THE PREVALENCE OF CARDIOVASCULAR RISK FACTORS AMONG SCHOOL TEACHERS IN JEDDAH, SAUDI ARABIA

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Objectives: To describe the prevalence of cardiovascular risk factors among school teachers in Jeddah, Saudi Arabia. Methods: A cross-sectional study was conducted during 1995 on a sample of teachers selected from 33 public schools, using a stratified random sampling technique. For all teachers, a questionnaire was administered and anthropometric and blood pressure measurements were obtained. Fasting glucose, total cholesterol and triglyceride levels were measured using Refletron for a subsample of teachers. Results: Of the 780 teachers selected, 74% were males and the overall mean age was 33.4 ± 7.1 years. About 46% of males and 49% of females were obese. About 12% of all teachers were considered hypertensives. Eighteen percent of males and 2% of females were current cigarette smokers. A greater proportion of males (57%) than females (20%) indicated they were performing a physical exercise at least one hour per week. Among 404 teachers, 13% of males and 11% of females had hypercholesterolemia. Hypertriglyceridemia was found in 12% of males and 4% of females, and hyperglycemia was found in 8% of males and 4% of females. Conclusions: The prevalence of cardiovascular risk factors among school teachers is not much different from that found in developed countries. However, population-based studies are needed to reveal the real prevalence rate in the general population in order to plan for future interventions.

CARDIOVASCULAR DISEASES (CVD) are important causes of morbidity and mortality in most industrialized nations, and are gaining importance as major diseases in developing countries as well. These diseases are responsible for one quarter of all deaths worldwide. In the United States, they are responsible for nearly one of every two deaths and their economic costs have been estimated at more than $127 billion annually.

Elevated blood pressure or blood cholesterol levels increase the risk for premature CVD morbidity and/or mortality. Other major CVD risk factors include cigarette smoking, diabetes mellitus, a low highdensity lipoprotein cholesterol level, severe obesity, male sex, and a family history of CVD.

Epidemiological data have demonstrated that individuals with fewer or lower levels of CVD risk factors are less likely to suffer a cardiovascular event. In addition, the greater the level of any single CVD risk factor, the greater the chance of incurring disease. Moreover, a combination of risk factors creates a synergistic effect further increasing risk. Conversely, reducing cardiovascular risk factors prevents death and disability from cardiovascular diseases.

In Saudi Arabia, data on mortality due to CVD are not available. However, hospital-based data provide useful information on disease pattern where circulatory diseases were marked as the leading causes of admission. Accurate population-based data on CVD risk factors are also not generally available. This study involving teachers was done in order to estimate the prevalence of risk factors in our region, since teachers resemble the middle age mainstream population of the community. The aim was to...
investigate a presumably healthy adult population for the prevalence of cardiovascular risk factors, and to discuss the potential for their prevention and control.

Materials and Methods

Setting and Population

Leddah city is one of the largest cities of the Kingdom with a population of 2.1 millions. It has a total of 620 public schools with a total number of teachers amounting to 16,300.9

Study Design

To achieve the objectives of this study a cross sectional or prevalence study design was followed.

Sample Selection and Study Subjects

A stratified random sampling technique with proportional allocation was used to select the required number of schools from each educational level (primary, intermediate and secondary) based on its size for each sex separately. From each selected school all teachers were then obtained, so as to achieve the required sample size. The latter was calculated using the following equation:

where \( a = 0.05 \), power = 80%, \( d \) (one-half of the desired 95% confidence interval) = 0.02 , with an estimated prevalence for any CVD risk factor of at least 7%. The calculated sample size was found to be 625 subjects. In order to handle any missing data, a larger sample size was aimed. Therefore, a total number of 780 teachers was selected from 33 public schools (24 male schools and 9 female schools) in the three educational levels during 1995.

Methods of Data and Specimen Collection

Using anthropometric measurements, blood pressure measurement and blood testing equipments (Reflotron!), medical students trained in interviewing skills were recruited and divided into task groups to conduct the study under the direct supervision of the authors.

