The Prevalence of Reversible Cardiovascular Risk Factors in Israelis Aged 25–55 Years

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Key words: cardiovascular disease, risk factors, dyslipidemia, smoking, obesity, hypertension, sedentary lifestyle

Abstract

Background: Coronary heart disease is a major cause of morbidity and mortality worldwide. Early detection of cardiovascular risk factors and intervention may reduce consequential morbidity and mortality.

Objectives: To assess the prevalence of reversible and treatable cardiovascular risk factors among 26,477 healthy Israeli adults: 23,339 men and 3138 women aged 25–55 years.

Methods: We collected data during routine examinations performed as part of a screening program for Israel Defense Force personnel.

Results: The three most prevalent cardiovascular risk factors were a sedentary lifestyle (64%), dyslipidemia (55.1%) and smoking (26.8%). Overall, 52.9% of the men and 48.4% of the women had two or more cardiovascular risk factors. Moreover, 52.4% of young adult men and 43.3% of young adult women, age 25–34 years, had two or more reversible cardiovascular risk factors.

Conclusions: In this expectedly healthy population there was a high prevalence of reversible and treatable cardiovascular risk factors in both genders and in young ages. These observations stress the need for routine health examinations and lifestyle modification programs even in the young healthy Israeli population.

IMAJ 2006;8:527–531

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Coronary heart disease is a leading cause for morbidity and mortality in developed countries as well as in developing countries around the world. Since the early 1960s and particularly following the Framingham study in the late 1970s, risk factors for atherosclerosis and CHD have been thoroughly investigated [1]. Several cardiovascular risk factors are non-modifiable, such as advanced age, family history of CHD, and male gender. Other cardiovascular risk factors are subject to intervention, e.g., diabetes mellitus, dyslipidemia, essential hypertension, lack of physical activity, obesity and smoking. It is well established that early management of these cardiovascular risk factors by lifestyle modifications and/or pharmacological intervention results in a significant reduction in cardiovascular morbidity and mortality. This underscores the importance of early detection of individuals with reversible and treatable cardiovascular risk factors [2-7]. Since CHD has become ever more prevalent worldwide, and in view of the rising cost of healthcare, especially advanced CHD healthcare, even a mild reduction in morbidity and mortality that accompanies CHD may result in saving many lives and reducing the burden on healthcare resources.

In this study we evaluated the prevalence of reversible and treatable cardiovascular risk factors in a large population of healthy Israeli adults by collecting data on subjects during routine periodic medical examinations at the Israel Defense Force Staff Periodic Examination Center for 7 years.

Patients and Methods

All IDF personnel aged 25 years and older undergo a routine medical examination every 3–5 years at this Center. Each examinee completes a detailed computerized questionnaire that includes questions on medical history, current symptoms, smoking, and physical activity. Blood samples for glucose levels and lipid profile are drawn first thing in the morning following a 14 hour fast. A complete physical examination is performed, including height and weight measurements. Finally, a detailed medical summary is mailed to the subjects as well as to their primary care physician with relevant findings and recommendations. The summary focuses on preventing and treating cardiovascular risk factors. Primary care physicians inform their patients of the medical findings, discuss cardiovascular risk factors with them, and implement the recommendations set forth in the medical summary.

Cardiovascular risk factors

We studied six amenable cardiovascular risk factors: current smoking, diabetes mellitus, dyslipidemia, essential hypertension, obesity, and sedentary lifestyle. The diagnosis of diabetes mellitus and pre-diabetes was consistent with the guidelines of the American Diabetic Association. Diabetic subjects were those with fasting plasma glucose levels of 126 mg/dl or higher, or those taking hypoglycemic agents. Pre-diabetic subiects were those with FPG levels between 100 and 125 mg/dl [8]. The diagnosis of dyslipidemia was consistent with the third report of the expert panel on detection, evaluation and treatment of high blood cholesterol in adults

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CHD = coronary heart disease

