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Prevalence of risk factors to coronary heart disease in an Arab–American population in Southeast Michigan

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Although significant advances have been made in the area of cardiovascular disease, few studies have targeted ethnic groups. There is a large and growing Arab–American (AA) population living in Southeast Michigan, whose risk of cardiovascular disease may be on the increase. The objective of this study was to evaluate the prevalence of cardiovascular disease risk factors and associated behavioral factors in an AA community with a large population of emigrants, subjected to significant lifestyle changes. Three hundred and fifty-two AA living in Southeast Michigan, mostly from the Middle East, were screened to determine their eating and smoking habits, body mass index (BMI) body fat analysis, blood pressure, and complete lipid profiling. Overweight was defined as a BMI greater than or equal to the 85th percentile value for age- and sex-specific reference data from the third National Health and Nutrition Examination Survey (NHANES III). Correlation analysis was used to examine factors associated with being overweight, with adjustment for age and sex. Blood cholesterol concentrations were compared with published data for Arabs from the Middle Eastern countries. The overall prevalence of being overweight in subjects aged 35 and older was significantly higher than NHANES III reference data (Men, 27.7% (95% confidence interval, 21.8–34.5); women, 33.7% (95% confidence interval, 27.9–40.1)). A mean cholesterol concentration of 210 ± 4 mg/dl was observed in those over the age of 40. The mean high-density lipoprotein (HDL)-cholesterol levels for men and women were 38 and 48 mg/dl, respectively. Greater than 54.6% of all subjects had a total cholesterol:HDL ratio >4.5. Although being overweight and obesity were prevalent in this population, the mean BMI for men was 25.7 ± 0.34, compared with 27 ± 0.58 for women. Increased BMI was significantly correlated ($P < 0.01$) with increased blood pressure, increased glucose levels, increased total cholesterol and decreased HDL-cholesterol levels ($P < 0.01$). Elevation in risk factors to cardivoascular disease is prevalent in this population and indicates a need for programs targeting primary prevention of obesity in men and women. These results, which could be attributed in part to lifestyle changes typical of most emigrant populations, suggest an increase in the risk for developing cardiovascular disease. In addition, this study provides a basis for future intervention to improve the health of this population.

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Introduction

Current estimates suggest that more than 58 million US residents have some form of cardiovascular disease (CVD) and that CVD claims the life of more than 960,000 Americans every year (National Center for Health Statistics, 2001). Although CVD continues to be the leading cause of death in the US, a decline in the incidence of CVD during the past 30 years has been observed. To further prevent this disesase, many strategies have been suggested, and the one proven to be the most effective takes into consideration many of the risk factors associated with the disease (Keaven, 1990). Thus, the Framingham Heart studies have been the catalyst in the study of CVD and its risk factors (Levy & Kannel, 1988). However, until recently, few studies have investigated the risk of CVD among ethnic populations, particularly those who are recent immigrants to the US.

One such immigrant population is Arab–Americans (AA). There is a large and growing population of AA living in Southeastern Michigan, particularly in or around metropolitan Detroit. Many are recent immigrants or first-generation offspring of Arabs who migrated predominantly from the Middle East to the US within the past 10–30 years. Published data regarding the prevalence of CVD in the AA in Michigan in particular, and the US in general, are not available. Existing studies about this population are limited to the Middle East and Gulf countries that are native to many. Such data suggest that, because of increasing adoption of western life styles by Arab communities from Kuwait, Saudi Arabia and Bahrain, the incidences of being overweight, obesity, lack of physical activity, diabetes, hypertension, and the prevalence of high blood cholesterol and its association with other risk factors for CVD were on the increase (Agrwal *et al.*, 1995; Al-Isa, 1997; Al-Nuaim *et al.*, 1996). Accordingly, the combination of all these factors increases the risk for CVD (Musaiger & Al-Roomi, 1997) even in their native countries.

