# ASSESSMENT OF CARDIAC RISK FACTORS IN MEDICAL STUDENTS OF TEHRAN UNIVERSITY

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**Abstract-** Prevention of coronary heart disease, mainly by reducing the levels of known risk factors in the population, remains a priority in public health. This cross-sectional study on randomly selected medical students during their internship was conducted from July 2001 to April 2002 in order to determine the prevalence of major coronary artery disease (CAD) risk factors. This survey was done by filling the questionnaire, measuring physical parameters, and taking a fasting blood sample. Two hundred and sixty four medical students were evaluated in this study (48 female, 216 male) with the mean age of 26.5 ± 2.8 years. The main risk factors in descending order of frequency were physical inactivity (43.5%), low high-density lipoprotein cholesterol (26.2%), family history of premature CAD (15.9%), smoking (10.3%), abdominal obesity (10.2%), high triglyceride level (5.3%), high blood pressure (3.4%), and high low-density lipoprotein cholesterol (1.5%). Also, 25% of married females were using oral contraceptives regularly. The number of risk factors per person was 2.2 on average (1.1 in females and 2.5 in males). Prevalence of CAD risk factors in this medical students' population was unacceptably high. Additional studies should be done to gather more information and determine the need for preventive, educational or curative interventions.

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## INTRODUCTION

Prevention of coronary heart disease (CHD) remains a priority in public health. Despite dramatic improvement in control of risk factors of CHD, it is still the leading cause of death and disability among men and women in the world (1). While mortality from ischemic heart disease is decreasing in many countries, it is increasing in many others (2). Prevalence of risk factors for atherosclerosis and cardiovascular disease (CVD) as well as the manifestations of coronary heart disease, stroke, and peripheral vascular disease used to be low in Iranian population. However, over the past several decades the rates of these CVD-associated risk factors have markedly increased with the concomitant development of a significant and alarming rise in the manifestations of atherosclerosis (3).

Prospective cohort studies have shown that the absolute risk of cardiovascular disease in any individual is determined by a complex interplay of several factors of which age, sex, cigarette smoking, hyperlipidemia, hypertension, diabetes mellitus, obesity, physical inactivity, diet high in saturated fats, hyperhomocysteinemia, raised lipoprotein (a) concentrations and hypercoagulable states are more important (4). Most industrialized countries are developing and adopting national strategies to prevent ischemic heart disease, mainly by reducing the levels of these known risk factors in the population (5).

People's susceptibility to CVD varies widely and may be a reflection of differences in biological

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predispositions, personality, behavior and environmental exposures. In addition, psychological stress is commonly believed to play an important part in illness and premature death, particularly with respect to cardiovascular diseases (6). The most recent European guidelines for CHD prevention acknowledge that stress, anxiety and depression are independent risk factors for CHD.

The work environment is probably an important source of stress for most adults (7). Furthermore, previous studies indicate that stressful jobs have a role in the illness and death caused by cardiovascular disease (7-9). Medical professions seem to be stressful jobs; thus medical students are predisposed to psychological stress which is widely believed to be important determinant of heart disease (6). This survey was performed in order to define the prevalence of coronary risk factors in a stressful social group, medical students.

## MATERIALS AND METHODS

The cross-sectional evaluation on randomly selected 264 medical students (216 men and 48 women) during their internship was conducted in three educational hospitals of Tehran University of Medical Sciences. Subjects were screened from July 2001 to April 2002. This survey was performed by filling the questionnaire, measuring physical parameters and taking a fasting blood sample. We obtained informed consent, including following up of medical records, from all participants.

Subjects completed a self-administered questionnaire which covered mainly questions on current health, health behavior, family history and medical history of coronary risk factors. Smoking was assessed with a standard set of questions in the self-administered questionnaire. On the basis of their responses the respondents were classified as smokers or non-smokers. Smokers were those who had smoked cigarettes, cigars, or a pipe regularly for at least one year and had smoked more than once a day on average during the preceding six months; non-smokers were those who had never smoked regularly and those who had smoked regularly but had stopped smoking at least six months before the start of the survey. Also, amount of exercise taken were ascertained by questionnaire. Physical activity was assessed by asking about both work related and leisure activities, as suggested by Paffenberger *et al.* (10). Their criteria classify a person as leading a sedentary lifestyle who walks less than 14.5 km a week, climbs fewer than 20 flights of stairs a week, or performs no moderately vigorous physical activity on five days a week.