IDF = Israel Defense Force
FPG = fasting plasma glucose

(ATP III). Dyslipidemic subjects were defined as having at least one of the following: total cholesterol levels ≥ 240 mg/dl, low density lipoprotein-cholesterol ≤ 160 mg/dl, high density lipoprotein-cholesterol ≤ 40 mg/dl in men, HDL-cholesterol ≤ 50 mg/dl in women, and triglyceride ≥150 mg/dl [9]. FPG and cholesterol were measured with a BM/Hitachi 917 machine (Boehringer Mannheim GmbH, Germany). The diagnosis of essential hypertension was consistent with the seventh report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC 7). Hypertensive examinees were defined as having systolic blood pressure ≥ 140 mmHg and/or a diastolic BP ≥ 90 mmHg repeatedly, or subjects who were taking anti-hypertensive agents [10]. Physical activity and smoking habits were self-reported. A sedentary lifestyle was defined as less than 60 minutes of aerobic activity per week. Current smoking was defined as smoking one or more cigarettes, cigars or pipe tobacco, in the last 3 months [11]. Body mass index was calculated as weight/height squared (kg/m^2). Normal weight was defined as BMI ≤ 24.9 kg/m^2. Overweight was defined as BMI between 25 and 29.9 kg/m^2. Obesity was defined as BMI ≤ 30 kg/m^2 [12]. The prevalence of the metabolic syndrome was also studied. The diagnosis of the metabolic syndrome was consistent with the definition set by the U.S. National Heart Lung and Blood Institute and the American Heart Association. Subjects with metabolic syndrome were defined as having at least three of the following: men with HDL-cholesterol levels ≤ 40 mg/dl, women with HDL-cholesterol ≤ 50 mg/dl, triglyceride ≥ 150 mg/dl for both men and women, blood pressure ≥ 130/85 mmHg for both men and women, and FPG levels ≥ 100 mg/dl for both men and women. Since waist circumference was not measured in the Staff Periodic Examination Center, we used BMI ≥ 25 kg/m^2 instead [13].

Statistical analysis

Continuous variables such as age, BMI, cholesterol levels, FPG levels, diastolic BP and systolic BP were expressed for the population as well as separately for men and for women, as mean ± standard deviation. The prevalence of cardiovascular risk factors was also presented. Student's *t*-test was used to compare the differences between continuous variables in men and in women. Chi-square test was used to compare the differences between the prevalence of cardiovascular risk factors in men and in women. The population was divided to three age groups: young adults (25–34 years), adults (35–44 years) and young middle-aged subjects (45–55 years). Chi-square test was used to compare the differences between the prevalence of cardiovascular risk factors in different age groups. Statistical significance was considered as $P < 0.05$. All analyses were done using SAS software, version 8 (SAS institute Inc., Cary, NC, USA).

Results

A total of 29,807 subjects underwent a health check at the Staff Periodic Examination Center between January 1997 and December 2003. Overall, 3330 subjects – 2919 men and 411 women – with incomplete data of any type were excluded. The population distribution by age group and gender is illustrated in Table 1. Overall, 26,477 examinees, mean age 34.6 ± 7.3, were included in this survey: 23,339 men (88.1%) and 3138 women (11.9%). Most (89.4%) were young adults (age 25–34) and adults (age 25–44). The vast majority of the population was healthy in terms of cardiovascular morbidity: only 83 men (0.3%) and 2 women (0.06%) had CHD.

All the differences between men and women in terms of mean BMI, mean systolic BP, mean diastolic BP, mean FPG, mean LDL-cholesterol and mean triglyceride levels were statistically significant ($P < 0.0001$): men were heavier than women, had higher blood pressure, higher FPG, higher triglyceride, higher LDL-cholesterol and higher total cholesterol compared with women. Women had higher HDL-cholesterol compared with men [Table 2]. The prevalence of all cardiovascular risk factors, except for sedentary lifestyle, was significantly higher among men than among women ($P < 0.0001$); sedentary lifestyle was more prevalent among women ($P < 0.0001$), as illustrated in Table 2.