Thus, the large and significant AA population living in Southeast Michigan may also be at risk for developing CVD as a consequence of differences in lifestyles adopted in their new homes in the US. A cross-section of the population studied could trace their recent roots to the Middle-Eastern countries of Syria, Kuwait, Saudi Arabia, Bahrain, United Arab Emirates, Iraq, Yemen, Jordan, and Lebanon. The main objective of this study, therefore, was to determine the prevalence of CVD risk factors in this population. The results obtained suggest that although risk factors to CVD are generally lower than in the general American population, they are on the rise and are likely to catch up with the general population if steps are not taken to modify their lifestyle to a more health conscious one. Data from this study has appeared previously in abstract form (Hatahet & Fungwe, 1999).

Materials and methods

Subjects

The AA population in Southeast Michigan is the largest in the US, and exceeds >200,000 people. Most AA living in this area trace their ancestry back to countries in the Middle East (i.e. Kuwait, Saudi Arabia, Bahrain, United Arab Emirates, Iraq, Yemen, Jordan, Syria and Lebanon). This population has been growing at a very fast rate, with the City of Dearborn having the highest concentration of AA. The Arab Community Center for Economic and Social Services (ACCESS) overseas issues related to health and provides health care primarily through ACCESS clinics and other private practices in the area. The study participants consisted of 352 free-living males and females who were informed about the free health screening through Arabic and English radio announcements.

Measurements and data collection

Demographic questionnaire. All participants signed a consent from approved by the Human Investigation Committee of Wayne State University. Participants were asked to fill a socio-demographic questionnaire, which included questions relevant to their diet and health. The questionnaire was modified to accommodate some of the known social and cultural preferences of AA. Food groups listed on the questionnaire included items that are regularly consumed by this community and replaced items that are not part of the daily food intake (e.g. lamb instead of pork, yogurt as the main dairy item, etc.). The validity of this questionnaire has been tested and found to be comparable with a detailed food record in identifying people of different ethnic background, with high or low fat intake (Kristal *et al.*, 1997). In addition to the dietary section, the questionnaire included questions that elicited information about age, education and socioeconomic status, weight management, tobacco and alcohol use, and physical activity. Some questions were translated into Arabic during the course of interview for participants, who had little English background.

Body fat and body mass index measurements. Height was measured without shoes (to the nearest 0.1 inch) and body weight recorded. The Tanita Body Fat analyzer (Tanita Corporation, Skokie, IL, USA) was used to obtain body weight, body mass index (BMI) (after entering the height for each subject), and to obtain percent body fat. This instrument uses a four-electrode foot to foot, 50 kHz, 800 μAMP (AC only) bioimpedence analysis (BIA) technique. The validity of this instrument has been assessed by Rubiano *et al.* (1999), who noted that the mean percent fat estimates by Tanita BIA and dual-energy X-ray obsorptiometry (DXA) were not significantly different. Linear regression demonstrated a high correlation between Tanita BIA and DXA fat estimates ($r = 0.90$, $P < 0.001$).

Hypertension measurements. Subjects were seated and adult cuffs were used to assess the brachial artery blood pressure. Systolic and diastolic blood pressures were measured. Hypertension was defined as blood pressure that exceeded 140/90 mg/Hg.

Blood lipid and glucose measurements. The Cholestech L.D.X (Cholestech Corporation, Hayward, CA, USA) analyzer was used to determine total cholesterol (TC), high-density lipoprotein (HDL)-cholesterol, low-density lipoprotein (LDL)-cholesterol, triglyceride (TG) and glucose levels from blood obtained by the finger prick method. TC, HDL, TG and glucose results from this instrument have been compared with validated methods (Cobbaert *et al.*, 1994; Issa *et al.*, 1996; Brad *et al.*, 1997) According to the manufacturer, correlations between the venous and finger prick samples were 0.985 for TC, 0.977, for HDL-cholesterol 0.99 for glucose, respectively. The Cholestech L.D.X instrument utilizes two types of cartridges: one is designed for fasting blood samples from which TC, HDL-cholesterol, glucose, LDL-cholesterol, very LDL-cholesterol, and TG can be measured; and the other is a 'non-fasting' cartridge designed to measure total cholesterol, HDL-cholesterol, and glucose only. The former was used only if the fasting state could be determined with certainty. The 200 mg/dl cut-off for cholesterol concentration was used as borderline high in accordance with American Heart Association (2001) guidelines. A blood glucose cut-off of 140 mg/dl was used considering the fact that most patients were 2 h postprandial.

