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ORIGINAL PAPER

Prevalence of dyslipidemia and associated risk factors among Turkish adults: Trabzon lipid study

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Abstract The objective of this study was to estimate the prevalence of dyslipidemia as defined by NCEP ATP III criteria in the Trabzon Region of Turkey and to determine its associations with cardiovascular risk factors [hypertension (HT), body mass index (BMI), waist circumference (WC), waist-to-hip ratio (WHR), and fasting serum glucose (FBG)] demographic factors (age, sex, obesity, marital status, reproductive history in women, and level of education), socioeconomic factors (household income and occupation), a family history of selected medical conditions (diabetes, HT, obesity, and cardiovascular disease), and lifestyle factors (smoking habits, physical activity, and alcohol consumption) in the adult population. In this cross-sectional survey, a sample of households was systematically selected from the central province of Trabzon city and its nine towns, namely, Akcaabat, Duzkoy, Vakfikebir, Yomra, Arakli, Of, Caykara, Surmene, and Macka. A total of 4,809 subjects (2,601 women and 2,208 men) were included in the study. Individuals older than 20 years were selected from their family health cards. Demographic and socioeconomic factors, a family history of selected medical conditions, and lifestyle factors were obtained for all participants. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) levels were measured for all subjects. The individuals included in the questionnaire were invited to the local medical centers for blood tests between 08:00 and 10:00 after 12 h of fasting. The levels of serum glucose (FBG), total cholesterol (TC), high-density cholesterol (HDL-C), low-density cholesterol (LDL-C), and trigylcerides were measured with autoanalyzer. Dyslipidemia was defined according to guidelines from the US NCEP ATP III diagnostic criteria. The ratio of TC to HDL-C was calculated. Definition and classification of HT were performed according to guidelines from the US JNC-7 report. The results obtained indicated that the age-adjusted mean values (mg/dl) of TC, LDL-C, HDL-C, [TC/HDL-C ratio], and TG were 190 ± 0.6, 127.5 ± 0.5, 50.3 ± 0.3, 3.96 ± 0.02, and 137.3 ± 1.5, respectively. Overall, the mean levels of LDL-C, TG and TC/HDL-C ratio were higher in men than in women, whereas the mean level of HDL-C was higher in women than in men. The prevalences of hypercholesterolemia ($\geq$200 mg/dl), elevated LDL-C ($\geq$130 mg/dl), low HDL-C (<40 mg/dl), and hypertriglyceridemia ($\geq$150 mg/dl) were 37.5, 44.5, 21.1, and 30.4%, respectively. Prevalences of dyslipidemia were higher in men than in women, except for TC ($P < 0.0001$). The prevalences of high TC, LDL-C, TG, and TC/HDL-C ratio increased with age, with the highest prevalences in the 60–69-year-old group, and declined thereafter. The prevalences of high TC, LDL-C and TG, a high TC/HDL-C ratio and low HDL-C increased steadily in line with BP, BMI, WC, WHR, and FBG ($P < 0.0001$). Dyslipidemia was positively associated with marital status, parity, cessation of cigarette smoking and current cigarette use, and alcohol

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consumption, and negatively associated with the level of education, household income, and physical activity. Multiple logistic regression analysis revealed that dyslipidemia was significantly associated with the factors of age, male gender, BMI, WC (except for TC and LDL-C), HT (only for LDL-C and TG), FBG (only for LDL-C and TG), education level, cigarette smoking (only for HDL-C and TC/HDL-C ratio), alcohol consumption (except for HDL-C and TC/HDL-C ratio), occupation (especially housewives), marital status (widows and widowers), and a family history of selected medical conditions (for only TC). In conclusion, Trabzon Lipid Study data indicate that dyslipidemias are very common and an important health problem among the adult population of Trabzon. To control dyslipidemias, effective public health education and urgent measures are essential.

Keywords Dyslipidemia · Prevalence · Associated risk factors · Turkish population · Trabzon

Background

Cardiovascular disease (CVD) is the most important cause of death in both developed and developing countries of the world population [1, 2]. Dyslipidemias, including elevated serum total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), triglycerides (TGs), and low high-density lipoprotein cholesterol (HDL-C) levels, are modifiable major risk factors for coronary heart disease (CHD), whereas high levels of HDL-C appear to be protective [3–5]. The World Health Report for 2002 indicates that hypercholesterolemia is the 10th leading risk factor in high mortality in developing countries, the sixth in low mortality in developing countries and the fourth in developed countries [1]. A number of major studies have shown that reduction in serum TC and LDL-C levels by a variety of therapeutic modulators significantly lowers the risk of fatal and nonfatal coronary events [6–8]. The prevalence of dyslipidemia varies widely according to the ethnic, socioeconomic, and cultural characteristics of distinct population groups [9–14].

As a developing country, Turkey has a high level of cardiovascular morbidity and mortality. The designation of the 290 instances of death in adults (≥20 years) comprised 42% coronary deaths, far exceeding those due to cancer (20%), cerebrovascular accident (11%), and other suspected causes [15]. There have been only a few studies in Turkey regarding the epidemiology of dyslipidemia [15–18].

The objective of this study was to assess the prevalence of dyslipidemia in the Trabzon Region according to the Third Report of the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) diagnostic criteria and to examine its associations with a number of risk factors in a large sample of the Turkish adult population.

Methods

Study population

The study was carried out in the central province of Trabzon city and its nine towns, namely, Akcaabat, Duzkoy, Arakli, Surmene, Of, Caykara, Vakfıkebir, Macka, and Yomra, from September 2003 to September 2005. Trabzon city, located in northeastern part of Turkey, has a population of ∼975,000 people. The towns of Yomra, Arakli, Of, Caykara, and Surmene were selected from the eastern, Akcaabat, Duzkoy, and Vakfikebir from the western, and Macka from the southern part of the province. Selection of the towns was based on geographic distribution and logistic considerations, such as the presence of a health center in which the study procedures could be performed. The sample size was calculated based on a 50.0% prevalence (p) of dyslipidemia with a 2% uncertainty level (d), using the formula $n = Z^2_{1-\alpha/2}/[p(1-p)/d^2]$ ($z = 2.576$, with 99% CI). We estimated that this would necessitate studying 4,147 subjects. A total of 5,000 eligible subjects (2,300 men and 2,700 women) were selected from 22 health districts in accordance with the household registration records for the year 2000. Of those, 4,809 subjects (2,601 women and 2,208 men) eventually participated in the study. All subjects were chosen by age-standardized procedures. Random cluster sampling was applied to select the subjects. In the first phase of the study, each health station region was considered as a separate unit. In the second phase, individuals ≥20 years old were selected from their family health cards. A written invitation was sent ∼2 weeks before the survey. All of the households in the study were visited by field workers, and all the subjects were investigated for the presence of dyslipidemia and its associated risk factors. A structured questionnaire was administered to all household members. Anthropometric and demographic data were obtained for each subject. Demographic variables included age, sex, marital status, level of education, occupation, reproductive history in women, and a family history of obesity, diabetes, hypertension (HT), and cardiovascular disease. Questions on lifestyle included physical exercise, smoking habits, and frequency of alcohol consumption. Physical exercise was defined as exercising strenuously for at least 20 min and outside professional activity (never, less than once a week = mild, at least once a week = moderate–heavy). Waist circumference (WC) and hip circumference were measured in duplicate, with subjects standing in a relaxed

position and in underclothes only. 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. Hip circumference was measured at the horizontal level around the buttocks that yielded the maximum measurement. Central obesity was defined as waist-to-hip ratio (WHR) $\geq$1.0 in men and $\geq$0.85 in women, or WC >102 cm in men and >88 cm in women. BMI was calculated as weight (kilograms) divided by the square of height (meters squared). All subjects gave informed consent and the study protocol was approved by the Local Ethical Board (No: 2000/65).

Blood pressure measurement and classification

The SBP and DBP were measured after the subject had rested for 15 min by using a standardized aneroid sphygmanometer and cuffs of appropriate sizes (23 × 12.5 cm) by well-trained personnel. The subject's arm was placed at the heart level in a sitting position. The measurements were taken thrice and the mean was taken for all cases. If readings varied by >10 mmHg, an additional reading was taken. Participants were advised to avoid cigarette smoking, alcohol, caffeinated beverages, and exercise for at least 30 min before their blood pressure (BP) was measured. The Korotkoff phase I (appearance) and phase V (disappearance) were recorded for SBP and DBP, respectively. The classification of normotensives, prehypertensives, and hypertensives was based on the classification of BP from the JNC-7 [19]. Normal BP was defined as a subject not being on antihypertensive medication and having an SBP of less than 120 mmHg and a DBP of less than 80 mmHg. PreHT was defined as not being on antihypertensive medication and having an SBP of 120–139 mmHg or an DBP of 80–89 mmHg. HT was defined based on the JNC-7 cut-off point of 140 mmHg and above for SBP and/or 90 mmHg and above for DBP, and also whether the subject was on antihypertensive medication.