Height, weight, body mass index (BMI), hip circumstance, and waist circumstance were measured by specially trained physicians. Weight and height were measured after removing shoes and outer clothing. BMI (weight (kg) / [height (m)]$^2$) was calculated and obesity defined as a body mass index of 27 or more. Blood pressure was measured from the right arm of subjects after he or she had been seated for five minutes with a random zero sphygmomanometer. Phase V of the Korotkoff sounds was recorded as the diastolic pressure. Two readings five minutes apart were taken according to World Health Organization guidelines (11). When a high blood pressure ($\geq$ 140/90 mm Hg) was noted a third reading was taken after 30 minutes. The lowest of the three readings was recorded. Hypertension was diagnosed when systolic blood pressure was 140 mmHg or more and diastolic blood pressure was 90 mmHg or more, according to guidelines of the United States National Health and Nutrition Assessment Survey (12).

A fasting blood sample (FBS) was obtained from all of the subjects. Venous blood specimens were taken after 12 hours fasting for the measurement of glucose, uric acid, and lipids, including: total cholesterol, fasting plasma triglyceride (TG), high-density lipoprotein cholesterol (HDLC) and low-density lipoprotein cholesterol (LDLC). Total cholesterol and TG concentrations were estimated by an enzymatic method. The concentration of HDLC was measured after precipitation of non- HDLC with manganese-heparin substrate. Normal serum samples and laboratory standards served as control. The value of LDLC was derived by using Friedewald's formula: LDLC = total cholesterol- HDLC - (TG/5).

Data were pooled and computerized and mean values expressed with standard deviation. Prevalence rates are given as percentages. We analyzed data using SPSS statistical software version 10.0.

# RESULTS

Two hundred and sixty-four medical students (81.8% male, 18.2% female) with the mean (±SD) age of 26.5 (±2.8) years (range 24-35 years) were studied. Among them, 67.4% were single and 32.6% had been married.

Percentage of non-smokers, passive smokers and active smokers were 75%, 14.8% and 10.2%, respectively; 87.4% of females and 72.2% of males were non-smokers. Regular physical activity was reported only in 11.4% (males, 8.3%; females, 25%) and irregular physical activity in 45.1% of students; others (43.6%) had no physical activity (Table 1).

Positive history of high blood pressure, high cholesterol level, low serum HDLC, high serum TG and history of CHD was present in 2.2% (males, 2.8%; females, 0%), 6.1% (males, 7.4%; females, 0%), 1.1% (males, 1.4%; females,0%), 3.4% (males, 4.2%; females, 0%), and 3.1% (males, 2.8%; females, 4.2%), respectively. Family history of early onset CHD was present in 15.9% of subjects (males, 14.4%; females, 22.9%). Family history of cardiovascular risk factors was present in 74.6% (males, 73.6%; females, 79.2%), smoking in 15.7%, high blood pressure in 23.8%, hypercholesterolemia in 21.4% and obesity in 23.4% of students.

The average of height, weight, and BMI were 174.8±7.3 cm, 72.9±5.6 kg, and 23.78±2.18 kg/m$^2$, respectively (Table 2). On the basis of NHLBI Obesity Education Initiative Expert Panel (13), 67.1% of subjects were in normal range of weight (BMI, 18.5-24.9 kg/m$^2$), 25% were overweight (BMI, 25-29.9 kg/m$^2$), and 7.9% had class I obesity (BMI, 30-34.9 kg/m$^2$). The average of waist circumference, hip circumference, and waist/hip circumference ratio were 84.7±7.1 cm, 10l.9±0.7 cm and 0.82±0.07, respectively (Table 2). On the basis of abdominal obesity definition according to waist circumference (males >102 cm, females >88 cm) 89.8% of students (males, 90.3%; females, 87.5%) had abdominal obesity and 10.2% had no abdominal obesity (males, 9.7%; females 12.5%). In another definition according to waist/hip circumference ratio (males >1, females >0.8), 98.9% had abdominal obesity and 1.1% had not abdominal obesity (males, 100% and 0%; females, 93.7% and 6.3%).

