Traditional coronary risk factors in healthy Turkish military personnel between 20 and 50 years old: focus on high-density lipoprotein cholesterol

Yirmi-elli yaş arası sağlıklı erkeklerde geleneksel koroner risk faktörleri: Yüksek yoğunluklu lipoprotein kolesterol üzerine odaklanma

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Abstract

Objective: Previous studies presented the Turkish population as a typical example of nations with low levels of high-density lipoprotein cholesterol (HDL-c). Nevertheless, some recent studies opposed this suggestion. We aimed to examine the traditional cardiovascular risk factors in young-middle age male military professionals, focusing especially on HDL-c.

Methods: In this observational and cross-sectional study, the data of 820 male military personnel between 20-50 years old (mean age: 35.3±6.9) who applied to the hospital for routine health examination were included. Blood biochemistry, arterial blood pressure and anthropometric measurements were noted. Statistical analysis was performed using Kruskal-Wallis test and ANCOVA.

Results: The mean age was 35.3±6.9, body mass index was 25.8±3.4 kg/m^2 and waist circumference was 93.1±8.7 cm. HDL-c, low-density cholesterol, triglyceride and fasting blood glucose levels were 47.6±11.3, 120.4±33.2, 150.4±86.4 and 96,6±13.0 mg/dL, respectively. Only 23.2% of the participants had HDL-c level less than 40 mg/dL. The ratio of current smokers was 40.7%. Almost 66% of the participants (n=545) were making regular exercise. Mean systolic and diastolic arterial blood pressures were 124.1±13.0 and 75.7±9.3 mm Hg, respectively.

Conclusion: The "mean" levels of traditional coronary risk factors were in almost "normal" limits in healthy young-middle age male military professionals that were examined. It must be emphasized that the HDL-c level, which was defined as "genetically low in Turks" in some previous epidemiologic studies, was not really low. This finding may be due to relatively favorable life style of the study population. On the other hand, some recent population studies in Turkey had found HDL-c levels higher than it was thought. This issue needs further clarification in specific age groups without sedentary lifestyle. *(Anadolu Kardiyol Derg 2013; 13: 552-8)*

Key words: High density lipoprotein cholesterol, Turkish population, male, cardiovascular risk

Özet

Amaç: Önceki çalışmalar Türk toplumunu, yüksek yoğunluklu lipoprotein kolesterolü (YYL-k) düşük seviyede seyreden toplumların tipik bir örneği olarak gösteriyordu. Ancak yeni bazı çalışmalar bu görüşün tersini desteklemektedir. Biz bu çalışmamızda genç-orta yaşlı profesyonel erkek askerlerde geleneksel kardiyovasküler risk faktörlerini, özellikle YYL-k düzeyleri üzerinde yoğunlaşarak araştırmayı hedefledik.

Yöntemler: Rutin sağlık kontrolü için hastaneye başvuran 20-50 (ortalama yaş: 35,3±6,9) yaş arası 820 erkek askeri personel bu gözlemsel ve enine-kesitli çalışmaya dahil edildi. Kan biyokimyası, arteriyal kan basıncı ve antropometrik ölçümler kayıt edildi. İstatistiksel analiz Kruskal-Wallis testi ve ANCOVA ile yapıldı.

Bulgular: İncelenen grupta ortalama yaş 35,3±6,9, vücut kitle indeksi 25,8±3,4 kg/m^2 ve bel çevresi 93,1±8,7 cm idi. YYL -k, düşük yoğunluklu kolesterol, trigliserid ve açlık kan şekeri düzeyleri sırasıyla 47,6±11,3, 120,4±33,2, 150,4±86,4 ve 96,6±13,0 mg/dL idi. Çalışmaya katılanların sadece %23,2'nin YYL-k düzeyi 40 mg/dL'nin altında bulundu. Aktif sigara içenlerin oranı %40,7, düzenli egzersiz yapanların oranı %66 idi. Ortalama sistolik ve diyastolik kan basınçları sırasıyla 124,1±13,0 ve 75,7±9,3 mm Hg olarak bulundu.

