Original Article

Plasma total cholesterol level and some related factors in northern Iranian people

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Abstract

Background: In middle age people, hypercholesterolemia (HC) has been included as a risk factor for cardiovascular disease. **Objectives:** The main objective of this study was to evaluate the prevalence of HC and some related factors in the north of Iran. **Materials and Methods:**This was a population-based cross-sectional study that enrolled 1995 subjects (997 males and 998 females) in 25-65 year age using stratified cluster sampling. Interviewers recorded the data using a multidimensional questionnaire including anthropometric indexes. Plasma cholesterol was measured in the morning after a 12-hour fast and determined by an auto-analyzer. HC was defined by a total plasma total cholesterol level over 200 mg/dl. The SPSS.16 software was used to analyze data. **Results:** The mean age of the participant was 44.2 years and mean ± SD plasma total cholesterol level in men and women was 196.7 ± 39.11 and 209.4 ± 42.9, respectively. Generally, the prevalence of HC was 50.4% with a significant differences between men (44.7%) and women (57%) ($P < 0.05$). The mean plasma total cholesterol levels were significantly differenced among age groups, location area, BMI, and waist circumferences ($P < 0.001$). Women gender (OR = 1.64), 55-65 years old (OR = 2.79), BMI ≥40 kg/m^2 (OR = 10.0), and abdominal obesity (OR = 2.47) were associated with increased risk of HC ($P = 0.001$ and 95%CI for all). **Conclusion:** HC is one of the most health problems in the northern Iran and it is more common in women than in men. General and abdominal obesity are the most common risk factors for HC.

Key words: Hypercholesterolemia, Iran, obesity, socio-demographic, total cholesterol

INTRODUCTION

In middle age people, total cholesterol levels have been established as a risk factor for a cardiovascular disease (CVD) risk marker.[1] In Finland data have been shown that mortality rate from CVD among people high plasma total cholesterol level people (>300 mg/dl) is fivefold higher than other factors and reducing plasma total cholesterol level by 10% can reduce the mortality due to CVD up 30%.[2]

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According to a survey in the USA, 50% of adults showed cholesterol level higher than 200 mg/dl, while 37 million people had levels higher than 240 mg/dl.[3] Framingham *et al.*[4] showed that the prevalence of mortality and morbidity due to CVD can be estimated by the determination of plasma cholesterol levels in young and adult people. Several other studies have shown that many factors such as lifestyle, diet, smoking, BMI, gender, physical activity, and age are correlated with mean plasma cholesterol level.[5-7]

Of 1.6 million people in Golestan province (northern Iran and south east of Caspian sea), 66.39% are 25-65 years old, whereas 43.9% and 56.1% are living in urban and rural area, respectively.[8] Agriculture is the main occupation in the rural area.

The main objective of this study was to determine the plasma total cholesterol status and some associated factors in people of urban and rural areas in northern Iran. This

study may suggest the ways to decline or prevent the risk of CVD in this area.

MATERIALS AND METHODS

This was a population-based cross-sectional study conducted in Golastan Province (northern Iran). Regarding the previous study[3] and 95% confidence interval, 1995 subjects (997 males and 998 females) were chosen by the stratified cluster sampling method. From 11 districts, 100 clusters of 20 cases were randomly selected by family code in Primary Health Centers in rural areas and postal code in urban areas with equal proportions of genders. From each district, one team was trained to complete the questionnaire and measure anthropometric indexes. The questionnaire included demographic characteristics, residential area, educational level, and physical activity.

All family members in blocks who were in 25-65 years were included in the clusters. Pregnant women and those who were unwilling to participate in this study were excluded from the study. Weight was measured with light clothing without shoes and height was measured with standing up and head, back, and buttock on the vertical land of the height gauge.

Body mass index (BMI) was calculated as weight (kg)/height (m^2) and using World Health Organization classification.[9] BMI of 25.0-29.9 kg/m^2 was classified as overweight, BMI of 30.0-39.9 kg/m^2 was classified as obese, and BMI ≥40 kg/m^2 was classified as pathologic obese. Waist circumference higher than the normal range (men >102 and women >88 cm) was determined as abdominal obesity.[10]

Physical activity was categorized into five categories based on daily work and activity including no physical activities (without moving from one place to another), low physical activity (activity that requires extension of the muscular–skeletal system and moving from one place to another), moderate physical activity (activity that requires sometimes increased respiratory rate like cleanliness, gardening, building painting, etc.), high physical activity (activity that requires highly increased reparatory rate like manual labor, building labor, etc.), and very high activity (a combination of above activities).[11]

For measuring plasma total cholesterol level, blood was drowned from each subject after 12 hours fast in the morning. Plasma total cholesterol was measured with commercial kits (Pars Azmoon, Karaj, Iran) by an auto-analyzer. The plasma cholesterol level more than 200 mg/dl was diagnosed as hypercholesterolemia (HC).[12]

SPSS 16.0 software was used for the statistical analysis, the Chi-square test was used for comparing frequencies and the *t*-test and ANOVA were used for comparing the means. Logistic regression analysis was applied in order to estimate the odds ratio (OR) of HC considering the socio-demographic factors at 95% significant level. A P value <0.05 included significations. The reliability was assessed using Cronbach's alpha coefficient and was found to be 0.86. This study was approved by Ethical Research Committee and consent was received from all participants. Unwilling subjects and pregnant women were excluded from this study.