The results of blood pressure measurements are shown in table 3. High blood pressure (≥140/90 mm Hg) was seen in first and second measurements in 6.8% and 3.4%, respectively (males, 8.3% and 4.2%; females 0% and 0%). After third measurement of blood pressure in these patients, hypertension was detected in 3.4% of patients (Table 1).

**Table 1.** Prevalence of coronary artery risk factors in 264 medical students*

| Risk factor | Male (n= 216) | Female (n= 48) | Total (n= 264) |
|---|---|---|---|
| **Smoking** | | | |
| Active smoking | 24 (11.15) | 3 (6.3) | 27 (10.2) |
| Passive smoking | 36 (16.7) | 3 (6.3) | 39 (14.8) |
| **Low physical activity** | | | |
| Irregular physical activity | 100 (46.3) | 19 (39.6) | 119 (45.1) |
| No physical activity | 98 (45.4) | 17 (35.4) | 115 (43.6) |
| **Body mass index ≥ 27** | 87 (40.3) | 0 (0) | 87 (32.9) |
| **Blood pressure ≥ 140/90 mmHg** | 9 (4.2) | 0 (0) | 9 (3.4) |
| **Abnormal lipoprotein lipid values** | | | |
| Cholesterol ≥ 260 mg/kl | 3 (1.4) | 0 (0) | 3 (1.1) |
| Triglyceride ≥ 200 mg/dl | 14 (6.5) | 0 (0) | 14 (5.3) |
| HDLC < 29 mg/dl | 24 (11.1) | 2 (4.2) | 26 (9.8) |
| LDLC> 190 mg/dl | 4 (1.9) | 0 (0) | 4 (1.5) |

Abbrivations: HDLC, high density lipoprotein cholesterol; LDLC, low density lipoprotein cholesterol.
*Data are given as number (percent).

**Table 2.** Anthropometric findings in 264 medical students

| Anthropometric finding | Male | Female | Total | |
|---|---|---|---|---|
| | Mean ± SD | Mean ± SD | Mean ± SD | Median (Range) |
| Height (cm) | 178.5±12.0 | 163.0±14.1 | 174.8±7.3 | 168.5 (153-190) |
| Weight (kg) | 64.5±0.7 | 60.0±15.5 | 72.9±5.6 | 61.0 (49-110) |
| BMI (kg/m$^2$) | 20.9±3.1 | 21.8±2.7 | 23.78±2.18 | 21.49 (15.43-33.95) |
| Waist circumstance (cm) | 81.0±1.4 | 81.0±12.7 | 84.7±7.1 | 77.0 (64-116) |
| Hip circumstance (cm) | 94.5±3.5 | 101.0±4.2 | 101.9±0.7 | 97.5 (87-124) |
| Waist/Hip circumstance | 0.85±0.01 | 0.79±0.09 | 0.82±0.07 | 0.84 (0.65-0.95) |

Abbreviations: SD, standard deviation; BMI, body mass index.

The means of FBS, uric acid, serum total cholesterol, and fasting serum TG were 83.3±10.1 mg/dl, 4.9±1.1 mg/dl, 169.4±41.6 mg/dl, and 101.6±55.5 mg/dl, respectively (Table 4). On the basis of American Diabetes Association definition of diabetes (FBS> 126 mg/dl), none of the subjects had diabetes. In comparison with normal range of uric acid (males, 3.4-7.0 mg/dl; females, 2.4-5.7 mg/dl), 90.9% had normal levels of uric acid and 9.1% had abnormal levels of uric acid (males, 91.7% and 8.3%; females, 87.5% and 12.5%). Considering normal range of serum total cholesterol (normal: <220, borderline: 220-260, and pathologic: >260 mg/dl), cholesterol was in normal range in 86%, borderline in 12.9% and high in 1.1% (males, 83.8%, 14.8%, and 1.4%; females, 95.8%, 4.2% and 0%). Considering normal range of fasting serum TG (normal: <150, borderline: 150-200, and pathologic: >200 mg/dl), TG was in normal range in 83%, borderline in 11.7% and high in 5.3% (males, 79.2%, 14.3%, and 6.5%; females, 100%, 0% and 0%) (Table 1). Mean of serum HDLC, serum LDLC, total cholesterol/ HDLC ratio, and LDLC/ HDLC were 43.0±12.4 mg/dl, 106.8±37.7 mg/dl, 4.18±1.40, and 2.66±1.19, respectively. In comparison with normal range of serum HDLC (normal: 29-80 mg/dl), 90.2% were in normal range, 9.8% were abnormal (males, 88.9%, and 11.1 %; females, 95.8%, and 4.2%). In comparison with normal range of serum LDLC (normal: <150, borderline: 150-190, and pathologic: >190 mg/dl), 85.2% were in normal range, 13.3% were borderline, and 1.5% were pathologic (males, 83.8%, 14.3%, and 1.9%; females, 91.7%, 8.3% and 0%) (Table 1).