Sonuç: Çalışma grubunu oluşturan sağlıklı, genç/orta yaşlı, erkek, profesyonel askerlerde incelenen geleneksel kardiyovasküler risk faktörleri normal sınırlarda idi. Vurgulanması gereken, önceki bazı epidemiyolojik çalışmaların Türk toplumunda YYL-k düzeyinin "genetik olarak" düşük olduğunu iddia etmesine rağmen çalışma grubunda YYL-k'nin düşük olmamasıdır. Bu bulgu değerlendirilen grubun yaşam şeklinin olumlu özelliklerine bağlı olabilir. Bununla birlikte Türkiye'de yapılan bazı yeni çalışmalar YYL-k seviyelerini sanıldığından daha yüksek bulmuşlardır. Bu konunun özellikle sedanter yaşam tarzı olmayan belli yaş aralığındaki gruplarda aydınlatılmasına ihtiyaç vardır. *(Anadolu Kardiyol Derg 2013; 13: 552-8)*

Anahtar kelimeler: Yüksek yoğunluklu lipoprotein kolesterol, Türk toplumu, erkek, kardiyovasküler risk

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Introduction

Cardiovascular diseases are the leading causes of mortality and morbidity worldwide and contributes remarkably to the increase of health expenditures (1). Population -based preventive measures focusing especially on people with established disease or high cardiovascular risk, may change this outcome (1-3). A low level of high-density lipoprotein cholesterol (HDL-c) is one of the important independent risk factors of cardiovascular disease (4, 5). Although some life style changes may raise this lipoprotein level, it is mostly determined genetically with variations among different ethnic groups. Some well-known epidemiological studies suggested that the average HDL-c level in Turkish population is lower than many other populations (6, 7). On the other hand, we had previously shown that HDL-c was not "low" in a homogenous population of military school students who had a substantially favorable life style (8). Nevertheless, we do not know how these risk factors change with age and after adaptation to a "more sedentary" life.

In this study, we assessed to find out the traditional cardiovascular risk factors in young-middle age male military professionals, focusing especially on HDL-c.

Methods

Study design and population

This cross-sectional, observational study was conducted in a secondary care hospital. Medical reports of 1014 male military personnel between 20-50 years old who applied to the hospital for routine health examination during 2005 and the first half of 2006 (18 months) were examined. The military staff in the army undergoes routine health examination every two years if they are ≥40 years old and every three years if they are <40 years old. The military hospitals that examine the staff are predefined according to the location of the base they work in. During the study period, the participants were given a self-reported questionnaire in order to figure out the cardiovascular risk factors and guide the physicians during the examinations. The data of 820 participants (80%) were included in the analysis. The reason for the exclusion was known coronary artery disease in 4 and incomplete data in 190 of them. Incomplete data refers to incomplete answers, lack of information related to demographic/anthropometric values, blood pressures as well as ID numbers which prevents correct matching between the questionnaire and the participant. Among the 820 participants 20 were on the hypertensive medications and 15 were on lipid lowering therapy (11 statins, 4 fenofibrate). The results of these participants were included in the study. Institutional Ethics Committee approved the protocol of this study.

Anthropometric measurements

Trained nurses performed measurements of weight, height, and waist circumferences. For waist measurement, the midpoint of the lowest level of the last rib and the crest of the ilium was taken. All of the above measurements were obtained with underwear while the participant was standing. Body mass index (BMI) was calculated by dividing the individual's body mass (kg) by the square of his height (meter). The participants were defined as overweight if the BMI was between 25 and 29.9 kg/m^2 and obese if the BMI is => 30 kg/m^2.

Blood pressure measurements

Each participant measured his arterial blood pressure by himself via a fully automated professional blood pressure device (Life Source TM-2655 Professional Blood Pressure Monitor), which allows the user to properly position himself and his arm. Measurements were taken twice in a sitting position and from the right arm after at least 15 minutes rest. The mean of both measurements (mmHg) was noted as arterial blood pressure of the patient.

Blood samples and analysis

Venous blood samples were taken after at least 10 hours of fasting. The samples were centrifuged for 10 minutes at 4000 rpm for the separation of the serum. Total serum cholesterol was determined via CHOD-PAP enzymatic colorimetric method, HDL-C was determined via homogenous enzymatic colorimetric method, triglyceride was measured via GPO-PAP enzymatic colorimetric method and serum glucose was measured via hexokinase method. All of these tests were performed in Hitachi 912 Chemistry Analyzer using Roche Diagnostic kits (Roche Diagnostics, Indianapolis, USA). The laboratory was a center in which internal and external validity test are routinely performed. We calculated LDL-c with Friedwald formula [(LDL-c=Total cholesterol - HDL-c – (Triglyceride/5)] if the triglyceride is below 400 mg/dL. Otherwise it was measured it directly via homogenous enzymatic colorimetric method.