Serum glucose and lipid analyses

Blood samples were obtained in the morning from an antecubital vein and placed into vacutainer tubes without anticoagulant after 10–12 h fasting for lipid profile and serum glucose measurement. Blood was allowed to clot for 2 h at room temperature and the serum was obtained by centrifugation (3,000×g for 15 min). Sera obtained were transferred to the laboratory immediately in cold boxes filled with ice and analyzed at a central, certified laboratory (K.T.U Farabi Hospital, Clinical Chemistry Laboratory) on the same day. TC was measured in EDTA plasma using the cholesterol oxidase method. The laboratory between-run CV was 1.7% at 126.7 mg/dl. TG was measured using the enzymatic peroxidase method. The laboratory between-run CV was 2.4% at 130.5 mg/dl. HDL-cholesterol was measured using a direct enzymatic assay. The laboratory between-run CV was 0.9% at 40.2 mg/dl. The laboratory CV was 3.064. LDL-C was calculated in plasma specimens having a TG value < 400 mg/dl by the formula described by Friedewalt et al. [20]. LDL-C was measured using a direct homogenous enzymatic assay. The laboratory between-run CV was 0.96% at 88 mg/dl. The ratio of TC to HDL-C was calculated.

Dyslipidemias were defined according to NCEP ATP III criteria [21]. Accordingly, TC < 200 mg/dl is normal, 200–239 mg/dl borderline high and $\geq$240 mg/dl high; LDL-C < 100 mg/dl is optimal, 100–129 near optimal/above optimal, 130–159 borderline high, 160–189 high and $\geq$190 mg/dl very high; HDL-C < 40 mg/dl is low (adverse) and $\geq$60 mg/dl high (protective); and TG < 150 mg/dl is normal, 150–199 mg/dl borderline high, 200–499 mg/dl high, and >500 mg/dl very high. Fasting serum glucose (FBG) was measured using an enzymatic (glucose oxidase) colorimetric method. All determinations were performed with an autoanalyzer (Roche, Modular, Switzerland). Reagents used were supplied by the same manufacturer.

Participants receiving pharmacological treatment for dyslipidemia (i.e. statins, fibrates, or both) were included in the high lipid group.

Statistical analyses

Data normality was assessed by the Kolmogorov-Smirnov test. Comparisons among dyslipidemia groups were performed using ANOVA (Bonferroni test as post hoc) for normally distributed data, or Kruskal–Wallis test (Mann–Whitney U test with Bonferroni correction as post hoc) otherwise. Comparisons between groups for quantitative data and prevalence of dyslipidemia were performed using the χ^2 test. For associated risk factors of dyslipidemia, analysis was performed using logistic regression analysis in which dyslipidemias were taken as the dependent variables. Cardiovascular, demographic, socioeconomic, lifestyle factors, and a family history of selected medical conditions were taken as independent variables. Results were shown as arithmetic mean standard error of mean (SEM) for quantitative data, and as percentages for qualitative data. Odds ratio (OR) (95% CI) was used in logistic regression analysis and $P < 0.05$ was considered as significant.

Results

The mean plasma lipid levels

The age-adjusted mean serum lipid levels and the ratio of TC to HDL-C are presented in Table 1. Overall, the mean

Table 1 The age-adjusted mean values of plasma lipids and TC/HDL-C ratio in all subjects by gender and age groups (mean ± SEM)

	n	TC (mg/dl) $P < 0.0005$	LDL-C (mg/dl) $P < 0.0005$	HDL-C (mg/dl) $P < 0.0005$	TC/HDL-C Ratio $P < 0.0005$	TG (mg/dl) $P < 0.0005$
Women						
20–29	699	166.7 ± 1.4	103.5 ± 1.2	56.8 ± 0.4	3.02 ± 0.03	89.2 ± 2.5
30–39	665	183.8 ± 1.5	121.0 ± 1.4	53.5 ± 0.4	3.56 ± 0.05	117.3 ± 4.4
40–49	589	198.6 ± 1.7	133.4 ± 1.5	53.6 ± 0.4	3.86 ± 0.05	134.3 ± 4.1
50–59	296	215.4 ± 2.3	148.6 ± 2.2	54.0 ± 0.6	4.14 ± 0.07	154.0 ± 6.2
60–69	205	220.8 ± 3.2	150.9 ± 2.8	52.9 ± 0.7	4.32 ± 0.08	181.1 ± 10.2
70+	147	212.6 ± 3.7	145.4 ± 3.4	54.1 ± 0.9	4.07 ± 0.10	153.3 ± 6.3
Total	2,601	190.7 ± 0.8	125.9 ± 0.7*	54.4 ± 0.2*	3.64 ± 0.02*	124.7 ± 1.8*
Men						
20–29	607	166.4 ± 1.5	110.2 ± 1.3	46.5 ± 0.4	3.70 ± 0.04	114.7 ± 2.7
30–39	542	191.4 ± 1.7	131.0 ± 1.5	44.3 ± 0.5	4.51 ± 0.05	164.1 ± 4.8
40–49	510	202.7 ± 1.8	140.8 ± 1.6	44.4 ± 0.5	4.73 ± 0.05	172.2 ± 4.4
50–59	283	199.8 ± 2.4	138.7 ± 2.2	45.2 ± 0.6	4.61 ± 0.07	169.9 ± 6.3
60–69	160	202.6 ± 3.6	139.2 ± 3.1	46.0 ± 0.8	4.57 ± 0.10	170.2 ± 11.5
70+	106	194.0 ± 4.4	133.1 ± 4.0	47.2 ± 1.1	4.32 ± 0.11	134.5 ± 7.5
Total	2,208	189.3 ± 0.9	129.3 ± 0.8	45.3 ± 0.2	4.35 ± 0.08	152.1 ± 2.4
All						
20–29	1,306	166.7 ± 1.0	106.7 ± 0.9	52.0 ± 0.3	3.34 ± 0.03	101.1 ± 1.9
30–39	1,207	187.3 ± 1.1	125.5 ± 1.0	49.4 ± 0.3	3.99 ± 0.04	138.1 ± 3.3
40–49	1,099	200.5 ± 1.2	136.8 ± 1.1	49.3 ± 0.4	4.26 ± 0.04	151.7 ± 3.1
50–59	579	207.7 ± 1.7	143.7 ± 1.6	49.7 ± 0.5	4.37 ± 0.05	161.7 ± 4.4
60–69	365	212.8 ± 2.4	145.8 ± 2.1	49.8 ± 0.6	4.43 ± 0.06	176.4 ± 7.6
70+	253	205.0 ± 2.8	140.3 ± 2.6	51.3 ± 0.7	4.16 ± 0.07	145.0 ± 4.8
Total	4,809	190.0 ± 0.6	127.5 ± 0.5	50.3 ± 0.3	3.96 ± 0.02	137.3 ± 1.5

* $P < 0.0005$ significantly different from the males

levels of LDL-C, TG, and TC/HDL-C ratio were slightly higher in men than in women ($P < 0.0005$), whereas the mean level of HDL-C was higher in women than in men ($P < 0.0001$). The levels of TC, LDL-C and TG, and the TC/HDL-C ratio in both women and men increased with age ($P < 0.0005$), with the highest values being observed in the 60-to-69-year old group, and declined thereafter, whereas HDL-C levels decreased.

Prevalence of dyslipidemia

The prevalence of dyslipidemia by gender and age groups is shown in Table 2. The prevalences of borderline high TC and high TC were 24.8% (24.2% for women and 25.5% for men, $P > 0.05$) and 12.7% (13% for women and 12.4% for men, $P > 0.05$), respectively. Approximately two-thirds of men and women had plasma TC levels lower than 200 mg/dl (Table 2).

The prevalence of borderline high, high, and very high LDL-C was 25.2% (23.5% for women and 27.3% for men), 12.8% (11.8% for women and 13.9% for men), and 6.5% (6.3% for women and 6.7% for men), respectively. The prevalence of elevated LDL-C (≥130 mg/dl) was higher in women than in men ($P < 0.0005$).Nearly 58.3% of women and 52.2% of men had LDL-C levels < 130 mg/dl.