Body mass index

Only 49.6% of all subjects had normal weight (BMI ≤ 24.9 kg/m^2), while 18% were obese (BMI > 30 kg/m^2). The prevalence of obesity was higher in men independent of age, and related with age

Table 1. Number of participants by gender and age group

Age (yrs)	No. of men (%)	No. of women (%)	Total (%)
25–34	11,549 (49.5)	1633 (52.0)	13,182 (49.7)
35–44	9220 (39.5)	1291 (41.1)	10,511 (39.7)
45–55	2570 (11.0)	214 (6.8)	2784 (10.5)
Total	23,339	3138	26,477

Table 2. Physical findings, laboratory findings and the prevalence of cardiovascular risk factors by gender

	Men (n=23,339)	Women (n=3138)	Total (n=26,477)
Age (yrs)	34.7 ± 7.1	34.1 ± 6.5	34.6 ± 7.3
Physical findings			
BMI (kg/m^2)	26.2 ± 4.1	24.3 ± 4.7	25.9 ± 4.2
Systolic BP (mmHg)	117.2 ± 13.0	108.6 ± 12.7	116.1 ± 13.2
Diastolic BP (mmHg)	75.5 ± 9.9	70.4 ± 9.5	74.9 ± 10.1
Laboratory findings			
FPG (mg/dl)	92.1 ± 17.9	86.9 ± 13.3	91.5 ± 17.5
LDL-C (mg/dl)	128.0 ± 35.2	120.8 ± 32.6	127.1 ± 35.0
HDL-C (mg/dl)	44.5 ± 10.8	58.2 ± 14.6	46.1 ± 12.2
Triglycerides (mg/dl)	136.0 ± 92.0	101.7 ± 57.2	131.9 ± 89.2
Prevalence of cardiovascular risk factors			
Smoking	27.4%	22.1%	26.8%
Essential hypertension	4.5%	2.7%	4.3%
Diabetes mellitus	1.5%	0.5%	1.3%
Dyslipidemia	56.4%	45.3%	55.1%
Obesity	13.9%	10.2%	13.5%
Sedentary lifestyle	63.2%	69.5%	64.0%

HDL = high density lipoprotein
BMI = body mass index
LDL = low density lipoprotein