Interview were conducted with the teachers, using a structured questionnaire which included information on sociodemographic factors, past medical history, physical activity and family history. Additional information on smoking habits was also obtained using a separate self administered questionnaire. The following measurements of the teachers were also taken: weight using Secal! (model 777) personal scale to the nearest 0.1 kg and height, using a standard measuring tape to the nearest 0.1 cm. Both measurements were taken without shoes and with the teacher wearing light clothes. The body mass index (BMI) \( \frac{\text{weight} \ (\text{kg})}{\text{height}^2 \ (\text{m})} \) was calculated from these measurements. Waist and hip measurements were taken in order to calculate waist/ hip ratio; blood pressure were also taken using Baumanometer! desk model. This was taken on the right arm with a standard cuff while the subject was sitting and in a relaxed position. Two separate measurements were taken and the average was recorded. This was adhered to especially if the first reading was 140/90 mmHg or above. In addition, fasting glucose, total cholesterol and triglyceride levels on a capillary blood sample were measured using Refletron!, (Boehringer Mannheim) for a subsample of the teachers who were selected randomly and were instructed to fast for 2: 14 hours.

Throughout the study, scales were calibrated at the beginning of each session and each time they were moved. Similarly, different meters were checked for accuracy of reading on a continuous basis according to the manufacturer's protocol.

For all purposes, a BMI greater than 27.2 for males or 26.9 for females indicates obesity. Furthermore, a BMI greater than 31.8 for males or 31.4 for females indicates severe obe~ity. Hypertension is defined as (I) diastolic blood pressure equal to or above 90 mmHg and (2) systolic blood pressure equal to or above 140 mmHg.11 Hyperglycemia is defined as a fasting blood glucose level of greater than 120 mg/L, hypertriglyceridemia as a fasting blood triglyceride level of greater than 200 mg/dL, and hypercholesterolemia as a fasting blood total cholesterol level of greater than 240 mg/dL.12

Data Management and Statistical Analysis

Data were entered in a database file and scrutinized for outliers and influential points. The analysis was done using SPSS statistical package. Descriptive statistics (i.e., mean, median, standard deviation, range and standard error) were performed to describe the studied variables. Since the distribution of blood glucose and triglyceride levels was skewed, medians rather than means were used. Prevalence rates for the
The mean BMI for the entire sample was 27.1±4.7. Although not significant, female teachers had higher BMI than male teachers (27.6±5.5 vs 26.9±4.5, P = 0.15) and there was a positive trend for BMI with age in both sexes.

It was found that 46.0% of males and 48.5% of females were obese. Moreover, the proportion of severely obese females was significantly greater than males (20.5% vs 13.8%, P = 0.02).

A higher proportion of males (41.0%) than females (33.2%) had a BMI of between 25 and < 30. Conversely, females had a higher proportion (31.0%) than males (24.5%) in the categories 30+. In addition, the proportions of teachers with a BMI of 30+ increased with age, reaching its peak in the age group 40 to 49 years. The results also showed that waist hip ratio increased with age, and that it was higher in males than females in all age groups (P < 0.001).

Blood Pressure

Both mean Systolic and mean diastolic blood
pressure were higher in males than in females, and increased with age in both sexes. Mean diastolic blood pressure was 81.4 mm Hg in males aged 20 to 29 years and 85.1 mm Hg in males aged 40 to 49 years; the corresponding figures for females were 73.6 mm Hg and 80.4 mm Hg, respectively. Overall, 11.8% of all teachers were considered hypertensives, with a higher prevalence among males than females (14.7% vs 4.4%, \( P < 0.001 \)). The prevalence of hypertension increased with age in both sexes and of all the hypertensive teachers, 59.5% were obese.

Smoking Status

Overall, 13.5% of the teachers were current cigarette smokers (18.1% of males and 2.2% of females), and 14.7% were ex-smokers (20.0% of males and 1.4% of females). Almost half of both current smokers and ex-smokers were in the age group 30 to 39 years. For current smokers mean number of cigarettes per day was 22.6 :\( \pm \) 11.1 (22.8 :\( \pm \) 11.2 for males vs 16.3 :\( \pm \) 6.3 for females). The mean duration of smoking was 13.2 :\( \pm \) 6.7 years.