RESULTS

The mean and standard deviation of age was 44.2 ± 11.3 years. Of the 1995 subjects, 50%, 46.7%, 29%, and 43.3% were men, urban residence, general, and abdominal obese, respectively [Table 1].

The mean and standard deviation of plasma total cholesterol levels were 203.6 ± 40.7 mg/dl and it was 12.7 mg/dl higher in women than in men. There was a positive significant correlation between age and plasma total cholesterol level ($P = 0.001$). Plasma total cholesterol level decreased with physical activity; the mean of plasma total cholesterol level in the low active group (205.1 mg/dl) was 14.9 mg/dl higher than in the very active group (190.2 mg/dl) which was statistically significant ($P = 0.019$). The plasma total cholesterol level had a positive correlation with BMI $P = 0.001$), and in the obese group (BMI ≤40 kg/m^2) (255.5 mg/dl) it was 71.4 mg/dl higher

Table 1: Characteristics of study subjects (*n*=1995)

Category	*N*	%
Sex, men	997	50
Age groups (years)		
25-35	547	27.4
35-45	537	26.9
45-55	488	24.5
55-65	423	21.2
Abdominal obesity, yes	864	43.3
Residence, urban	931	46.7
Physical activity		
No	426	21.3
Slight	509	25.5
Moderate	883	44.3
Stringent	83	4.2
Whole	94	4.7
BMI (kg/m^2)		
18.5	57	2.9
18.5-24.9	683	34.3
25-29.9	676	33.9
30-34.9	405	20.3
35-39.9	132	6.6
≤40	42	2.1

BMI: Body mass index

than in the thin group (BMI <18.5 kg/m^2) (184.1 mg/dl) [Table 2].

The overall prevalence of HC was 50.9% and it was up to 12.3% higher in women (57%) than in men (44.7%) (P = 0.001). The prevalence of HC was 25.1% among 55-65 years age participants (61.5%) higher than among that observed in the 25-35 years age group (36.4%). HC was significantly common in abdominal obese subjects (63.2%) higher than in normal subjects (41%) (P = 0.001) and in the urban area (53.1%) it was 4.1% higher than in the rural area (49%) without statistically significant difference [Table 3].

Multiple logistic regressions were used to identify variables that contribute to HC. The risk of HC was found to be 1.64 [95% CI: 1.31-1.99] in female compared to male; 2.79 [95% CI: 2.15-3.631] in 55-65 years subjects compared to 25-35 years; 10.00 [95% CI: 3.75-26.67] in BMI ≥40 compared to BMI ≤18.5 and 2.47 [95% CI: 2.06-2.98] in abdominal obesity compare to normal people. No significant differences were found among residential area and physical activities [Table 4].

Table 2: The mean and standard deviation of plasma total cholesterol levels based on some related factors

Characteristics	*N*	Plasma total cholesterol	*P* value*
		Mean (SD) mg/dl	
Sex			
Men	997	196.7 (39.5)	0.001
Women	998	209.4 (42.9)	
Age groups (years)			
25-35	547	189.1 (37.8)	
35-45	537	202.6 (39.9)	0.001
45-55	488	210.8 (41.9)	
55-65	423	213.1 (44.1)	
Abdominal obesity			
No	1131	193.2 (39.6)	0.001
Yes	864	215.2 (40.3)	
Location area			
Urban	931	205.7 (41.4)	0.012
Rural	1064	200.9 (41.9)	
Physical activity			
No	426	207.8 (38.8)	
Slight	509	205.1 (40.1)	
Moderate	883	201.1 (41.5)	0.001
Stringent	83	190.2 (41.3)	
Whole	94	202.6 (44.3)	
BMI (kg/m^2)			
18.5	57	184.1 (34.1)	0.001
18.5-24.9	683	188.6 (40)	
25-29.9	676	209.5 (41.5)	
30-34.9	405	212.4 (39.7)	
35-39.9	132	217.9 (39.3)	
≤40	42	255.5 (29.6)	

*T test and ANOVA were used for two and over two groups, respectively

DISCUSSION

The results of this study show that half of adult population living in northern Iran is hypercholestrolomic. The prevalence of HC has been reported to be in Romania (70%), Northwest Mexico (52.6%), Indian rural (22.3%), Spain (24%), Western Samoa (36%), Koki (25%), and Saudi Arabia (54%).[6,13-18] HC prevalence in Tehran (capital of Iran) and in Arak (a capital city in central Iran) has been reported up to be 40.4% and 26.7%, respectively.[19] As like as mentioned studies[13,14,18] the prevalence of HC in the north of Iran is high and should be consider as the most common health problem in this area.