The prevalence of low HDL-C (<40 mg/dl) was 21.1% (10.2% for women and 33.9% for men, $P < 0.0001$).

The prevalence of borderline high, high, and very high TG was 13.6% (12.4% for women and 15.1% for men, $P < 0.001$), 15.7% (12.6% for women and 19.3% for men, $P < 0.001$), and 1.1% (0.7% for women and 1.6% for men), respectively. The prevalence of hypertriglyceridemia (≥150 mg/dl) was higher in men than in women ($P < 0.0005$). Approximately 74.2% of Turkish women and 63.9% of Turkish men had TG levels < 150 mg/dl.

The prevalence of a TC/HDL-C ratio ≥ 4.5 was 29% (20% for women and 39.6% for men, $P < 0.0005$).

The prevalences of high TC, LDL-C and TG, and the TC/HDL-C ratio increased with age, with the highest prevalences being observed in the 60–69-year-old group, and then declined thereafter. The prevalence of hypercholesterolemia (≥200 mg/dl) among women increased markedly from the 20–29-year-old group (14.2%) to the 60–69-year-old group (67.3%) ($P < 0.0005$). Among men,

Table 2 The prevalence of dyslipidemia in all subjects by gender and age groups (%)

Age groups	TC (mg/dl)[a]			LDL-C (mg/dl)[b]					HDL-C (mg/dl)[c]			TC/HDL-C ratio[d]			TG (mg/dl)[e]			
	<200	200–239	≥240	<100	100–129	130–159	160–189	≥190	<40	40–59	≥60	≤3.5	3.51–4.50	>4.5	<150	150–199	200–499	≥500
Women	χ^2:405.940 $P < 0.0005$			χ^2:554.314 $P < 0.0005$					χ^2:43.038 $P < 0.0005$			χ^2:375.280 $P < 0.0005$			χ^2:253.419 $P < 0.0005$			
20–29	85.8	10.3	3.9	51.9	30.9	12.0	3.3	1.9	5.9	54.2	39.9	78.0	16.5	5.6	91.0	4.6	4.3	0.1
30–39	70.4	22.0	7.7	28.0	34.9	25.4	9.3	2.4	12.9	57.7	29.3	54.6	29.0	16.4	77.0	13.7	8.9	0.5
40–49	55.7	30.1	14.3	16.4	34.1	28.4	14.6	6.5	12.6	58.1	29.4	43.5	31.4	25.1	71.3	12.4	15.8	0.5
50–59	37.5	36.5	26.0	7.1	27.7	28.7	22.0	14.5	8.4	61.1	30.4	30.1	37.8	32.1	60.8	16.9	20.9	1.4
60–69	32.7	36.6	30.7	8.8	22.4	31.7	21.5	15.6	11.2	61.5	27.3	25.4	37.1	37.6	50.2	21.0	25.4	3.4
70+	41.5	34.7	23.8	10.2	27.2	27.9	19.0	15.6	11.6	58.5	29.9	32.0	32.7	35.4	54.4	22.4	22.4	0.7
Total	62.9	24.2	13.0	26.9	31.4	23.5	11.8	6.3	10.2	57.6	32.2	52.0	28.0	20.0	74.2	12.4	12.6	0.7
Men	χ^2:154.652 $P < 0.0005$			χ^2:258.038 $P < 0.0005$					χ^2:30.764 P:0.001			χ^2:230.549 $P < 0.0005$			χ^2:139.619 $P < 0.0005$			
20–29	81.5	13.8	4.6	43.5	29.5	18.9	5.4	2.6	29.3	59.8	10.9	50.4	29.8	19.8	80.9	10.4	8.2	0.5
30–39	60.7	26.6	12.7	19.6	32.3	28.8	11.8	7.6	36.0	57.6	6.5	25.8	31.9	42.3	60.0	15.5	22.5	2.0
40–49	50.4	33.1	16.5	12.2	26.7	32.2	20.2	8.8	37.1	55.9	7.1	16.3	32.0	51.8	50.8	20.4	27.1	1.8
50–59	51.9	32.5	15.5	15.9	22.6	35.0	18.0	8.5	37.1	55.8	7.1	18.7	30.7	50.5	56.9	17.7	22.6	2.8
60–69	50.6	30.0	19.4	18.1	23.8	28.1	21.3	8.8	28.8	63.1	8.1	22.0	28.9	49.1	61.3	13.8	21.9	3.1
70+	57.5	25.5	17.0	22.6	29.2	21.7	19.8	6.6	33.0	49.1	17.9	30.2	34.0	35.8	73.6	10.4	16.0	–
Total	62.0	25.5	12.4	24.0	28.2	27.3	13.9	6.7	33.9	57.6	8.6	29.3	31.0	39.6	63.9	15.1	19.3	1.6
All	χ^2:503.758 $P < 0.0005$			χ^2:731.910 $P < 0.0005$					χ^2:47.440 $P < 0.0005$			χ^2:519.209 $P < 0.0005$			χ^2:298.076 $P < 0.0005$			
20–29	83.8	11.9	4.2	48.0	30.2	15.2	4.3	2.2	16.8	56.8	26.4	65.1	22.6	12.3	86.3	7.3	6.1	0.3
30–39	66.0	24.0	9.9	24.2	33.7	26.9	10.4	4.7	23.3	57.7	19.1	41.7	30.3	28.0	69.3	14.5	15.0	1.2
40–49	53.2	31.5	15.3	14.5	30.7	30.1	17.2	7.6	23.9	57.1	19.0	30.8	31.7	37.5	61.8	16.1	21.0	1.1
50–59	44.6	34.5	20.9	11.4	25.2	31.8	20.0	11.6	22.5	58.5	19.0	24.5	34.4	41.1	58.9	17.3	21.8	2.1
60–69	40.5	33.7	25.8	12.9	23.0	30.1	21.4	12.6	18.9	62.2	18.9	23.8	33.4	42.7	55.1	17.8	23.8	3.3
70+	48.2	30.8	20.9	15.4	28.1	25.3	19.4	11.9	20.6	54.5	24.9	31.2	33.2	35.6	62.5	17.4	19.8	0.4
Total	62.5	24.8	12.7	25.6	29.9	25.2	12.8	6.5	21.1	57.6	21.3	41.6	29.4	29.0	69.5	13.6	15.7	1.1

[a] χ^2:0.064, P:0.800 (for TC ≥ 200 mg/dl)

[b] χ^2:18,021, $P < 0.0005$ (for LDL-C ≥ 130 mg/dl)

[c] χ^2:361.635, $P < 0.0005$ (for HDL-C < 40 mg/dl)

[d] χ^2: 223.662, $P < 0.0005$ (for TC/HDL-C > 4.5)

[e] χ^2:57.964, $P < 0.0005$ (for TG ≥ 150 mg/dl)

Table 3 The prevalences of dyslipidemia in adult Turkish subjects by BMI, WC, WHR, BP, FBG, education level, occupation, marital status, cigarette smoking, alcohol consumption, physical activity, household income, family history of selected medical conditions, and parity (%)