Regarding shisha smoking, 15.3% of males were current smokers and 13.8% were ex-smokers. No female teachers were current shisha smokers and only one (0.7%) was an ex-smoker.

Physical Exercise

Overall, 47.3% of school teachers were performing a physical exercise at least one hour per week. However, the proportion of males (57.3%) was almost three times that of females (20.0%, \( P < 0.001 \)). With the exception of the last age group, these proportions decreased by age.

Family History of Cardiovascular Disease

Overall, 18.5% of teachers reported that one or both of their parents had cardiovascular disease (19.0% of males and 17.0% of females).

Blood Cholesterol, Triglyceride and Glucose Levels

Blood testing for fasting total cholesterol, triglyceride and glucose was done for 404 teachers, 290 (71.8%) males and 114 (28.2%) females. Among male teachers, the mean total cholesterol was 185.8 :\( \pm \) 49.3 mg/dL which was slightly lower than that for females (189.7 :\( \pm \) 50.9 mg/dL). For both sexes, a positive trend for cholesterol level with age was observed (\( P = 0.001 \)). The proportion of males with hypercholesterolemia was 13.4%, while in females the proportion was 10.5%. The proportion increased with age for both sexes. About 69.0% of hypercholesterolemic teachers were also obese.

Overall median triglyceride level was 87.0 mg/dL and it was significantly higher among males (95.0 mg/dL) than females (69.0 mg/dL, \( P < 0.001 \)). The proportion of males with hypertriglyceridemia was 11.5%, while in females the proportion was 4.4% (\( P = 0.04 \)). For both sexes, a positive trend with age was observed.

Overall median glucose level was 91.0 mg/dL and it was significantly higher in males (94.0 mg/dL) than in females (87.0 mg/dL, \( P < 0.001 \)). The proportion of male teachers with hyperglycemia was 8.1% while in females it was 4.3%. A positive trend with age was observed for both sexes. Of all hyperglycemic teachers, only 34.6% had a diagnosis of diabetes mellitus made by a physician. Fifty percent of those who had diabetes mellitus diagnosed by a physician also had a family history of same illness.

History of Coronary Heart Disease

Of all the teachers, only 3 (0.4%) reported that they have had angina pectoris diagnosed by a physician while only one teacher had an attack of myocardial infarction.

Discussion

Although precise data on the magnitude of cardiovascular diseases (CVD) as a public health problem in the Middle East countries is generally scarce, studies conducted on the risk factor profile and related lifestyle patterns have revealed levels generally similar to those in industrialized countries.13 Saudi Arabia has experienced significant demographic, socioeconomic and nutritional changes over the last three decades, resulting in a rise in the magnitude of CVD risk factors. Accurate population-based data on these risk factors are not generally available, however, recent studies indicate that diabetes, hypertension and hyperlipidemia are major risk factors.6

Body Mass Index (BMI), as a measure of obesity, increased with age in our sample, and indicated a general tendency for females to be more overweight than males. Obesity is a known risk factor associated with CVD and is an important factor in the development of hypertension and diabetes mellitus. It also contributes to elevation of blood lipid levels, especially in raising triglyceride and lowering HDL-cholesterol. Mean BMI values for both
male and female teachers in our study were higher than that reported by Khoja et al.4 (26.9 and 27.6 vs 24.1 and 23.3, respectively) in a similar sample of subjects with the same age range from the Western region of Saudi Arabia. In addition, mean BMI for males is similar to that reported from Riyadh city (26.0) by Mitwalli et al.18

Proportions of obese subjects found among teachers in Jeddah in this study and that from other research in other parts of Saudi Arabia6-11 are quite comparable, and should be considered alarming for the potential risk of developing CVD. Almost two thirds of our sample (65.5% of males, 64.2% of females) had a BMI of 25+, which is a similar finding to that of Binhemd et al.17 in a study of adults attending a primary health care center in Saudi Arabia. The reported proportion for adult males (62.3%) in a study from the United Kingdom (UK)19 was similar to ours, but that for adult females (44.2%) was lower. Moreover, severe obesity (BMI of 30+) was found among 25% to 31% of our sample, which is similar to that reported by Al-Shammari et al.16 but double that reported in the study from UK (12.9% of males and 13.4% of females).19 The higher proportion of marked obesity among females as compared to males observed in our study could be partly explained by the lesser practice of physical activity among females, together with other social factors. On the other hand, waist:hip ratio, as a measure of central adiposity, was higher in males than females, which is in agreement to that reported by Al-Shammari et al.16 but double that reported in the study from the UK.