Physical exercise, smoking and alcohol consumption

In order to figure out the physical activity levels, the participants were asked the amount of exercise they perform during a week. The information was categorized into four groups according self-reported answers: Almost none, less than 60 minutes, between 60-120 minutes, more than 120 minutes. The amount of smoking was grouped according to number of cigarettes smoked in a day as follows: None, between 1-10, between 11-20 and >20. Alcohol consumption was grouped into 4 categories: None, mild (rarely -not most of the days of a week-), moderate [most of the days of a week but usually not more than a glass of wine, a bottle of beer or a glass of raki (a Turkish alcoholic beverage)] and severe (most of the days of the week but more than the amount defined in the moderate category). Because only 2 participants were consuming "severe" amount of alcohol, moderate and severe categories were combined in the analysis.

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Statistical analysis

Statistical analyses were performed by SPSS version 20 (Chicago, Illinois USA) software package. For description of the variables, we used both mean±standard deviation and median (interquartile). Normality of the data was analyzed using Bonferroni test. Independent t test was used for the comparison of continuous variables of the study group with that of the historical control group. For the comparisons of continuous variables between subgroups, we used Kruskal -Wallis test, and for post-hoc analysis, we used Mann-Whitney U test. Analysis of covariance was used when needed, to assess whether the subgroup differences in the target variable still exists after accounting the effects of potential covariates. The statistical significance was set at a p level of <0.05.

Table 1. Results of anthropometric, biochemical and arterial blood pressure measurements

Variables	Study Group (n=820)	
	Mean±SD	Median (Q1-Q3)
Age, years	35.3±6.9	35 (30-40)
Height, cm	176.2±5.9	176 (172-180)
Weight, kg	80.2±9.8	80 (73-86)
BMI, kg/m^2	25.8±3.4	25.6 (23.9-27.7)
Waist, cm	93.1±8.7	93 (88-99)
Cholesterol, mg/dL	197.9±33.1	196 (170-222)
LDL-c, mg/dL	120.4±33.2	117.8 (96.2-142.0)
HDL-c, mg/dL	47.6±11.3	46 (40-54)
Triglyceride, mg/dL	150.4±86.4	133 (92-187)
FBG, mg/dL	96.6±13.0	95 (90-100)
SBP, mmHg	124.1±13.0	124 (116-132)
DBP, mmHg	75.7±9.3	75 (70-81)
Smokers, n (%)*	334 (40.7)	-

Data are shown in mean±standard deviation and median (first quartile-third quartile) for the study group and in mean±Standard Deviation for historical control group
[*Smokers are shown as number (percentage) of the patients]
BMI - Body mass index, DBP - Diastolic blood pressure, FBG - Fasting blood glucose, HDL-c - High density lipoprotein cholesterol, LDL-c - low density lipoprotein cholesterol, Q1 -First quartile, Q3 -Third quartile, SBP - Systolic blood pressure, SD - Standard deviation

Results

Table 1 shows the anthropometric values, results of biochemical tests and arterial blood pressure of the participants. All of the participants were male and the mean age was 35.3±6.9 (95% CI 34.8-35.8). Of these, 201 (24.5%) were between 20-29, 376 (45.8%) were between 30-39 and 243 (29.6%) were between 40-49 years old. The differences in biochemical risk factors, arterial blood pressure and anthropometric values among these age groups are shown in Table 2. According to their BMIs, 398 (48.5%) of the participants were overweight and 79 (9.7%) of them were obese.

As depicted in the Table 1, the mean HDL-c level was 47.6±11.3 mg/dL and only 23.2% of the individuals had HDL-c level less than 40mg/dL.

The number of current smokers was 334 (40.7%). Of all the current smokers 84 (25.1%) were smoking between 1-10, 172 (51.5%) were smoking between 11-20 and 78 (23.3%) were smoking > 20 cigarettes a day. According to self-reported questionnaire 275 (33.5%) of the participants stated that the amount of regular exercise that they make weekly was "almost none". Among the remaining individuals, 168 (20.5%) were having less than 60 minutes/week, 175 (21.3%) were having between 60-120 minutes/week and 202 (24.6%) were performing >120 minutes/week.