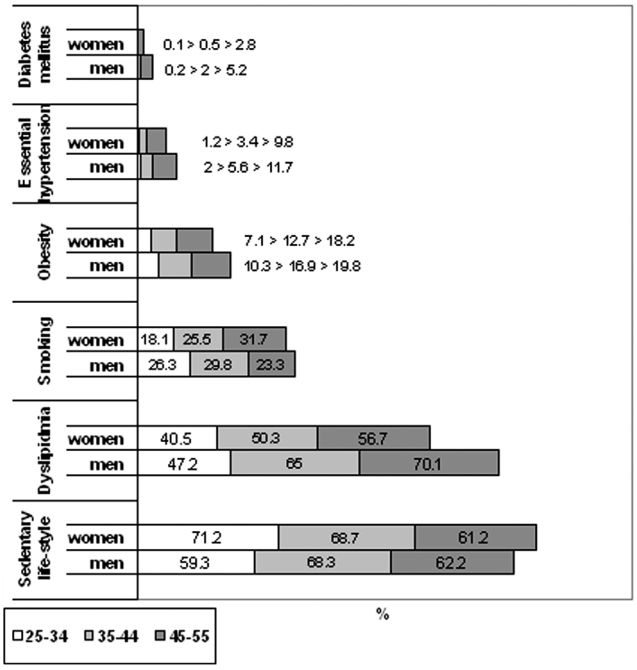

Figure 1. Prevalence of cardiovascular risk factors by gender and age group

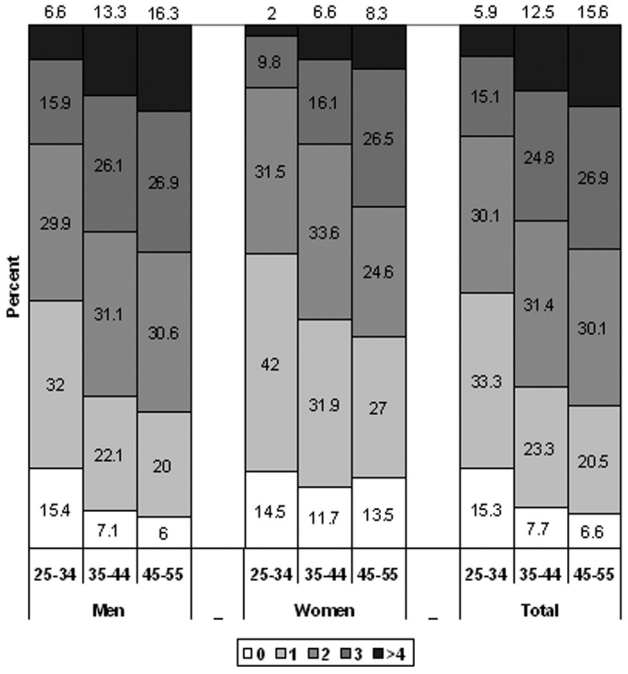

Figure 2. Distribution of participants by gender, age group and number of cardiovascular risk factors

in both genders [Figure 1]. Most men (81.2%) and most women (69.8%) did not watch their weight during the study.

Diabetes mellitus

The prevalence of diabetes mellitus was 1.3% among all subjects [Table 2]. The prevalence of diabetes mellitus was three times higher in men than in women (1.5% vs. 0.5%, $P < 0.0001$), and increased with age in both genders [Figure 1]. Most diabetics (52.5%) used oral hypoglycemic agents. Only 35.3% of all diabetics had FPG levels lower than 126 mg/dl during the study. The prevalence of pre-diabetes was 12.4% in the entire study population: 13.3% among men and 5.7% among women.

Dyslipidemia

More than half the subjects (55.1%) had dyslipidemia. The prevalence of dyslipidemia was higher in men than in women (56.4% vs. 45.3%, $P < 0.0001$), and increased with age in both genders. The prevalence of dyslipidemia in subjects aged 25–34 years was 40.5% among women and 47.2% among men [Figure 1]. While LDL-cholesterol and triglyceride were higher among men, HDL-cholesterol levels were higher among women [Table 2].

Essential hypertension

The prevalence of essential hypertension was 4.3% in all subjects [Table 2]. Overall, it was twice as high in men than in women (4.5% vs. 2.7%, $P < 0.0001$). An increase in the prevalence of essential hypertension with age was demonstrated in both genders [Figure 1]. Most hypertensive subjects, 86.5% of men and 81% of women, were taking anti-hypertensive agents.

Sedentary lifestyle

Almost two-thirds (64%) of all subjects did not exercise regularly [Table 2]. Women exercised less than men (63.2% vs. 69.5%, $P < 0.0001$), although a pattern of increase in exercising with age was observed in women but not in men [Figure 1]. Obese women exercised less than normal-weight women (67% vs.78.9%, $P < 0.0001$), and obese men exercised less than normal-weight men (59.2% vs. 72.7%, $P < 0.0001$).

Smoking

One of every four subjects (26.8%) reported smoking – mostly 20 cigarettes or less per day (77.6%) for more than 10 years (59.4%). Overall, 697 subjects (2.6%) smoked cigars or pipe tobacco, and men smoked more than women (27.4% vs. 22.1%, $P < 0.0001$). The prevalence of smoking among men increased with age until the age of 44 and decreased after age 45. Almost one of three women (31.7%) and four men (23.3%) smoked cigarettes after age 45 [Figure 1]. The prevalence of smoking was higher among men less than 44 years old compared with women in the same age group, and was higher among women 45 years or older compared with men of the same age.

Number of cardiovascular risk factors

Only 11.3% of men and 13.3% of women had no reversible cardiovascular risk factors. Moreover, 52.4% of young adult men and 43.3% of young adult women, age 25–34, had two or more reversible cardiovascular risk factors [Figure 2].

Association between cardiovascular risk factors

An association between BMI and systolic BP was found in both genders ($r = 0.3$ in men, $r = 0.33$ in women, $P < 0.0001$ in both

genders), as well as between BMI and diastolic BP (r = 0.28 in men, r = 0.32 in women, $P < 0.0001$ in both genders). Obese men had a higher prevalence of essential hypertension compared with normal-weight men (11.08% vs. 1.81%, $P < 0.0001$). Similarly, obese women had a higher prevalence of essential hypertension compared with normal-weight women (8.63% vs. 1.48%, $P < 0.0001$). A correlation was also found between BMI and FPG levels in both genders (r = 0.18 in men, r = 0.25 in women, $P <$ 0.0001 in both genders). Finally, the prevalence of the metabolic syndrome was 23% in the whole population: 25.1% among men and 7.6% among women.