This finding goes with the general trend of higher risk for CVD among males compared to females and the greater association of central obesity rather than peripheral obesity with CVD.20

High blood pressure is a well-documented major risk factor of coronary heart disease (CHD) and other atherosclerotic diseases. The higher the systolic or diastolic blood pressure, the greater the risk for CHD.21 The proportion of hypertensives in this study (11.8%) is comparable to that found by other investigators6,22 on Saudi adults and elderly, and much higher than that reported (about 3%) by Al-Nozha et al.21 in his survey in Riyadh region. However, higher proportions were reported from Egypt,6 UK19 and USA,24 which also confirm a higher prevalence among males as compared to females. It should be indicated, however, that accurate comparison between various studies should not be absolute. Differences could be attributed to several factors, including sample size, selection of subjects, ethnic distribution of the population or number of measurements made at different encounters over a period of time.23

Cigarette smoking is a major risk factor for the occurrence of CHD, stroke and peripheral vascular disease. It is known to increase risk of morbidity and mortality in both men and women and for all racial groups. It is estimated that approximately one pack of cigarettes per day doubles the CHD risk.25 The picture is more apparent in patients with hypertension, high blood cholesterol and diabetes.

The finding of a high proportion of male teachers who reported smoking at some time in their lives (38.1%) is clearly disturbing, especially if we consider their educational status and their influence on their students in advocating a healthy life. Smoking is not a socially acceptable habit among females in our society, hence a much lower proportion (3.6%) of female teachers reported smoking at some time in their lives.

Rates of current cigarette smokers in our sample among both males and females (18.1% and 2.2%) are fortunately less than those reported from other Gulf and Eastern Mediterranean countries, as well as many industrialized countries,6.2s which reported figures reaching almost 40%. Despite this finding, efforts should be continued to prevent incident occurrence of smoking among the general population and effective programs should be implemented to help reduce or stop smoking among smokers.

Shisha smoking is also prevalent among male school teachers and, although no clear epidemiological data are available to incriminate shisha smoking in increasing the risk of CVD, healthy lifestyles and habits should be encouraged in place of bad ones, especially in the educational setting.

The risk of CHD rises progressively with increases in serum total cholesterol. The effects of serum cholesterol on CHD mortality26 have a risk gradient similar to that for blood pressure. Thus, high serum cholesterol is one of the major etiologically significant risk factors for CHD and other atherosclerotic diseases.

Total serum cholesterol concentration is reported to vary considerably between populations.27 This picture was confirmed when comparing our findings with others. Mean level of total cholesterol for male teachers (185.8 mg/dL) observed in our study is in accordance with levels reported from the Western (184.1 mg/dL) and Central (189.6 mg/dL and 190 mg/dL) regions of Saudi Arabia;4.15,21 but higher than that (153.8 mg/dL) reported by Al-Nuaim et al.21 On the
other hand, the corresponding value for female teachers in our study is higher than that (161.5 mg/dL and 177.8 mg/dL) reported by Al-Nuaim et al. and Khoja et al, respectively, but lower than that (197.7 mg/dL) observed by Inam et al. Variations between our results and findings from other countries were more evident where, for instance, mean values among males and females in the United Kingdom ranged from 200 to 223 mg/dL and 192 to 235 mg/dL, respectively. Findings from other European countries were sometimes higher than those observed in UK, or lower and similar to ours as in Poland. Markedly lower levels reaching as low as 120 mg/dL were also reported in African males as in Nigeria. In many of the previously cited studies, as well as ours, mean levels increased with age.