In our study, the prevalence of HC was seen to be higher in urban than in rural and higher in women than in men. There was a positive association between age, waist circumference, and BMI with plasma total cholesterol level.

Increasing HC in an urban population in the worldwide has been shown in some studies.[18,20,21] Similarly, women suffer from HC than man.[13,21-24] After menopause, estrogen has a positive role in serum cholesterol level, therefore, estrogen therapy has been recommended for the control of CVD.[22] In our study, half of the women were over 45 years, which may be used as a interfering factor for increased plasma total cholesterol level.

The correlation between plasma total cholesterol level and age, waist circumference, and BMI in our study is similar to the earlier reports.[13,23,25-28]

The influence of physical activity on the serum cholesterol level was not similar in all studies. Although the role of physical activity in decreasing plasma total cholesterol level has been shown in many studies,[29,30] there was not any correlation between them in another.[31] Physical activities decreased the plasma lipid profile with statistical significant differences in HDLc and ApoA1.[4,24]

We don't know whether there is any signification between physical activity and HC, but it seems that other related factors which are not included in our study such as ethnicity and food behavior do have influence on the plasma total cholesterol level.

CONCLUSION

Our study showed that HC is a health problem in northern Iran and it is common in half the adult population. Socio-economic status, general, and abdominal obesity are predispose factors for HC. Screening and intervention programs for the prevention of HC are necessary. Further

Table 3: The prevalence of hypercholesterolemia based on some related factors

Characteristic	N	Cholesterol status		Chi-2 P value
		Normal N (%)	Hypercholesterolemia N (%)	
Sex				
Men	997	551 (55.3)	446 (44.7)	0.001
Women	998	429 (43)	569 (57)	
Age groups (years)				
25-35	547	438 (63.6)	199 (36.4)	0.001
35-45	537	263 (49)	274 (51)	
45-55	488	203 (41.6)	285 (58.4)	
55-65	423	165 (38.5)	258 (61.5)	
Abdominal obesity				
No	1131	667 (59)	464 (41)	0.001
Yes	864	318 (36.8)	546 (63.2)	
Location area				
Urban	931	437 (46.9)	494 (53.1)	0.148
Rural	1064	543 (51)	521 (49)	
Physical activity				
No	426	200 (47.1)	225 (52.9)	0.144
Slight	509	235 (44.3)	273 (53.7)	
Moderate	883	442 (50.1)	440 (49.9)	
Stringent	83	49 (59)	34 (41)	
Whole	94	51 (54.3)	43 (45.7)	
BMI (kg/m^2)				
18.5	57	38 (66.7)	19 (33.3)	0.001
18.5-24.9	683	439 (64.4)	243 (35.6)	
25-29.9	676	286 (42.4)	389 (57.6)	
30-34.9	405	163 (40.3)	241 (59.7)	
35-39.9	132	44 (33.6)	87 (66.4)	
≤40	42	7 (16.7)	35 (83.3)	

Hypercholesterolemia (HC): Plasma total cholesterol leve >200 mg/ dl, BMI: Body mass index

Table 4: Odds ratio and 95% CI obtained from logistic regression analysis for hypercholesterolemia

Risk factor	Level	OR (95% CI)	P value
Gender	Men	1.0 (–)	0.001
	Women	1.639 (1.37-1.96)	
Age group (year)	25-35	1.0 (–)	
	35-45	1.822 (1.43-2.32)	0.001
	45-55	2.455 (1.91-3.15)	0.001
	55-65	2.791 (2.15-3.63)	0.001
Residential area	Rural	1.0 (–)	
	Urban	1.178 (0.99-1.41)	0.001
Abdominal obesity	−	1.0 (–)	
	+	2.474 (2.06-2.98)	0.001
BMI (kg/m^2)	≥18.5	1.0 (–)	
	18.5-24.9	1.10 (0.62-1.94)	0.756
	25-29.9	2.73 (1.54-4.84)	0.001
	30-39.9	3.16 (1.78-5.64)	0.001
	40≤	10.00 (3.75-26.67)	0.001
Physical activity	No	1.0 (–)	
	Low	1.38 (0.89-2.14)	0.155
	Moderate	1.18 (0.77-1.81)	0.446
	Severe	0.82 (0.45-1.50)	0.522
	Combine	1.05 (0.87-1.27)	0.628

BMI: Body mass index

studies are necessary to examine the related factors such as life style, food behavior, ethnic differences, and awareness with HC.

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