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

Gholamreza Veghari, Mehdi Sedaghat¹, Hamidraza Joshghani, Farhad Nizkazad², Abdolhamid Angizeh¹, Ebrahim Tazik¹, Pooneh Moharloei¹, Samieh Banihashem¹

Departments of Biochemistery and Nutrition, ²Microbiology, ¹Deputy of Health, Golestan University of Medical Sciences, Gorgan, Iran

Address for correspondence:
Mr. Gholamreza Veghari, Ischemic Disorders Research Center, Golestan University of Medical Sciences, Gorgan, Iran. E-mail: greghari@yahoo.com

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/m² (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 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 al⁴ 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 Golestani Province (northern Iran). Regarding the previous study 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 (m²) and using World Health Organization classification. BMI of 25.0-29.9 kg/m² was classified as overweight, BMI of 30.0-39.9 kg/m² was classified as obese, and BMI ≥40 kg/m² was classified as pathologic obese. Waist circumference higher than the normal range (men >102 and women >88 cm) was determined as abdominal obesity.

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 respiratory rate like manual labor, building labor, etc.), and very high activity (a combination of above activities).

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).

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/m²) (255.5 mg/dl) it was 71.4 mg/dl higher.

**Table 1: Characteristics of study subjects**

| 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/m²)               |    |      |
| 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/m²) (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 those 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: 2.15-3.63] in 55-65 years subjects compared to 25-35 years; 10.00 [95% CI: 3.75-26.67] in BMI ≥ 25 to 18.5 and 2.47 [95% CI: 2.06-2.98] in female compared to male; 2.79 [95% CI: 1.31-1.99] in female compared to male.

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 men.[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 an 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.[6,24]

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 of 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

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**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/m²)              |    |                          |          |
| 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 | 258.5 (29.6)             |          |

* T test and ANOVA were used for two and over two groups, respectively.
Hypercholesterolemia (HC): Plasma total cholesterol level >200 mg/dl, BMI: Body mass index

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

| Characteristic       | N     | Normal N (%) | Hypercholesterolemia N (%) | Chi-2 P value |
|----------------------|-------|--------------|-----------------------------|---------------|
| 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/m²)          |       |              |                             |               |
| 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)                  |               |
| 30-39.9              | 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)                   |               |

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 (–)     |         |
|                     | ≥18.5          | 2.474 (2.06-2.98) | 0.001   |
|                     | 18.5-24.9      | 1.10 (0.62-1.94)  | 0.756   |
| BMI (kg/m²)          | 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    | 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   |

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