In comparison with normal range of total cholesterol/ HDLC ratio (optimum: <3, average: 3-5, and high: >5), 22.7% were in optimum range, 56.8% were in average range, and 20.5% had high total cholesterol/ HDLC ratio (males, 19.9%, 55.1 %, and 25%, F: 35.4%, 64.6% and 0%). In comparison with normal range of LDLC/ HDLC ratio (normal: <3.1, and pathologic: >3.1), 68.6% were in normal range, and 31.4% were pathologic (males, 65.3%, and 34.7%; females, 83.3%, and 16.7%).

**Table 3.** Blood pressure distribution in two separate measurements in 264 medical students

| Blood pressure (mmHg) | 1$^{st}$ measurement | | 2$^{nd}$ measurement | |
|---|---|---|---|---|
| | Systolic | Diastolic | Systolic | Diastolic |
| Min-Max | 100-135 | 60-90 | 95-130 | 60-90 |
| Average | 117.8±3.5 | 77.3±3.5 | 116.1±3.5 | 75.0-0.5 |
| Median | 117.5 | 77.5 | 117.5 | 75.0 |
| Average in female | 115.0±7.1 | 70.0±7.1 | 110.0±14.1 | 67.5±10.6 |
| Average in male | 112.5±3.5 | 72.5±10.6 | 115.0±0.6 | 72.5±3.5 |

Abbreviations: Min, minimum; Max, maximum.

**Table 4.** Laboratory findings in 264 medical students

| Laboratory finding | Male | Female | Total | |
|---|---|---|---|---|
| | Mean ± SD | Mean ± SD | Mean ± SD | Median (Range) |
| Fasting blood sugar (mg/dl) | 84.1±10.5 | 79.2±6.9 | 83.3±10.1 | 82.0 (60-110) |
| Uric acid (mg/dl) | 5.0±1.1 | 4.4±1 | 4.9±1.1 | 4.8 (2.7-7.8) |
| Total cholesterol (mg/dl) | 171.8±43.1 | 158.9±33.2 | 169.4±41.6 | 169.5 (78-300) |
| Fasting serum triglyceride (mg/dl) | 108.7±58.1 | 70.1±24.6 | 101.6±55.5 | 84.5 (39-337) |
| HDLC (mg/dl) | 41.3±10.6 | 51.1±16.3 | 43.0±12.4 | 40.0 (78-300) |
| LDLC (mg/dl) | 109.2±38.1 | 96.0±34.9 | 106.8±37.7 | 105.5 (12-196) |
| Total cholesterol/ HDLC ratio | 4.36±1.41 | 3.37±1.07 | 4.18±1.40 | 4.06 (1.37-7.78) |
| LDLC/HDLC ratio | 2.79±1.21 | 2.07±0.93 | 2.66±1.19 | 2.61 (0.17-5.86) |

Abbreviations: HDLC: high density lipoprotein cholesterol; LDLC, low density lipoprotein cholesterol.

Considerind risk factors according to sex, male subjects were more prone to risk factors of CAD. Number of risk factors per person was 2.5 in males (range: 0-6) and 1.1 in females (range: 0-3). Women were less likely than men to have inactivity (35.4% vs. 45.4%), smoking (6.3% vs. 11.1%) and hypertension (0% vs. 4.2%). Women were also less likely to have a low HDL (4.2% vs. 11.1 %), and high LDL (0% vs. 1.9%) but were more likely to be obese (12.5% vs. 9.7%) and have positive family history of early onset CAD (22.9% vs. 14.4%). High TG and high total cholesterol were detected only in male subjects, with a prevalence of 6.5% and 1.4%, respectively.