We evaluated the HDL-c as well as other risk factors according to age (Table 2), amount of smoking (Table 3), exercise

Table 2. Change in anthropometric, biochemical and blood pressure measurements by age intervals

Variables	Age			#Chi-square	#p
	20-29 (n=201)	30-39 (n=376)	40-50 (n=243)		
Weight, kg	77.1±8.9	80.4±9.6	82.4±10.3	30.9	< 0.001
BMI, kg/m^2	24.4±2.6	26,0±3.8	26.7 ±3.0	70.9	< 0.001
Waist, cm	89.1±8.0	93.0±8.3	96.6±8.4	78.6	< 0.001
Cholesterol, mg/dL	183.4±31.8	197.6±38.4	210.4±38,0	56.4	< 0.001
LDL-c, mg/dL	110.9±27.0	120.1±34.0	128.9±34.3	34.5	< 0.001
HDL-c, mg/dL	48.9±11.0*	46.2±10.9	48.7±12.0*	10.5	0.005
Triglyceride, mg/dL	118.0±59.4	157.5±89.5*	166.0±93.4*	47.9	< 0.001
FBG, mg/dL	92.7±7.6	95.6±10.1	101.1±22.6	51.5	< 0.001
SBP, mmHg	120±13	123±12	128±13	37.2	< 0.001
DBP, mmHg	72±8	75±9	78±9	45.0	< 0.001

Data are shown in mean±standard deviation
#Kruskal-Wallis test, Mann-Whitney posttest for pairwise comparisons: all of the pairwise differences were statistically significant except between the groups with "*" sign
BMI - body mass index, DBP - diastolic blood pressure, FBG - fasting blood glucose, HDL-c - high density lipoprotein cholesterol, LDL-c - low density lipoprotein cholesterol, SBP - systolic blood pressure

Table 3. Blood pressure and lipid parameters according to number of cigarettes smoked daily

Variables	Number of cigarettes smoked daily				*Chi-square	*p
	0	1-10	11-20	> 20		
	(n=486)	(n=84)	(n=172)	(n=78)		
Weight, kg	81.0±9.6*∞	79.2±10.3*	78.0±9.7∞α	80.1±10.2 α	17.4	0.001
Waist, cm	94.1±8.5*	93.0±.5	91.0±8.8*	92.7±8.9	18.4	<0.001
BMI, kg/m²	26.1±2.8*∞	25.4±3.3*	25.0±2.8∞	26.4±6.3	22.9	<0.001
FBG, mg/dL	97.9±11.5*∞	96.1±22.8*	94.0±19.1∞α	95.3±9.3α	37.6	<0.001
Cholesterol, mg/dL	200.1±38.3	189.3±35.9	196.9±38.4	197.1±37.2	5.9	0.118
LDL-c, mg/dL	122.6±33.6	113.4±32.9	118.6±33.7	119.7±28.7	6.3	0.096
HDL-c, mg/dL	49.0±11.2*∞	47.1±11.5α	46.2±11.3*β	43.3±11.0∞αβ	25.3	<0.001
Triglyceride, mg/dL	144.0±80.8	144.5±72.6	160.5±89.2	171.8±116.5	6.9	0.074
SBP, mmHg	125.6±12.6*∞	122.4±13.0*	121.8±13.6∞	122.8.1±13.4	12.4	0.006
DBP, mmHg	76.5±9.1	75.1±9.8	74.8±9.1	74.1±9.7	6.2	0.105

Data are shown in mean±standard deviation
#Kruskal-Wallis test, Mann-Whitney posttest for pairwise comparisons: if 2 group variables carry the same superscript (*∞αβ) it means that the difference between these two variables is significant after posttest pairwise comparison.
BMI - body mass index, DBP - diastolic blood pressure, FBG - fasting blood glucose, HDL-c - high density lipoprotein cholesterol, LDL-c - low density lipoprotein cholesterol, SBP - systolic blood pressure

Table 4. Lipid parameters and blood pressure measurements according to weekly exercise duration