The use of different cut-off values for defining hypercholesterolemia in the literature made it difficult to accurately compare our results with other studies. Among Saudis, total cholesterol > 260 mg/dL was found among 9.5% of 1005 family practice attendants in Riyadh; and among 3.6% of 475 male adults invited to participate in a cholesterol screening campaign at several public gatherings in Riyadh city. In Northern Europe, 41% of males and 49% of females had total cholesterol levels above 250 mg/dL. In Southern Europe, about 25% of the population exceeded this limit. In the United States, as high as 25% of the population over the age of 20 had a total cholesterol level exceeding 240 mg/dL. Our findings thus indicate a modest prevalence among school teachers, using > 240 mg/dL as a definition of hypercholesterolemia, a finding also confirmed (7% of males and 8% of females) by Al-Nuaim et al. However, it should be emphasized that coronary risk rises progressively when cholesterol levels rise above 200 mg/dL. Moreover, there is substantial evidence that lowering total and LDL-cholesterol levels will reduce the incidence of CHD. Hence, screening for serum cholesterol can be of value in detecting subjects at high risk for subsequent appropriate interventions.

Although the mean total cholesterol for female teachers was slightly higher than males, a higher proportion of males (13.4%) than females (10.5%) had a total cholesterol level > 240 mg/dL.

The levels of triglycerides among male and female teachers in our study were clearly lower than those reported (136.3 mg/dL for males and 125.4 mg/dL for females) previously from the Western region of Saudi Arabia. These differences could be explained by the fact that measurements of triglycerides are less reliable than measurement of total cholesterol due to greater biologic and analytic variability. Hypertriglyceridemia was encountered almost three times more among males (11.5%) than females (4.4%). However, elevated serum triglycerides are only positively correlated with risk for CHD in univariate analysis, but they lose some or most of their ability to associate with CHD in multivariate analysis when other lipid risk factors are added to the predictive model. Thus, patients with borderline-high and high triglycerides may have accompanying dyslipidemias that increase risk for CHD.

Diabetes mellitus (DM) and impaired glucose tolerance are well recognized risk factors for CHD. On average, the acute and late manifestations and outcomes of coronary events are more severe and more lethal in diabetics than in nondiabetic persons of the same age. On the basis of various diagnostic criteria, diabetes has been detected in 4.3%, 4.8% and 5% of Egyptian, Iraqi and Saudi Arabian samples, respectively. Using the WHO diagnostic criteria, two national surveys in Saudi Arabia reported even higher prevalences among males (11.8% and 9.5%, respectively) and females (12.8% and 6.8%, respectively). Although our study did not intend to apply the WHO criteria to diagnose DM, rates of hyperglycemia among males (8.1%) and females (4.35%), as a preliminary screening for DM, were in agreement with the general trend of DM prevalence rates observed in the cited studies. Moreover, the male and female differences were consistent with their findings.

It is estimated that half of all persons with diabetes (primarily patients with non-insulin-dependent DM) are currently unaware of their diagnosis. This picture is similar to that among teachers with hyperglycemia in our study, where only 35% already had a diagnosis of DM made by a physician. This justifies the importance of screening where the right conditions exist.

Although teachers can be considered as a selected group of the general population, the prevalence of CVD risk factors was not uncommon among both sexes and, in fact, some of these risk factors are in the intermediate risk group compared to other countries. The findings also confirm the fact that the prevalence of major CVD risk factors varies both among and within populations. However, population-based epidemiologic studies are needed to reveal the real
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prevalence rate in the general population of Saudi Arabia in order to plan adequately for future interventions.

The importance of identifying modifiable risk factors in the population such as obesity, high blood lipids, hypertension, smoking, and lack of physical exercise and their subsequent modification cannot be overemphasized. In the light of the findings from this study and others, the authors recommend routine screening in Saudi Arabia, provided effective screening strategies in identifying subjects at risk are available and intervention techniques prove viable in our society. Major modifications are required in our lifestyle through health promotion and education programs to improve diet, stop smoking and encourage good physical activity. While women are at a lower risk compared to men, it seems appropriate to target both in all CVD preventive strategies.

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