Statistical analysis

All data collected were entered directly onto a standardized recording form using Excel 5.0 (Microsoft, Redmond, WA, USA) and later exported to SPSS 9.0 (SPSS Inc., Chicago, IL, USA) for analysis. A descriptive analysis that included means, percentages, and correlation was conducted. The association between age and sex, and between diabetes, BMI, smoking, hypertension and blood lipid parameters were examined using correlation analysis. In addition, the relationship between cholesterol and fat intake was examined using regression analysis.

Results

Among the 352 subjects participating in the study, 94.3% considered themselves AA and 5.7% categorized themselves under non-Arabs (Table 1). Males constituted 58.4% of the total sample population, compared with females constituting 41.6%. The age distribution of the total sample population was: 30 years and younger, 37.7%; 31–40 years, 28.7%; 41–50 years, 16.8%; 51–60 years, 11.3%; and 61–70 years, 5.5% (Table 2). Only two males and one female above age 71 participated in this study. When split by genders, 34.2% of the males were under the age of 30, compared with 42.7% of the females. For the ages 31–40, 26.7% were males and 29.4% were females, respectively. Males in the age group 41–50 years comprised 15.8% of the total male population, and females constituted 18.2%. Among subjects in the age

Table 1. Background and income of research participants

Subjects Race	*Frequency*	*Percent*
Arab*	332	94.3
Others**	20	5.7
Total	352	100
Income		
< $10,000	147	51.9
$10,000–15,000	61	21.6
$15,000–20,000	25	8.8
$20,000–25,000	20	7.1
> $25,000	30	10.6
Total	283	100

*Participants with Middle Eastern heritage.
**Participants identifying themselves as non-Arabs.

Table 2. Participant distribution (%) by age and gender

	Frequency		
Age group	*Males*	*Females*	*Percent of Total*
≤30 years	69	61	37.7
31–40 years	54	42	27.8
41–50 years	32	26	16.8
51–60 years	28	11	11.3
61–70 years	17	2	5.5

range 51–60 years, males and females were 13.9% and 7.7% of the total sample population, respectively (Table 2). Fewer subjects of the age range 61–70 years participated in the study, but among those participating 8.4% were male and only 1.4% were female.

Although some participants declined some measurements or refused to respond to some questions, cooperation among participants was higher than anticipated (>95%). Many participants were hesitant in responding to questions about household income, until they were assured that all the information would be confidential. The questions were aimed at assessing the financial status of families and individuals as an index to healthy lifestyle. According to the results obtained, most of the families had only one source of income, while others were dependent on government welfare programs. About 80% of participants responded to questions about income. Of those, 41.8% reported incomes below $10,000, 17% reported incomes of $10,000–$15,000, 5.7% reported incomes of $20,000–$25,000, and 8.5% of the total sample population reported incomes in excess of $25,000 (Table 1).

Smoking was not prevalent in this sample population. Of the 309 subjects who responded to questions about smoking, only 18.8% identified themselves as current smokers. Even though more men than women reported smoking, women constituted 44.6% of those currently smoking. Female smokers were even higher in the age group 51–60 years, consisting of 57.1% of the current smokers in that age group. Overall, smoking was less common in the older age group (61–70 years), who made up only 6.7% of all current smokers. This was followed by the age group 30 years and under, who comprised 10.7% of all smokers. Smoking was prevalent in other age groups constituting 24.1%, 26.4%, and 22.6% for the age groups ranging from 31–40, 41–50, and 51–60 years, respectively (Table 4).