Variables	Weekly Exercise Duration (minutes)				#Chi-square	#p
	None	<60	60-120	>120		
	(n=275)	(n=168)	(n=175)	(n=202)		
Weight, kg	81.4±10.4*∞	80.3±8.3	79.4±10.0*	79.0±10.0∞	8.7	0.033
Waist, cm	94.5±8.5*∞	93.5±8.5α	92.4±9.1*	91.7±8.5∞α	14.4	0.002
BMI, kg/m²	26.5±4.3*∞	26.0±2.7α	25.5±2.7*	25.2±2.9∞α	17.8	<0.001
FBG, mg/dL	96.6±111.7	95.7±12.2	96.4±18.5	97.5±17.4	1.8	0.624
Cholesterol, mg/dL	200.4±36.8	196.2±37.5	194.4±39.2	198.7±38.8	3.1	0.378
LDL-c, mg/dL	121.9±32.0	118.7±31.4	118.0±35.4	121.9±34.3	2.5	0.476
HDL-c, mg/dL	45.0±10.6*∞	45.7±10.0α	48.9±12.0*	51.5±11.5*∞α	50.0	<0.001
Triglyceride, mg/dL	169.8±97.6*∞	158.6±89.0α	139.4±76.7*β	126.5±67.0*∞αβ	37.9	<0.001
SBP, mmHg	126.1±13.7*	124.7±11.4∞	124.2±11.0α	120.7±14.4*∞α	18.3	<0.001
DBP, mmHg	77.0±9.4*	76.2±8.5∞	76.6±9.1α	72.6±9.2*∞α	27.0	<0.001

Data are shown in mean±standard deviation
#Kruskal-Wallis test, Mann-Whitney posttest for pairwise comparisons: if 2 group variables carry the same superscript (*∞αβ) it means that the difference between these two variables is significant after posttest pairwise comparison.
BMI - body mass index, DBP - diastolic blood pressure, FBG - fasting blood glucose, HDL-c - high density lipoprotein cholesterol, LDL-c - low density lipoprotein cholesterol, SBP - systolic blood pressure

levels (Table 4) and the amount of alcohol consumed. The tables also indicate the results of post-hoc analysis between different sub-groups. As depicted, weight, waist circumference, LDL-c, triglyceride, fasting glucose as well as arterial blood pressure were all escalated gradually as the age (in decades) increased (p<0.05 for all) (Table 2). HDL-c, on the other hand, did not show such a gradual change but participants between 30-39 years had a lower level of HDL-c compared to participants in 3rd and 5th decades (p<0.05).

According to smoking status, univariate analyze showed that LDL-c and total cholesterol did not change between groups. However, HDL-c decreased whereas triglyceride increased as the amount of cigarette increased (Table 3). Similarly, HDL-c was higher and triglyceride was lower in groups with higher amount of exercise (Table 4). In both analyzes, the differences in HDL-c among groups were still significant after correction according to the triglyceride levels (p<0.001 for both smoking and exercise groups). As depicted in Table 5, almost half of the participants

Table 5. Lipid parameters according to alcohol consumption

Variables	Alcohol consumption			#Chi-square	#p
	None (n=388)	Mild (n=397)	Moderate-severe (n=35)		
Weight, kg	79.7±9.6	80.4±10.0	82.0±10.5	1.7	0.429
Waist, cm	92.9±9.1	93.2±8.3	94.7±7.9	1.0	0.596
BMI, kg/m^2	25.8±3.0	25.9±3.8	25.9±2.9	0.3	0.852
FBG, mg/dL	96.6±14.3	96.8±15.9	94.5±8.9	0.2	0.915
Cholesterol, mg/dL	194.6±37.7*	200.5±37.7*	206.1±42.5	6.1	0.048
LDL-c, mg/dL	117.8±33.7*	122.3±32.6*	127.9±32.1	6.9	0.032
HDL-c, mg/dL	47.6±11.2	47.4±10.9	49.7±16.5	0.1	0.992
Triglyceride, mg/dL	147.0±83.0	154.4±90.7	142.5±71.0	1.7	0.424

Data are shown in mean±standard deviation
#Kruskal-Wallis test, Mann-Whitney posttest for pairwise comparisons: *-p<0.05
BMI - body mass index, FBG - fasting blood glucose, HDL-c - high density lipoprotein cholesterol, LDL-c - low density lipoprotein cholesterol

(47.3%) were not consuming alcohol and similar ratio of the participants (48.4%) was consuming only a little amount of alcohol. HDL-c level did not differed between subgroups of alcohol consumption. Although LDL-c and total cholesterol were higher in the participants who were taking "little" amount of alcohol compared to "non-drinkers", the difference in both variables was lost after correction according to the weight (p=0.101 for LDL-c; p=0.066 for total cholesterol).