## DISCUSSION

Our data show that major coronary risk factors are prevalent among medical students. The prevalences of major risk factors were 43.6% for inactivity, 9.8% for low HDLC, 15.9% for positive family history of early onset CAD, 10.2% for smoking, 10.2% for abdominal obesity, 7.9% for obesity, 5.3% for high TG, 3.4% for hypertension, 1.5% for high LDLC, and 1.1% for high total cholesterol. This may make these people prone to CHD. Smoking, a high fat diet, lack of exercise, and obesity are well established risk factors, as are less “visible” (14) factors such as hypertension, cholesterol concentration, and diabetes (15).

Among our subjects, 10.2% were active smokers and 14.8% were passive smokers. Cigarette smoking contributes to a third of all deaths from coronary artery disease. Synergy between smoking and other risk factors substantially increases the risks of cardiovascular death associated with these factors (4). Also, passive smoking is a risk factor for coronary heart disease (16).

Regular physical activity was uncommon and inactivity was seen in approximately half of our subjects. Overweight and obesity among this group may be due to irregular physical activity or inactivity. Overweight/obesity is a complex multifactorial chronic disorder and the American Heart Association (AHA) has recently classified it as a modifiable risk factor for CAD (17). The obesity causes an approximately threefold increase in CHD risk (13). Being overweight is an important contributor to risk of morbidity in younger people, particularly due to CHD (18). Diet high in fat is a CHD risk factor that is modifiable, and therefore has the potential to alter the risk for CHD (19). We did not ask about dietary items and therefore cannot comment on these aspects.

For adults, a BMI of 20-27 kg/m$^2$ is widely recommended as the standard weight range within which there is little benefit from further leanness in relation to all cause mortality (20). BMI ≥ 27 kg/m$^2$ were seen in 32.9% of our subjects. In 1993, the proportion of men and women in England who were obese was 13% and 16%, respectively with a mean BMI of 25.9 for men and 25.7 for women. Half of the adult population of England is overweight or obese (21). CHD incidence increased progressively with increasing BMI (22, 23). The American Institute of Nutrition recommends a single BMI criterion of 18-25 for both sexes and suggests that “most people will be healthier towards the lower end of the range”.

They proposed a format indicating gradations of risk: BMI 18-23 confers lowest risk; 24-25, mild risk; 26-29, medium risk and >30, high risk (24). It is well established that at all BMI individuals with visceral obesity (excess deep abdominal fat as indicated by waist-hip ratio or waist circumference) are at highest risk of cardiovascular disease (25). Within the "normal" range of BMI (26) it is better to be leaner, and the optimal healthy BMI for adults is about 22 (23).

Hypertension is one of the most powerful and prevalent contributor of atherosclerotic cardiovascular disease. Increased blood pressure is a major risk factor for CAD, with a 15% increased risk for an increase in systolic blood pressure of 10 mm Hg in the general population (27). In one prospective study of sudden cardiac death among women in the United States, smoking, hypertension and diabetes conferred markedly elevated (2.5- to 4.0-fold) risk of sudden cardiac death, similar to that conferred by a history of nonfatal myocardial infarction (relative risk, 4.1; 95% confidence interval, 2.9 to 6.7). Family history of myocardial infarction before age 60 years and obesity were associated with moderate (1.6-fold) elevations in risk (28).

Hypercholesterolemia and hypertriglyceridemia which were seen in 1.1% and 5.3% of our subjects, respectively, are recognized risk factors for CHD (29). Hyperlipidemia plays a strong role in CHD and was the second major risk factor in a previous study in Iran (3). Hypercholesterolemia and hypertension are both associated with endothelial dysfunction, and their coexistence is associated with an increased incidence of cardiac events in epidemiological studies (30). An increased concentration of LDLC or total cholesterol at baseline is a minor risk factor for CAD (31). Both high fasting cholesterol and high fasting TG strongly predicted coronary events (32).