Discussion

Most examinees at the Staff Periodic Examination Center were young healthy adults; only 10.5% of all subjects were over 45, and only 85 (0.36%) had CHD. Nevertheless, the prevalence of cardiovascular risk factors was high in both men and women of all ages, as well as in young adults, age 25–34.

Israeli Arabs, ultra-Orthodox Jews, and the unemployed were not included in this population cross-section. In these populations the prevalence of cardiovascular risk factors may be different. For example, Israeli Arabs are less physically active than Israeli Jews [14], and Israeli Arab men smoke more than Israeli Jewish men [15]. Nevertheless, this study probably represents the majority of the Israeli people, since it includes apparently healthy non-ultra-Orthodox employed Jewish adults.

Sedentary lifestyle is a well-known independent cardiovascular risk factor [11]. Almost two-thirds of all subjects in this study did not exercise regularly; obese subjects exercised even less. Interestingly, more women than men exercised regularly as they became older. We ascribe this phenomenon to the fact that many young women have little time to exercise regularly due to a dual career – being mothers and career women. We hypothesize that these women exercise more as their maternal responsibilities decrease.

The high prevalence of dyslipidemia in this study (55.1%) is probably an underestimation since we did not adjust an individual threshold of LDL level for every examinee according to the number of cardiovascular risk factors. While the high prevalence of dyslipidemia in young adults (age 25–34) calls for an earlier screening for dyslipidemia, the high prevalence of dyslipidemia in the whole population calls for reevaluation of the army's diet and for the establishment of a metabolic clinic in the IDF.

The prevalence of smoking in this study, 27.4% in men and 22.1% in women, was similar to that in the United States [16]. The high prevalence of smoking is of tremendous importance since about 30% of cardiovascular deaths are related to this habit [17]. Of note, 697 subjects smoked pipe tobacco or cigars. This is also significant because, contrary to common belief, smoking cigars and pipe tobacco, just like cigarette smoking, increases the risk for CHD [18].

Obesity is a common health problem worldwide, particularly in developed countries. The prevalence of obesity in the U.S. almost doubled from 17.9% to 30.5% between the early 1960s and the early 1990s [19]. The overall prevalence of obesity in our study was 13.5%. The mean BMI in our population was 25.9 ± 4.2 kg/m^2, which was lower than the mean BMI among healthy executives in Israel [20]. The high BMI found in our study is of immense importance since the risk for cardiovascular morbidity increases at a BMI of 25 kg/m^2 or higher [21]. Obese subjects of both genders had significantly higher FPG levels and essential hypertension compared with normal-weight subjects. Indeed, obesity, and mainly central obesity, has an adverse effect on blood pressure and glucose intolerance [13]. In addition to the high prevalence of obesity in the U.S., 6% of all Americans suffer from diabetes mellitus [22]. Although the prevalence of obesity in our study was quite high, the prevalence of diabetes mellitus was relatively low: only 1.3%. This was probably due to the fact that most of the subjects were young; unfortunately, some of the obese subjects might develop diabetes mellitus in the future.

The prevalence of essential hypertension in our study was lower compared to previous data [23], probably because most of the subjects (89.4%) were 44 years and younger. This was also likely due to the fact that we did not follow those with a single high blood pressure measurement. Instead we asked their primary care physicians to continue the follow-up. Some of these subjects probably suffered also from essential hypertension.

In summary, we report the prevalence of preventable and treatable cardiovascular risk factors in a relatively young population. Although this population was expectedly healthy, we found a high prevalence of cardiovascular risk factors in both genders and even in the youngest age group. These observations emphasize the need for routine health examinations and lifestyle modification – even in young healthy populations – in order to decrease cardiovascular morbidity and mortality in the future.

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