Discussion

The results of this study showed that mean HDL-c in young-middle age male military professionals, traditional cardiovascular risk factors were in almost normal levels (except smoking) and HDL-c was not "low" or even "high" although Turkish population was presented to have low HDL-c in some well-known epidemiologic studies (6, 7).

Low level of HDL-c is a well-known risk factor for cardiovascular disease (9). Although concerns have just risen on the clinical benefit of drug-induced increase of this macromolecule, HDL-c level and/or particle number is associated with cardiovascular events and plaque progression (10-13). In addition, it is still a component of widely used cardiovascular risk score calculations (14, 15).

In previous epidemiologic studies, Turkish population had been suggested to have low HDL-c level and presented as a typical example of nations with low HDL-c (6, 7, 16-18). Furthermore, in Turkish Adult Risk Factor (TEKHARF) Study, coronary mortality and morbidity was reported to be higher despite lower total and LDL-c levels compared to those of other European countries. The authors explained this paradox mainly by low HDL-c level in Turkish population (17).

In the present study, which consisted of only young-middle age males, we found that the mean HDL-c was 47.6±11.3 mg/dL. Meanwhile, the HDL-c for Turkish males was 37.2 mg/dL and 36.2 mg/dL in 1997/1998 survey of TEKHARF Study and Turkish Heart Study, respectively. In the latter of these studies, HDL-c was <40 mg/dL in 74% of the male participants in contrast to present study, which revealed that only 23.2% of the individuals had HDL-c < 40mg/dL. The investigators also found that total cholesterol and LDL-c were changing in different regions of Turkey and suggested that it was connected to diverse dietary habits, but HDL-c was low in all of the regions which was thought to be independent from the nutrition (6). These findings indicated that HDL-c in Turkish males was nearly 10 mg/dL lower compared to that of European and American males (19). Bersot et al. (20) suggested that the most important reason of "genetically" low HDL-c was the high levels of hepatic lipase, an enzyme that converts intermediate-density lipoprotein to LDL-c.

In contrary of these results, recent epidemiologic studies consistently supported that HDL-c is not as low as speculated even in high-risk groups. In their study aiming to find out the prevalence of metabolic syndrome in Turkish adults, Kozan et al. (21) found that average HDL-c in 2110 male participants was 46.3±16.6 mg/dL, which was very close to our findings. In another countrywide epidemiologic study, mean HDL-c was 48.7±19.1 mg/dL in nearly 8500 hypertensive patients (22). In the Prevalence, Awareness, Treatment and Control of Hypertension in Turkey (the PatenT) study, HDL-c was <40 mg/dL in only 35.1% of the male hypertensive population (23). Similarly, Uzunlulu et al. (24) found that average HDL cholesterol levels were 45.0±10.5 mg/dL (44.4±10.9 mg/dL in men, 46.5±9.6 mg/dL in women) in patients with CAD, and 47.7±9.0 mg/dL (45.5±8.4 mg/dL in men, 48.9±9.2 mg/dL in women) in non-CAD group. In summary, these new findings indicate that HDL-c does not seem to be low in Turkish population.

We also reach some interesting points when we compared the results of the present study with those of previous "military school students" study (8). We previously found that HDL-c was 48±9 mg/dL in 1104 male military school students between 19 and 25 years old which was very similar to the HDL-c level in young-middle age military professionals of the present study. Of note, in military school population, the mean age was 21.4±4.5, LDL-c was