	TC (mg/dl)			LDL-C (mg/dl)					HDL-C (mg/dl)			TC/HDL-C ratio			TG (mg/dl)			
	<200	200–239	≥240	<100	100–129	130–159	160–189	≥190	<40	40–59	≥60	≤3.5	3.51–4.50	>4.5	<150	150–199	200–499	≥500
BMI (kg/m^2)	χ^2:317.084 $P < 0.0005$			χ^2:547.834 $P < 0.0005$					χ^2:65.742 $P < 0.0005$			χ^2:464.065 $P < 0.0005$			χ^2:345.090 $P < 0.0005$			
<25	78.6	15.8	5.6	43.4	29.8	18.2	6.2	2.4	17.4	54.9	27.7	61.6	24.5	13.9	85.5	7.5	6.6	0.4
25–29,9	59.4	25.9	14.7	20.0	31.3	26.6	15.1	7.0	23.4	59.0	17.7	34.8	30.9	34.3	65.8	14.6	17.7	1.9
30–39,9	48.7	33.5	17.7	12.8	28.2	31.7	17.7	9.6	22.6	58.6	18.8	27.2	33.6	39.2	57.0	19.3	22.7	1.0
≥40	45.0	32.5	22.5	10.0	31.7	27.5	12.5	18.3	20.0	62.5	17.5	30.8	27.5	41.7	49.2	18.3	30.8	1.7
WC (Men)	χ^2:43.381 $P < 0.0005$			χ^2:71.927 $P < 0.0005$					χ^2:25.402 $P < 0.0005$			χ^2:105.923 $P < 0.0005$			χ^2:89.014 $P < 0.0005$			
≤102	65.7	23.2	11.3	27.4	29.1	25.1	12.6	5.9	31.7	58.6	9.7	33.8	31.5	34.7	68.9	13.7	16.1	1.3
>102	48.9	34.4	16.7	1.5	25.0	35.3	18.6	9.6	41.9	53.8	4.3	12.8	29.3	57.9	45.7	20.5	31.2	2.6
WHR (Men)	χ^2:8.627 P:0.013			χ^2:18.461 P:0.001					χ^2:18.773 $P < 0.0005$			χ^2:59.170 $P < 0.0005$			χ^2:36.675 $P < 0.0005$			
<1	63.0	24.9	12.1	25.0	28.4	26.4	13.8	6.4	32.6	58.3	9.0	30.8	32.1	37.1	65.9	14.6	18.1	1.5
≥1	52.3	32.3	15.4	13.8	26.2	35.9	14.4	9.7	46.7	49.7	3.6	14.9	20.0	65.1	44.6	20.5	31.8	3.1
WC (women)	χ^2:177.188 $P < 0.0005$			χ^2:281.914 $P < 0.0005$					χ^2:74.783 $P < 0.0005$			χ^2:297.213 $P < 0.0005$			χ^2:221.080 $P < 0.0005$			
≤88	77.1	17.1	5.8	41.8	31.8	17.6	6.8	2.1	6.3	53.4	40.3	70.7	21.1	8.2	89.0	5.9	4.9	0.2
>88	52.4	29.4	18.2	16.0	31.1	27.9	15.6	9.5	13.2	60.7	26.2	38.1	33.1	28.7	63.3	17.2	18.4	1.1
WHR (women)	χ^2:137.701 $P < 0.0005$			χ^2:161.121 $P < 0.0005$					χ^2:50.092 $P < 0.0005$			χ^2:186.225 $P < 0.0005$			χ^2:130.769 $P < 0.0005$			
<0.85	73.0	19.6	7.4	35.1	33.6	19.7	8.2	3.4	7.8	54.4	37.9	64.0	24.4	11.6	83.6	8.0	8.2	0.2
≥0.85	51.9	29.1	19.1	18.0	29.1	27.6	15.8	9.5	12.9	61.1	26.0	39.4	31.6	29.1	64.1	17.1	17.5	1.3
BP (mm Hg)	χ^2:207.838 $P < 0.0005$			χ^2:294.997 $P < 0.0005$					χ^2:28.359 $P < 0.0005$			χ^2:241.876 $P < 0.0005$			χ^2:172.364 $P < 0.0005$			
<120/80	73.3	19.5	7.2	35.4	31.0	20.7	9.6	3.3	19.3	56.4	24.3	52.7	26.5	20.8	78.9	10.5	9.9	0.7
Pre HT	62.1	25.7	12.2	25.5	33.3	25.5	10.0	5.7	24.3	53.9	21.7	45.4	26.6	28.0	70.4	13.0	15.6	1.0
HT	52.5	29.5	18.0	16.4	27.8	29.4	16.7	9.8	21.7	59.9	18.4	29.9	33.1	37.0	60.4	16.8	21.2	1.6
FBG (mg/dl)	χ^2:46.458 $P < 0.0005$			χ^2:35.572 $P < 0.0005$					χ^2:27.915 $P < 0.0005$			χ^2:56.542 $P < 0.0005$			χ^2:179.254 $P < 0.0005$			
<110	63.7	24.2	12.1	26.2	30.4	24.8	12.4	6.2	20.4	57.6	22.0	43.2	29.2	27.6	71.8	13.0	14.2	1.0
110–125	53.5	27.9	18.6	15.5	22.5	34.9	17.8	9.3	33.3	51.9	14.7	24.8	29.5	45.7	48.8	24.0	26.4	0.8
≥126	43.4	34.5	22.1	18.1	26.1	27.4	17.7	10.6	27.0	61.1	11.9	19.5	33.2	47.3	36.7	20.8	37.6	4.9
Education level	χ^2:182.683 $P < 0.0005$			χ^2:554.314 $P < 0.0005$					χ^2:32.833 $P < 0.0005$			χ^2:54.528 $P < 0.0005$			χ^2:66.567 $P < 0.0005$			
Illiterate	43.9	33.3	22.9	12.9	28.0	27.1	19.2	12.8	14.4	60.0	25.6	33.2	34.9	32.0	60.4	17.5	20.1	2.0
Primary	61.4	26.2	12.4	22.0	31.1	27.3	13.3	6.4	21.3	58.3	20.3	39.1	30.6	30.3	68.8	14.7	15.5	1.0
Secondary	67.6	20.7	11.6	29.5	28.9	22.7	13.2	5.8	24.6	55.2	20.2	43.0	27.5	29.5	67.8	13.6	18.0	0.6
High school	70.3	21.6	8.1	33.4	31.2	22.3	9.2	3.9	23.7	55.7	20.6	46.6	27.4	25.9	75.9	9.9	12.7	1.5
University	70.1	19.6	10.3	34.0	27.8	24.4	9.6	4.2	20.9	57.8	21.2	48.7	24.6	26.7	72.7	12.6	14.3	0.4
Marital status	χ^2:251.792 $P < 0.0005$			χ^2:398.529 $P < 0.0005$					χ^2:27.564 $P < 0.0005$			χ^2:247.231 $P < 0.0005$			χ^2:156.277 $P < 0.0005$			
Unmarried	84.1	12.3	3.6	49.4	29.8	14.4	4.5	1.9	18.6	55.6	25.8	65.4	21.3	13.3	86.9	6.8	6.2	0.1

