mula-abed W S, Chilmeran S K. Prevalence of dyslipidemia in Iraq adult population. Saudi Med J 2007; 28: 1868-1874.

16. Azizi F, Rahmani M, Ghanbarian A, Emami H, Salehi P, Mirmiran P et al. Serum lipid levels in an Iranian adults population: Tehran Lipid and Glucose Study. Eur J Epidemiol 2003; 18: 311-319.

17. Johnson CL, Rifkind BM, Sempos CT, Carroll MD, Bachorik PS, Briefel RR et al. Declining serum total cholesterol levels among US adults. The National Health and Nutrition Examination Surveys. J Am Med Assoc 1993; 269: 3002-3008.

18. Connelly P W, Maclean D R, Horlick L, O'Connor B, Petrasovits A, Little A, Canadian Heart Health Surveys Research Group. Plasma Lipids and lipoproteins and the prevalence of risk for coronary heart disease in Canadian adults. CMAJ 1992; 146: 1977.

19. Onat A. Lipids, lipoproteins and apolipoproteins among turks, and impact on coronary heart disease. Anadolu Kardiyol Derg 2004; 4: 236-245.

20. He J, Gu D, Reynolds K, Wu X, Muntner P, Zhao J et al. InterASIA Collaborative Group. Serum total and lipoprotein cholesterol levels and awareness, treatment, and control of hypercholesterolemia in China. Circulation 2004;110:405-411.

21. Castelli WP, Garrison RJ, Wilson PW, Abbott RD, Kalousdian S, Kannel WB. Incidence of coronary heart disease and lipoprotein cholesterol levels. The Framingham Study. JAMA 1986; 256: 2835-2838

22. Assmann G, Cullen P, Schulte H. The Münster Heart Study (PROCAM). Results of follow-up at 8 years. Eur Heart J 1998;19 (Suppl. A): A2-A11

23. Assmann G, Schulte H. Relation of high-density lipoprotein cholesterol and triglycerides to incidence of atherosclerotic coronary artery disease (the PROCAM experience). Prospective Cardiovascular Münster study. Am J Cardiol 1992; 70:733-737.

24. Onat A, Yıldırım B, Cetinkaya A, Aksu H, Keleş İ, Uslu N et al. Indices of obesity and central obesity in Turkish adults: Distinct rise in obesity in 1990-98 more pronounced among men (in Turkish). Arch Turk Soc Cardiol 1999;27:209-217.

25. Dattilo AM, Kris-Etherton PM. Effects of weight reduction on blood lipids and lipoproteins: a meta-analysis. Am J Clin Nutr 1992; 56: 320-328.

26. Onat A, Turkmen S, Karabulut A, Yazıcı M, Can G, Sansoy V. Combined Hypercholesterolemia and Hypertension Among Turkish Adults: Prevalence and Prediction of Cardiovascular Disease Risk. Arch Turk Soc Cardiol 2004; 32: 533-541.

27. Erem C, Hacihasanoglu A, Kocak M, Deger O, Topbas M. Prevalence of prehypertension and hypertension and associated risk factors among Turkish adults: Trabzon Hypertension Study. Journal of Public Health 2008; 31: 47–58.