85.0±23.0 mg/dL, triglyceride was 80.0±31.0 mg/dL, fasting blood glucose was 86.0±8.0 mg/dL, systolic blood pressure was 107.0±11.0 mmHg, diastolic blood pressure 68.0±9.0 mmHg, waist circumference was 77.0±5.0 cm and BMI was 22.2±1.6 kg/m^2(8). As clearly seen, all of the aforementioned parameters except HDL-c were remarkably and unfavorably different in our study group compared to military students. As expected, military school students had almost an "ideal" life style (except smoking which was noted in 39.8% of the students) with regular rigorous exercise and consequently ideal anthropometric measurements. Shifting into a professional and "family" life may result in decrease in exercise, increase in body mass index and waist circumference and unfavorable eating habits in addition to increasing age. Despite these changes, most of which may have negative influence on the levels of HDL-c, this lipoprotein was still similar between these two groups. Of course, we must emphasize that this comparison between the study group and the military students was between two different populations. However, the professional staff in the present study had been recruited to military school with the same criteria as the military students who were examined in the previous study. Therefore, we may make an assumption that the participants in this study had been "similar" when they were attending military school. Additionally, biochemical analyses of these two populations were made in the same laboratory with the same methods and diagnostic kits. This makes the comparison of these variables more reliable. Yu et al. (25) found that the effect of genetic factors on HDL-c was more prominent in Turks compared to Europeans and these are responsible from almost 80% of the level of HDL-c. If this finding is true and generalizable, we may explain, at least partly, the similarity in HDL-c between military students and professionals, despite the differences of other parameters. Similarly, Mahley et al. (26) showed that HDL-c in prepubertal Turkish children was not low compared to that in children of similar age group in different countries, another finding supporting the idea that HDL-c is not "genetically" low in Turkish population. As summarized previously, recent epidemiologic studies showed that HDL-c was not as low as TEKHARF and Turkish Heart Study stated (21-24). It is difficult to conclude the reason(s) of the low HDL-c in TEKHARF and Turkish Heart Study. This may stem from the methodology of biochemical measurements. The HDL-c levels were determined using the CHOD-PAP method in Turkish Heart study (after phosphotungstic acid-magnesium precipitation of very low density lipoproteins and LDL) and with Reflotron device in TEKHARF. Storage and transfer of the samples to the core laboratory may also be an issue. Ignatius et al. (27) found that storage of the serum at freezer temperature resulted in a slight decrease in HDL-c. The duration of hunger and selection bias is other possible reasons of the difference.

The results of this study were also in parallel with the classical data that both smoking and lack of exercise were associated with low levels of HDL-c. As depicted in Table 3, HDL-c was highest in non-smokers and the difference in HDL-c was significant between non-smokers and smokers of more than 10 cigarettes a day. We showed a similar association in military students previously (28). Exercise is also well known factor to increase HDL-c level (29). Consistent with this data, participants performing regular exercise of more than 60 minutes per week had higher HDL-c level compared to ones who did not have regular exercise (Table 4). However, the effect size of the favorable life style on the absolute HDL-c level is not high.

TEKHARF study also revealed an increase in HDL-c level with the increasing age decades. The HDL-c was 35.6±11, 36.3±12, 37.4±11, 39.2±13 mg/dL in 3rd, 4th, 5th, 6th decades, respectively (7). The present study, as well as the Turkish Heart Study, did not reveal such an association (Table 2). In our study, the HDL-c was lower minimally but significantly in the 4th decade compared to 3rd and 5th decades. This small decrease in HDL-c may be due to lesser exercise level of >60 minutes per week in this decade compared to other 2 decades or due only to chance alone.

Study limitations

There are some limitations of the present study. Firstly, the study population is not an actual representative of the Turkish population. The students who applied to military school as well as the ones who were recruited may be assumed to be healthier than the general population of the similar ages. The study group is more or less a homogenous population with similar life style, income and educational level. The exercise level in this population can also be assumed to be more than that of the general population. In this aspect, despite a potentially different life style compared to whole Turkish population, the HDL-c was not substantially different from the recent epidemiologic studies even the ones evaluating the individuals with high cardiovascular risk (21-24). Secondly, exclusion of 4 patients with coronary artery disease from the analyses might have contributed the relatively high levels of HDL-c, though the small number of these participants is unlikely to influence the results. It has to be noted that the participants who were on antihypertensive (n=20) and lipid-lowering (n=15) medications were included in the analysis considering the limited amount of these drugs on HDL-c.

Another point to emphasize is dietary habits of the participants were not questioned in the questionnaire. Nevertheless, as the effect of food consumption is not prominent on HDL-c as THS indicated, this issue may be ignored in terms of this macromolecule, which is the focus of the study. Lastly, the study population consisted only males and does not reflect the women.

Conclusion

In young/middle-age male healthy military professionals the mean levels of traditional coronary risk factors were almost in normal limits. Mean HDL-c was also high consistent with recent epidemiologic studies in Turkish population but contradictory to older well-known studies as TEKHARF and Turkish Heart Study, both of which found low levels of HDL-c in all of the different subgroups of Turkish population. It is not possible to generalize the results of the present study to the whole Turkish population, but considering the discrepancy in the evidence in the literature on HDL-c levels in Turkish population, further well-designed studies are needed.

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