Table 3 continued

	TC (mg/dl)			LDL-C (mg/dl)					HDL-C (mg/dl)			TC/HDL-C ratio			TG (mg/dl)			
	<200	200–239	≥240	<100	100–129	130–159	160–189	≥190	<40	40–59	≥60	≤3.5	3.51–4.50	>4.5	<150	150–199	200–499	≥500
Married	59.1	27.2	13.7	21.1	30.5	27.5	14.1	6.9	22.1	57.9	19.9	37.1	30.9	32.0	66.4	14.9	17.4	1.3
Widowed	41.1	30.9	28.0	13.4	22.8	27.6	20.3	15.9	13.4	58.9	27.6	30.1	34.1	35.8	57.8	18.3	21.1	2.8
Family history	χ^2:6.531 *P*:0.038			χ^2:5.418 *P*:0.247					χ^2:2.741 *P*:0.254			χ^2:0.715 *P*:0.699			χ^2:1.492 *P*:0.684			
No	63.8	22.4	13.8	26.1	29.6	24.2	12.4	7.7	22.4	57.5	20.1	40.7	29.5	29.8	68.8	14.2	16.0	0.9
Yes	62.0	25.7	12.3	25.4	30.1	25.6	12.9	6.0	20.6	57.6	21.8	41.9	29.4	28.7	69.8	13.4	15.6	1.2
Occupation	χ^2:51.942 $P < 0.0005$			χ^2:68.153 $P < 0.0005$					χ^2:358.000 $P < 0.0005$			χ^2:146.276 $P < 0.0005$			χ^2: 36.859 *P*:0.001			
Worker	66.2	21.3	12.5	30.2	27.4	22.7	13.0	6.7	30.7	55.7	13.6	38.9	25.9	35.2	68.7	13.2	16.3	1.8
Agriculture worker	54.9	29.3	15.9	14.6	29.3	29.3	18.3	8.5	29.3	54.9	15.8	24.4	30.5	45.1	64.6	7.3	28.1	–
Tradesman	61.4	28.0	10.6	23.3	28.8	28.2	13.6	6.1	35.1	55.5	9.4	27.5	34.3	38.2	64.5	15.1	18.8	1.6
Unemployed	82.9	14.9	2.2	41.8	32.1	21.6	3.0	1.5	23.9	61.2	14.9	52.3	27.6	20.1	79.9	10.4	9.7	–
Houseviwe	59.2	26.5	14.3	23.5	31.3	24.8	13.2	7.2	11.2	58.8	30.0	47.5	30.3	22.2	71.3	13.5	14.3	0.9
Official	64.4	23.9	11.7	25.0	30.3	27.9	11.9	4.9	23.1	58.1	18.8	39.8	28.3	31.9	68.1	14.7	16.2	1.0
Cigarette use	χ^2:24.806 $P < 0.0005$			χ^2:24.564 *P*:0.002					χ^2:213.338 $P < 0.0005$			χ^2:118.956 $P < 0.0005$			χ^2:27.868 *P*:0.383			
Smoker	66.7	22.7	10.6	27.2	29.4	26.0	11.7	5.7	31.5	54.6	13.9	37.2	27.3	35.5	70.4	12.9	15.4	1.3
Nonsmoker	61.7	25.2	13.1	25.9	30.6	24.2	12.6	6.7	14.9	59.0	26.1	45.9	30.6	23.5	70.8	13.5	14.8	0.9
Former smoker	55.2	28.6	16.2	19.3	27.8	28.6	16.6	7.7	26.6	57.9	15.4	29.9	28.4	41.7	60.3	16.4	21.4	1.9
Alcohol consumption	χ^2:7.263 *P*:0.123			χ^2:19.601 *P*:0.012					χ^2:59.875 $P < 0.0005$			χ^2:81.955 $P < 0.0005$			χ^2:35.741 $P < 0.0005$			
Drinker	56.3	28.6	15.1	19.0	29.1	31.4	11.8	8.7	28.8	56.6	14.6	29.2	31.9	38.9	63.0	13.2	21.0	2.8
Nondrinker	63.1	24.4	12.5	26.3	30.0	24.6	12.8	6.3	19.7	27.9	22.4	43.3	29.4	27.3	70.5	13.5	15.1	0.9
Ex-drinker	59.43	26.9	13.8	20.0	30.0	29.4	14.4	6.2	38.7	52.5	8.8	21.9	25.0	53.1	59.4	17.5	19.4	3.7
Physical activity	χ^2:16.015 *P*:0.003			χ^2:24.060 *P*:0.002					χ^2:36.932 $P < 0.0005$			χ^2:8.595 *P*:0.072d			χ^2:17.605 *P*:0.007			
Never	59.9	25.7	14.4	24.3	29.4	25.2	13.1	8.0	20.5	57.7	21.8	40.5	29.6	29.9	67.3	15.8	15.8	1.1
Mild	63.8	24.5	11.7	25.4	31.1	25.6	12.6	5.3	19.5	57.1	23.4	43.4	29.6	27.0	71.5	11.5	15.9	1.1
Moderate–heavy	66.6	23.1	10.3	30.0	28.6	24.2	12.3	4.9	27.3	58.5	14.2	39.5	28.5	32.0	70.6	13.1	15.1	1.3
Household income (U.S. $/mo)	χ^2:7.699 *P*:0.261			χ^2:24.349 *P*:0.018					χ^2:16.261 *P*:0.012			χ^2:16.729 $P < 0.0005$			χ^2:139.619 $P < 0.0005$			
1–250	59.5	25.3	15.2	25.4	26.8	26.0	12.6	9.2	17.3	58.6	24.1	43.3	30.8	25.9	72.9	12.9	12.9	1.3
250–500	62.2	25.1	12.7	25.6	29.5	25.1	13.5	6.3	21.4	58.7	19.9	40.1	31.2	28.7	68.7	13.5	16.7	1.1
500–750	64.6	24.1	11.3	27.0	30.6	24.9	12.2	5.3	22.3	56.5	21.2	42.7	27.1	30.2	68.8	14.5	15.4	1.3
>750	62.3	24.7	13.0	21.4	35.3	26.0	10.6	6.7	21.6	52.9	25.5	44.0	24.0	32.0	70.4	13.0	16.1	0.5
Number of births	χ^2:251.357 $P < 0.0005$			χ^2:366.766 $P < 0.0005$					χ^2:58.802 $P < 0.0005$			χ^2:279.575 $P < 0.0005$			χ^2:198.403 $P < 0.0005$			
Unmarried	88.2	9.5	2.3	55.2	30.3	10.4	2.9	1.2	3.5	50.9	45.6	84.1	12.1	3.8	94.5	3.2	2.3	–
Nulliparous	64.6	23.8	11.6	31.2	29.1	25.9	8.5	5.3	10.0	54.0	36.0	56.0	26.0	19.0	72.5	12.7	13.9	1.1
1	72.6	15.1	12.3	37.3	30.6	18.6	9.5	4.0	9.9	55.2	34.9	61.9	25.4	12.7	81.8	8.3	9.1	0.8
2	72.6	18.9	8.5	28.9	37.6	21.5	7.0	5.0	10.5	58.0	31.5	56.3	28.1	15.6	81.3	11.3	7.4	–

Table 3 continued

	TC (mg/dl)			LDL-C (mg/dl)					HDL-C (mg/dl)			TC/HDL-C ratio			TG (mg/dl)			
	<200	200–239	≥240	<100	100–129	130–159	160–189	≥190	<40	40–59	≥60	≤3.5	3.51–4.50	>4.5	<150	150–199	200–499	≥500
3	55.6	29.4	15.0	19.1	30.9	28.1	16.4	5.5	13.1	57.5	29.4	43.7	31.7	24.6	68.2	15.2	15.8	0.8
4	53.1	30.7	16.2	18.5	32.0	26.4	16.2	6.9	9.9	60.4	29.7	43.2	32.7	24.1	71.3	10.9	16.2	1.6
5+	41.5	36.2	22.3	10.5	26.9	30.2	18.8	13.6	12.2	63.0	24.8	31.6	34.9	33.5	56.7	20.2	21.9	1.2
Total	62.9	24.1	13.0	26.9	31.5	23.5	11.8	6.3	10.2	57.6	32.2	52.0	28.0	20.0	74.3	12.4	12.6	0.7

there was a steady increase in the prevalence of hypercholesterolemia from the 20–29-year-old group (18.4%) to the 60–69-year-old group (49.4%) ($P < 0.0005$) (Table 2). The prevalences of high LDL-C and hypertriglyceridemia also increased parallelly with the prevalence of increased hypercholesterolemia.

The prevalence of dyslipidemia and associated risk factors

Table 3 shows the relationships between dyslipidemia and various associated factors. The prevalences of high TC, LDL-C and TG, the TC/HDL-C ratio, and low HDL-C increased steadily in line with BP, BMI, WC, WHR, and FBG ($P < 0.0005$).

As for the education, an inverse relationship was observed between the level of education and the prevalence of dyslipidemia ($P < 0.0005$). Prevalence was the highest among illiterate individuals and the lowest among high school and university graduates. As education level rose, the prevalence of dyslipidemia decreased.

With regard to occupation, an association with dyslipidemia was determined in subjects ($P < 0.0005$). The prevalence of dyslipidemia was the highest among agricultural workers and tradesmen, and the lowest among unemployed group.

We determined a significant association between the prevalence of dyslipidemia and marital status ($P < 0.0005$). The prevalence was the highest among widows and widowers and the lowest among unmarried people.

We observed an association between cessation of cigarette smoking and the prevalence of dyslipidemia (except for TG). However, the prevalence of low HDL-C was the highest among smokers (31.5%) (Table 3). In addition, a significant relationship was detected between alcohol consumption and prevalence of dyslipidemia (again except for TC). Prevalence of elevated LDL-C (≥130 mg/dl) was the highest in alcohol drinkers (44.1%). The prevalences of high TG and TC, low HDL-C, and TG/HDL-C ratios were the highest among ex-drinkers (former drinkers) and drinkers ($P < 0.001$), and the lowest among nondrinkers.

We observed an inverse association between physical activity and prevalence of dyslipidemia ($P < 0.01$), which increased as physical activity decreased.

There was a significant association between household income and prevalence of dyslipidemia (except for TC). The prevalence decreased as income levels rose except for those with an income above $750 a month. The prevalence of a high TC/HDL-C ratio (≥4.5) rose in line with income levels ($P < 0.0005$).

The prevalence of hypercholestorelemia in subjects with a family history of obesity, HT, dyslipidemia, diabetes, or

CVD was higher than that in subjects with no such family history ($P < 0.05$).

Among women, a linear association was observed between parity (number of births) and the prevalence of dyslipidemia ($P < 0.0005$, Table 3). Prevalence increased in line with the parity.

Multivariate (linear logistic regression) analysis results, ORs for each of the demographic factors, cardiovascular risk factors, socioeconomic factors, lifestyle factors and a family history of selected medical conditions are presented in Table 4. Dyslipidemia was significantly associated with the factors of age, male sex, BMI, WC (except for TC and LDL-C), HT (only for LDL-C and TG), FBG (only for LDL-C and TG), education level (only for TC and TG), cigarette smoking (only for HDL-C and TC/HDL-C ratio), alcohol consumption (except for HDL-C and TC/HDL-C ratio), occupation (especially housewives), marital status (widows and widowers), and family history of selected medical conditions (only for TC).