All coronary risk factors in our study, except family history and abdominal obesity, were more prevalent in males, which was similar to previous studies (33-35). The difference in prevalence of risk factors remains even after adjustments for age, smoking status, obesity, diabetes, and hypertension. With few exceptions (36), studies identifying risk factors for CHD have focused on men (37-39), which suggest a systematic bias towards men compared with women in terms of secondary prevention of ischemic heart disease (35).

Studies using Karasek's job strain model have shown higher cardiovascular risk in jobs characterized by high demands and low control (7, 40). Also, educational level accurately reflects social class and may be a more important risk factor than social or economic class alone (41). So, level of education is the most widely used measure of socioeconomic status (34). A previous study showed that CHD and coronary risk factors were significantly associated with the level of education in a cohort of a rural population in India (34). However, we did not ask about other measures of social class, such as exact employment status, income inequality, deprivation and psychosocial factors (social isolation, coping styles, behavior, job strain and anger), which are also possible mechanisms by which social class and education may influence CHD incidence. Psychosocial factors, for example psychological stress, are widely believed to be important determinants of heart disease (42, 43). Exposures to such factors may influence health directly through neuroendocrine mechanisms or indirectly through their association with unhealthy behavior (44, 45). The work environment is probably an important source of stress and stressful jobs have a role in the illness and death caused by cardiovascular disease (7 -9). Medical students as a stressful social group predisposed to such psychological stress. However, studies from Europe and the United States show that low educational status, low social class, and poverty are major coronary risk factors (41, 46). Also in a study in India, an increasing level of education was associated with a significant falling trend in the prevalence of hypertension and smoking. There was no significant relation with hypercholesterolemia and obesity, but physical activity was greater with less education. There was a significant positive correlation between level of education with weight and BMI in men. There was no significant correlation between total cholesterol and other lipoprotein lipid concentrations with the level of education. There was a declining trend in both systolic and diastolic blood pressures, total cholesterol and low density lipoprotein cholesterol with increasing level of education in both men and women. No such trend was seen with high density lipoprotein cholesterol. There was a falling trend in triglyceride concentrations with increasing education in women. None of these trends was significant (34). Among people in lower social classes there is a higher prevalence of smoking, alcohol consumption, poor diet, stress and exposure to toxins (46).

Prevention of CHD and stroke is an important public health challenge and one that doctors and patients consider a priority. Primary prevention programmers in many countries attempt to reduce mortality and morbidity due to CHD through modifying risk factors (47). Systematic review and meta-analysis are powerful tools to aid policy and practice decisions in multiple risk factor intervention, in which wisdom and current practice are at odds with the emerging scientific evidence. Multiple risk factor interventions comprising counselling, education and drug treatments were ineffective in achieving reduction in total mortality or mortality from cardiovascular disease when used in general or workforce populations of middle aged adults. Preventive measures of proved efficacy include reducing hypertension (48), lowering blood cholesterol concentration (31), and stopping smoking (49). Reducing cholesterol and blood pressure, as well as smoking cessation, have been shown to be effective strategies for preventing cardiovascular diseases (50).

However, these “classical” risk factors, along with known non-modifiable risk factors such as age, sex and family history, cannot fully explain why some people develop myocardial infarction and stroke, while others do not (51). Although recent policy acknowledges broader influences on health (52), strategies for preventing CHD have relied heavily on mass health promotion aimed at persuading individuals to minimize behavioral risks. There is little evidence that this approach has been successful. This lack of success cannot be attributed to lack of knowledge. Recognition of behavioral risk factors has been incorporated into lay knowledge of heart disease as an element of “coronary candidacy”; the kind of person who “should” or “should not” develop heart disease (53). Highly visible risk factors, including a person's tobacco consumption, weight, levels of activity and diet, are invariably invoked (42, 53) in both retrospective explanations of past coronary events, particularly fatal heart attacks (54), and in discussions of the likelihood of future events.

The present report shows a disturbing burden of coronary risk factors in the study population. Our study shows a high prevalence of cardiovascular risk factors in medical students. Primary prevention may be one way to lower the risk burden of CHD. The main aim of health policy in Iran must be to prevent cardiovascular diseases by reducing level of the classic risk factors in population. There is an urgent need to undertake population-based measures to reverse the trend. Additional investigations are warranted to confirm these findings. There is a need for studies which include standardized measurements of lifestyle in evaluation of coronary risk factors in men and women.

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