Discussion

Dyslipidemia is a common health problem in developing countries, the prevalence of which is rising steadily [10]. This paper reports one of the largest population-based lipid studies ever conducted, in which the prevalence of dyslipidema and associated risk factors in Trabzon Region were analyzed for the first time. Also, the present study is the first study done in Trabzon Region according to NCEP ATP III criteria. In addition, in this present study, some risk factors associated with dyslipidemia (physical activity, marital statatus, number of births, and a family history of selected medical conditions) were investigated for the first time in Trabzon Region. Onat et al. in a study conducted in 1990 in Turkey (the Turkish Adult Risk Factor Study, TEKHARF study), reported that the mean TC levels of 192 mg/dl in women and 185 mg/dl in men [16], with the highest values in the 40–49-year-old group (188 mg/dl). The mean TG levels were 126 mg/dl for women and 149 mg/dl for men. In a study conducted during 1990–1993 (Turkish Heart Study), Mahley et al. reported that the mean levels of TC, LDL-C and HDL-C, the TC/HDL-C ratio and TG in Trabzon were 174.5 mg/dl (175 mg/dl for women and 174 mg/dl for men), 115 mg/dl (for both genders), 38 mg/dl (42 mg/dl for women and 34 mg/dl for men), 4.8 (4.3 for women and 5.3 for men), and 112 mg/dl (92 mg/dl for women and 129 mg/dl for men), respectively [17]. In the TEKHARF study from the survey of 1997/1998, Onat et al. reported mean LDL-C values were 114.6 mg/dl in men and 122.4 mg/dl in women [22]. In a previous study on the prevalence of obesity during 2001 and 2002, we reported that mean TC, LDL-C, HDL-C and TG levels in 293 nonobese subjects of 179 mg/dl (180 mg/dl for women and 179 mg/dl for men), 107 mg/dl (116 mg/dl for women and 109 mg/dl for men), 47.5 mg/dl (49.8 mg/dl for women and 43.6 mg/dl for men), 137 mg/dl (129 mg/dl for women and 151 mg/dl for men), respectively (unpublished data) [23]. We determined that the mean levels of TC, LDL-C and HDL-C, the TC/HDL-C ratio, and TG were 190, 127.5, 50.3, 3.96, and 137.3 mg/dl, respectively. Our results regarding lipid levels were partially consistent with those of previous studies [15–18]. We determined the most important differences in the levels of HDL-C the mean HDL-C levels being above 40 mg/dl. In contrast to Mahley et al. [17], we consider that Turks do not have relatively low levels of TC and uniquely low HDL-C levels. In addition, TC/HDL-C ratio was below 4.5.

Compared with surveys in some other countries in the world, the plasma lipid levels in the Trabzon region are lower than those in the Germany [24], Greece [25], England [26], and the USA [27], but it is higher than those in Bangladesh [28] and Vietnam [29], and similar to those in Chile [30] and India [31].

In this present study, the mean lipid levels increased with age. Our results were consistent with those in the literature [9, 13, 32, 33]. The exact mechanisms of the impact of age on lipid levels are unknown. They may, however, be related to hereditary characteristics and degenerative processes [34].

Using the NCEP ATP III criteria, the prevalence of hypercholesterolemia (≥200 mg/dl) was 37.5% in this present study. The estimated prevalence of hypercholesterolemia was comparable to and moderately higher than international standards. Compared with other surveys in other countries in the world, prevalence of hypercholesterolemia in Trabzon Region is higher than that in Saudi Arabia [35] and India [36], lower than that in England [26], Finland [37], and the USA [38], and similar to the levels in Guadeloupe [39] and Japan [40].

Onat et al. reported a prevalence of hypercholesterolemia as 28% for men and 35% for women in Turkey [22]. Data published later by Mahley et al. on a larger number of Turkish subjects substantiated this figure with a level of 25% in Trabzon [17]. The prevalence of hypercholesterolemia thus tends to be higher in Western than in Asian countries [10]. Over the past two decades, the prevalence has shown a tendency to increase in economically developing countries [10]. However, differences in methodology between national surveys make international comparisons difficult.

In this present study, the frequency of LDL-C levels above 160 mg/dl was found in 19.3% of the population and borderline levels in another 25.2%. This demonstrates the need to determine targets in order to reduce the risk of

Table 4 Odds ratios for dyslipidemia for demographic, cardiovascular, socioeconomic, lifestyle factors, and family history of selected medical conditions (logistic regression analysis)

	TC (≥200 mg/dl)			LDL-C (≥130 mg/dl)			HDL-C (<40 mg/dl)			TC/HDL-C (> 4.5)			TG(≥150 mg/dl)			Dyslipidemia[a]		
	OR	% 95 CI	*P*	OR	% 95 CI	*P*	OR	% 95 CI	*P*	OR	% 95 CI	*P*	OR	% 95 CI	*P*	OR	% 95 CI	*P*
Age group																		
20–29	1			1			1			1			1			1		
30–39	1.84	1.48–2.29	<0.001	1.71	1.39–2.09	<0.001	1.19	0.91–1.55	NS	1.79	1.40–2.31	<0.001	1.65	1.30–2.09	<0.001	1.65	1.36–2.00	<0.001
40–49	2.69	2.14–3.39	<0.001	2.38	1.91–2.96	<0.001	1.17	0.88–1.55	NS	2.24	1.73–2.92	<0.001	1.70	1.32–2.18	<0.001	2.14	1.72–2.66	<0.001
50–59	3.34	2.54–4.38	<0.001	3.06	2.35–3.99	<0.001	1.01	0.72–1.42	NS	2.33	1.73–3.16	<0.001	1.56	1.17–2.09	0.002	2.86	2.15–3.81	<0.001
60–69	3.58	2.59–4.94	<0.001	2.87	2.09–3.94	<0.001	0.82	0.54–1.24	NS	2.26	1.59–3.22	<0.001	1.45	1.03–2.04	0.029	2.25	1.59–3.18	<0.001
70+	2.63	1.82–3.80	<0.001	2.18	1.52–3.13	<0.001	1.07	0.66–1.72	NS	1.88	1.25–2.83	<0.001	1.12	0.75–1.66	NS	1.74	1.18–2.56	0.005
Gender																		
Women	1		<0.001	1		<0.001	1			1			1			1		
Men	1.60	1.24–2.06	<0.001	1.85	1.45–2.37	<0.001	5.095	3.59–7.22	<0.001	3.88	2.86–5.26	0.002	3.08	2.30–4.11	<0.001	2.93	2.31–3.72	<0.001
BMI (kg/m^2)																		
<25	1		<0.001	1		<0.001	1			1			1			1		
25–29.9	1.66	1.40–1.96	<0.001	1.75	1.49–2.07	<0.001	1.42	1.15–1.74	0.001	2.43	1.99–2.95	<0.001	2.00	1.6–2.42	<0.001	1.88	1.60–2.21	<0.001
30–39.9	2.02	1.63–2.52	<0.001	2.22	1.79–2.75	<0.001	1.90	1.44–2.50	<0.001	3.11	2.43–3.98	<0.001	2.44	1.93–3.09	<0.001	2.58	2.05–3.23	<0.001
≥40	2.20	1.43–3.37	<0.001	2.15	1.40–3.29	0.004	3.13	1.81–5.42	<0.001	4.39	2.81–6.86	<0.001	3.42	2.21–5.28	<0.001	2.47	1.54–3.97	<0.001
WC (men > 102 and women > 88)																		
≤102/≤ 88	1			1			1			1			1			1		
>102/>88	0.96	0.80–1.15	NS	0.88	0.73–1.05	NS	0.75	0.59–0.94	0.015	0.69	0.57–0.85	<0.001	0.61	0.51–0.74	<0.001	0.72	0.59–0.87	0.001
Hypertension (≥140/90)																		
No	1			1			1			1			1			1		
Yes	1.05	0.91–1.22	NS	1.21	1.05–1.40	0.006	0.95	0.79–1.13	NS	1.15	0.99–1.35	NS	1.2	1.05–1.42	0.009	1.19	1.02–1.38	0.025
FBG (mg/dl)																		
<126	1			1			1			1			1			1		
≥126	1.06	0.79–1.42	NS	0.74	0.55–0.99	0.043	1.07	0.75–1.53	NS	1.24	0.92–1.67	NS	2.48	1.84–3.34	<0.001	1.19	0.83–1.71	NS
Education level																		
Illiterate	1			1			1			1			1			1		
Primary	0.70	0.57–0.86	0.001	0.83	0.67–1.03	NS	0.95	0.70–1.29	NS	0.84	0.66–1.05	NS	0.73	0.59–0.91	0.007	0.79	0.63–0.99	0.046
Secondary	0.62	0.47–0.83	0.001	0.77	0.58–1.02	NS	0.90	0.62–1.32	NS	0.75	0.55–1.03	NS	0.82	0.61–1.11	NS	0.66	0.49–0.89	0.007
High school	0.76	0.58–1.00	NS	0.79	0.61–1.04	NS	0.91	0.63–1.32	NS	0.84	0.62–1.14	NS	0.69	0.52–0.92	0.014	0.80	0.60–1.06	NS
University	0.86	0.62–1.20	NS	1.03	0.74–1.43	NS	0.84	0.55–1.29	NS	0.98	0.68–1.41	NS	0.95	0.67–1.35	NS	0.93	0.66–1.32	NS
Cigarette use																		
Smoker	1			1			1			1			1			1		

Table 4 continued

	TC (≥200 mg/dl)			LDL-C (≥130 mg/dl)			HDL-C (<40 mg/dl)			TC/HDL-C (> 4.5)			TG(≥150 mg/dl)			Dyslipidemia[a]		
	OR	% 95 CI	*P*	OR	% 95 CI	*P*	OR	% 95 CI	*P*	OR	% 95 CI	*P*	OR	% 95 CI	*P*	OR	% 95 CI	*P*
Nonsmoker	1.13	0.97–1.33	NS	0.96	0.82–1.12	NS	0.56	0.47–0.68	<0.001	0.62	0.52–0.74	<0.001	1.03	0.87–1.22	NS	0.92	0.79–1.08	NS
Former smoker	1.11	0.89–1.39	NS	0.95	0.76–1.19	NS	0.53	0.41–0.69	<0.001	0.71	0.56–0.90	0.005	1.00	0.80–1.27	NS	0.91	0.71–1.16	NS
Alcohol consumption																		
Drinker	1			1			1			1			1			1		
Nondrinker	0.57	0.44–0.74	<0.001	0.64	0.50–0.82	0.001	1.33	1.01–1.75	0.042	0.86	0.66–1.12	NS	0.74	0.57–0.96	0.025	0.72	0.55–0.95	0.019
Ex-drinker	0.57	0.38–0.86	0.008	0.62	0.41–0.93	0.023	1.82	1.19–2.78	0.005	1.41	0.93–2.14	NS	0.81	0.53–1.24	NS	0.76	0.49–1.20	NS
Occupation																		
Worker	1			1			1			1			1			1		
Agriculture worker	1.15	0.71–1.86	NS	1.10	0.68–1.80	NS	0.81	0.47–1.40	NS	1.07	0.65–2.76	NS	0.93	0.56–1.5	NS	1.01	0.59–1.74	NS
Tradesman	1.10	0.88–1.38	NS	1.10	0.88–1.38	NS	1.07	0.84–1.36	NS	0.95	0.75–1.20	NS	1.04	0.82–1.32	NS	1.14	0.90–1.45	NS
Unemployed	0.49	0.30–0.80	0.005	0.59	0.38–0.91	NS	0.79	0.50–1.25	NS	0.59	0.36–0.96	NS	0.70	0.43–1.12	NS	0.60	0.40–0.90	NS
Housewife	1.37	1.03–1.81	0.026	1.19	0.91–1.57	NS	0.85	0.58–1.24	NS	1.00	0.72–1.39	NS	1.23	0.90–1.68	NS	1.11	0.85–1.45	NS
Official	1.00	0.79–1.27	NS	1.09	0.86–1.38	NS	0.81	0.62–1.06	NS	0.83	0.65–1.08	NS	0.98	0.76–1.26	NS	1.11	0.87–1.41	NS
Family history of selected medical conditions																		
No	1			1			1			1			1			1		
Yes	1.23	1.06–1.42	0.005	1.12	0.97–1.29	NS	0.99	0.83–1.18	NS	1.07	0.91–1.25	NS	1.03	0.89–1.20	NS	1.14	0.98–1.32	NS
Household income (U.S. $/mo)																		
1–250	1			1			1			1			1			1		
250–500	0.94	0.78–1.14	NS	0.86	0.71–1.04	NS	1.06	0.82–1.37	NS	1.02	0.82–1.26	NS	1.2	0.99–1.51	NS	0.98	0.80–1.19	NS
500–750	0.95	0.77–1.19	NS	0.82	0.66–1.02	NS	1.23	0.92–1.63	NS	1.16	0.91–1.48	NS	1.26	0.98–1.60	NS	0.94	0.75–1.17	NS
>750	1.08	0.80–1.45	NS	0.82	0.61–1.10	NS	1.11	0.76–1.62	NS	1.23	0.89–1.71	NS	1.13	0.82–1.56	NS	0.98	0.72–1.33	NS
Marital status																		
Unmarried	1			1			1			1			1			1		
Married	1.46	1.14–1.87	0.003	1.54	1.22–1.94	<0.001	1.04	0.78–1.38	NS	1.37	1.03–1.82	0.026	1.55	1.18–2.04	0.002	1.44	1.16–1.79	0.001
Widowed	2.01	1.36–2.96	<0.001	2.24	1.53–3.28	<0.001	1.11	0.65–1.89	NS	2.07	1.36–3.15	0.001	2.31	1.53–3.46	<0.001	2.59	1.72–3.90	0.001
Physical activity																		
Never	1			1			1			1			1			1		
Mild	0.93	0.81–1.07	NS	0.98	0.85–1.12	NS	1.02	0.86–1.22	NS	1.00	0.86–1.17	NS	0.92	0.79–1.07	NS	0.99	0.86–1.14	NS
Moderate–Heavy	1.01	0.82–1.24	NS	0.99	0.81–1.21	NS	0.83	0.66–1.05	NS	1.00	0.81–1.25	NS	0.96	0.79–1.07	NS	1.03	0.84–1.27	NS
Number of births (only for women)																		
Unmarried	1			1			1			1			1			1		

Table 4 continued

	TC (≥200 mg/dl)			LDL-C (≥130 mg/dl)			HDL-C (<40 mg/dl)			TC/HDL-C (> 4.5)			TG(≥150 mg/dl)			Dyslipidemia[a]		
	OR	% 95 CI	*P*	OR	% 95 CI	*P*	OR	% 95 CI	*P*	OR	% 95 CI	*P*	OR	% 95 CI	*P*	OR	% 95 CI	*P*
Nulliparous	0.88	0.59–1.32	NS	0.86	0.58–1.29	NS	0.919	0.47–1.77	NS	1.01	0.64–1.60	NS	1.17	0.77–1.78	NS	0.82	0.59–1.15	NS
1	0.90	0.60–1.35	NS	0.89	0.60–1.32	NS	1.11	0.59–2.11	NS	0.87	0.53–1.42	NS	0.90	0.58–1.40	NS	1.07	0.75–1.54	NS
2	0.80	0.58–1.10	NS	0.72	0.52–0.99	NS	0.96	0.57–1.61	NS	0.85	0.58–1.23	NS	0.75	0.53–1.07	NS	0.69	0.46–1.03	NS
3	1.11	0.82–1.49	NS	1.01	0.75–1.37	NS	1.02	0.62–1.65	NS	1.05	0.75–1.46	NS	1.09	0.80–1.49	NS	0.87	0.58–1.30	NS
4+	0.95	0.69–1.31	NS	0.80	0.58–1.10	NS	0.81	0.48–1.39	NS	0.81	0.57–1.16	NS	0.74	0.53–1.04	NS	0.77	0.53–1.18	NS

[a] Abnormality in at least one of lipid parameters

coronary events in 44.5% of the Turkish adult population, through both changes in lifestyle and pharmacological therapy. Borderline high and high values of LDL-C (≥130 mg/dl) were noted in the Turkish Heart Study in 33% of men and 35% of women in Trabzon [17]. The prevalence in the TEKHARF 2001/2002 cohort was 35% (31% for men and 38% for women) in Turkey [22].

The prevalence of low HDL-C levels was 21.1% in this present study. The alteration in the reference value, according to new recommendations [21], brought about some difficulties in the comparison with previous studies. Low HDL-C levels corresponded to the third most frequent dyslipidemia in Trabzon city being significantly higher in males (33.9% vs. 10.2%, $P < 0.001$). In the Turkish Heart Study in which HDL-C levels were examined in over 9,000 Turkish adults, 65% of men and 23% of women in Trabzon had values ≤35 mg/dl [17]. The TEKHARF cohort of 2001/02 revealed that the prevalence of low HDL-C levels (<40 mg/dl) was 64% in men and 35.5% in women [22]. Our results did not agree with those of previous studies from Turkey [17, 22].

Compared with the results of other surveys from other countries in the world, the prevalence of low HDL-C in the Trabzon region is lower than that in Mexico [41], Brazil [4], and Iran [42], but it is higher than that in the Guadeloupe [39], the United Kingdom [43], and China [11].

Abnormally low HDL-C levels are a risk factor for CHD [44]. The third report of the NCEP ATP III reaffirmed that HDL-C levels < 40 mg/dl are a major risk factor for CHD while HDL-C levels > 60 mg/dl are protective [21].

Many studies have shown that the TC/HDL-C ratio is a powerful predictor of CHD risk [21]. In our study, the prevalence of a TC/HDL-C ratio (>4.5) was 29%, being higher among men than women (39.6% vs. 20%, $P < 0.0001$). In the Turkish Heart Study, a ratio > 4.5 was determined in 70% of men and 40% of women in Trabzon [17]. In the TEKHARF cohort of 2001/02 exactly 25% of men exhibited a ratio > 6.0 and 37% a ratio over 5.5, which is generally considered to be high-risk [22].

A few studies have been reported regarding the prevalence of hypertriglyceridemia in Turkey [17, 22] and hypertriglyceridemia is thought to be an important risk factor. Onat et al. reported a prevalence of hypertriglyceridemia (≥150 mg/dl) of 39.6% for men and 29.2% for women in Turkey [22]. In the Turkish Heart Study, the prevalence was 13% for men and 6% for women in Trabzon [17]. We determined a prevalence of hypertriglyceridemia of 30.4%.

Many prospective epidemiological studies have reported a positive relationship between serum TG levels and incidence of CHD [45]. In this study, the higher prevalence of hypertriglyceridemia may be related to a high intake of carbohydrate (especially, through bread and meat

consumption) and fat (especially, through saturated fat and margarines, also fish fried in butter) by Turks as a part of their routine diet.

In this present study, the OR for the dyslipidemia was significantly greater in males in multivariate logistic regression analysis. Most studies state that dyslipidemia is more prevalent among men than among women [11, 13, 16, 17], but some other studies indicate that the prevalence is more prevalent among women than among men [26, 32]. The variation may be explained by differential distribution in risk factors (e.g., genetic predisposition, dietary factors, smoking, alcohol consumption, lack of physical activity) between women and men across populations. Male gender is an independent risk factor for CVD [46].

Age is strongly associated with dyslipidemia. Many studies have reported that the prevalence of dyslipidemia increased with age [2, 9, 11–13, 17, 32, 33, 39, 41]. In our study, prevalence increased dramatically with age in both sexes. The highest prevalence of dyslipidemia was in the 60–69-year-old group for women and in the 40–69-year-old group for men.

The relationship between dyslipidemia and obesity has been clearly shown in both men and women [12, 33, 39, 47]. Obesity not only increases the prevalence of dyslipidemia, but is also directly associated with HT, diabetes, and CHD [48]. Dyslipidemia in obesity may be the result of insulin resistance [49]. We observed associations among the dyslipidemias and obesity, and HT. The prevalence of dyslipidemia increased in line with BP and BMI levels. These results suggest a biological interrelation between blood lipid levels and BP and, consequently, an association with the risk for CHD. In addition, the prevalence of dyslipidemia was positively correlated with FBG in this study. The lipid abnormalities in diabetic individuals are due to insulin resistance and manifest themselves as hypertriglyceridemia and low HDL-C levels [50].

Dyslipidemia exhibited a strong inverse association with levels of education in our study. These results are in agreement with those of some previous studies in the literature [12, 14, 18]. In contrast to our study, Mahley et al. reported that higher education levels were associated with higher plasma levels of TC, LDL-C, and TG in men and higher education levels were associated with increased levels of TC, LDL-C, and HDL-C, and lower TG levels in women [17]. Low education levels were an independent risk factor for dyslipidemia in the present study. The high prevalence of dyslipidemia in the group with a low education level may result from risk factors such as stress, poor working conditions, and poor nutritional habits being more common in that group or from those individuals having greater difficulties in securing access to health care services [21]. Low education levels were also an independent risk factor for CHD [14]. However, the association between dyslipidemia and education level was lost during logistic regression analysis (except for TC).

We observed an association between occupation and employment status. The prevalence of dyslipidemia was significantly higher among the agricultural workers and housewives. Performing domestic duties without fixed hours or renumeration, constant exposure to food, and lack of physical activity may contribute to the appearance of obesity, dyslipidemia, and HT in such women. Interestingly, in this present study, we also determined a high prevalence of dyslipidemia among agricultural workers. This may be attributed to the fact that total time spent in agricultural work within one year is highly short in the region, approximately 1–2 months per year, due to Trabzon's geographical and physical structure, and climatic conditions. Mahley et al. reported that plasma levels of TC, LDL-C, and TG were higher in both men and women who described their occupations as administrative/management-level compared with those performing physical/labor positions [17]. Yarnell et al. reported that there was no significant association between the occupational status and hypercholesterolemia [14].

Our study also determined that marital status was related to dyslipidemia. No clear explanation exists for the increased risk among widowed individuals, although this may be due to the higher prevalence of obesity among the widowed [23].

Current smoking has been clearly established as a modulator of plasma lipid levels and as an independent risk factor for CHD [17]. Smoking is known to impair insulin action and may lead to insulin resistance [51]. The inverse relationship between cigarette smoking and weight is also well documented [23]. Cigarette smokers have higher cholesterol levels [12, 52] and lower HDL-C levels [53]. Smoking is a major health problem in Turkey, with a prevalence of 46–73% (depending on region) among male participants of the Turkish Heart Study [17]. We determined a prevalence of smoking (current smoking plus former smokers) of 40.4% in Trabzon. We also determined an association of smoking cessation with dyslipidemia (Table 3). The risk of the prevalence of low HDL-C and a low TC/HDL-C ratio was significantly higher in smokers in logistic regression analysis (Table 4). It is important to point out that our data, similar to other studies, confirmed the fact that smoking is one of the main risk factors for low HDL-C.

The effect of alcohol consumption on plasma lipid levels and their effects on cardiovascular death have been studied extensively [54]. Ruixing et al. reported that the prevalence of hyperlipidemia was positively correlated with alcohol consumption [48]. We observed a strong positive association between alcohol consumption and dyslipidemia. However, the OR for low HDL-C increased significantly among nondrinkers and ex-drinkers.

A positive relationship between the prevalence of dyslipidemia (except for HDL-C) and household income in Turkey has also been reported [17]. Polychronopoulos et al. reported that there was no significant associations between blood lipid levels and income among the participants in their study [52]. In our research, household income was inversely related to the prevalence of dyslipidemia. This may indicate that low income in Turkey may be a potential contributor to the high rates of dyslipidemia. However, the OR for dyslipidemia demonsrated by linear logistic analysis did not change in line with household income.

The OR for hypercholesterolemia was significantly greater in subjects with a family history of obesity, diabetes, HT, or atherosclerotic heart disease compared with those with no such history in this present study. In the literature, similar associations have been observed with regard to the elevation in TG and LDL-C levels [9]. Some studies have detected a family influence on the origin of dyslipidemias, because the individuals concerned are exposed to common environmental factors or because of a direct genetic predisposition [9]. Our results are consistent with those in the literature [39].

In our study, the prevalence of dyslipidemia increased with parity. In women we would have to consider various pregnancy-related circumstances, as BMI has been shown to increase with the number of pregnancies [55]. Interestingly, according to the results of chi-square analysis, the prevalence of dyslipidemia of nulliparous women was higher than that in unmarried women or those with 1 or 2 parities. However, the association was lost in logistic regression analysis.

Conclusion

This present study, which first examined the clustering of various risk factors, demonstrated a very high prevalence of dyslipidemia in the Turkish adult subjects in Trabzon. Dyslipidemia is a public health problem, of significance, even to people in their twenties. Therefore, subjects living in Trabzon may have a tendency towards dyslipidemia. Our results emphasize the urgent need for a public health strategy for the prevention, detection, and treatment of dyslipidemia.

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