BMI was assessed in 92.2% of all participants who participated in the study. Of those measured, 7.8% were categorized as athletes because they exercised regularly or more than three times a week, for 30 min or more. On average, the mean BMI for women were higher than men in all age groups with the exception of men 41–50 years of age. Women in the age group 61–70 years had a mean BMI that was almost 8 kg/m^2 higher than that for the men of the same age group (Table 3). Being overweight was common among all age groups, including the younger age group (30 years and under) who had an overweight prevalence of 37.9%. The prevalence of being overweight among other age groups was 60.9% for those aged 31–40, 67.9% of those aged 41–50, 73.3% of those aged 51–60, and 68.4% for those 61–70 years of age, respectively. The tendency to be overweight was not evenly distributed among genders. While participants 31–40 years old had almost the same overweight ratio in both men and women, more men (74.2%) were overweight in the 41–50 year age group compared with 60% of the women in the same age group. An exact opposite observation was made in the age group 51–60 years. In this subpopulation, 90% of the women were overweight or obese compared with 67.9% of the men of the same age. The lowest incidence of being overweight was observed in those 30 years or younger,

Table 3. Comparison of risk factors for cardiorascular disease between males and females

	Gender	n	*Age by decade* ≤ 30 years	31–40 years	41–50 years	51–60 years	61–70 years
Body mass index	Male	190	23.37 ± 0.65	26.44 ± 0.63	26.5 ± 0.66	27.67 ± 0.91	26.05 ± 0.75
	Female	134	25.76 ± 0.99	27.15 ± 1.11	26.79 ± 1.12	30.88 ± 1.68	33.85 ± 0.35
Fat(%)	Male	197	19.26 ± 2.02	21.12 ± 0.93	22.96 ± 1.13	22.00 ± 1.55	21.18 ± 1.19
	Female	141	34.88 ± 1.70	39.07 ± 1.60	35.66 ± 2.06	45.00 ± 6.40	47.20 ± 1.90
Total cholesterol (mg/dl)	Male	200	171.42 ± 4.37	190.24 ± 4.61	213.31 ± 5.98	215.54 ± 8.60	213.00 ± 11.4
	Female	140	171.54 ± 4.53	193.15 ± 6.22	203.60 ± 7.98	194.64 ± 14.2	227.50 ± 11.5
HDL (mg/dl)	Male	195	39.51 ± 1.29	36.26 ± 1.44	37.68 ± 1.71	36.69 ± 1.59	39.18 ± 2.52
	Female	139	49.95 ± 2.03	45.00 ± 1.97	50.50 ± 3.86	45.73 ± 6.72	52.50 ± 13.5
Total cholesterol/HDL (mg/dl)	Male	194	4.72 ± 0.23	5.46 ± 0.20	6.00 ± 0.32	5.88 ± 0.28	5.71 ± 0.43
	Female	136	3.83 ± 0.19	4.72 ± 0.26	5.07 ± 0.69	5.14 ± 0.78	4.70 ± 1.4
LDL (mg/dl)	Male	65	97.11 ± 9.88	122.70 ± 8.62	133.40 ± 10.19	134.44 ± 7.12	131.22 ± 13.08
	Female	32	107.18 ± 10.38	112.22 ± 10.98	100.17 ± 7.39	123.25 ± 13.10	ND
VLDL (mg/dl)	Male	65	24.00 ± 3.22	33.71 ± 4.62	29.27 ± 4.86	28.78 ± 2.33	28.33 ± 4.34
	Female	32	27.27 ± 2.91	26.25 ± 3.46	46.14 ± 17.01	32.50 ± 5.68	ND
Triglyceride (mg/dl)	Male	68	119.78 ± 16.14	192.78 ± 31.73	145.64 ± 24.39	202.09 ± 40.54	142.67 ± 21.66
	Female	32	138.36 ± 13.72	131.75 ± 17.30	116.83 ± 28.59	212.80 ± 55.63	ND
Glucose (mg/dl)	Male	198	101.12 ± 2.11	104.78 ± 3.40	123.67 ± 10.88	134.6 ± 11.52	137.41 ± 9.12
	Female	138	103.87 ± 3.36	104.41 ± 3.59	113.54 ± 9.36	129.09 ± 15.28	235.50 ± 131.9
Systolic BP	Male	194	113.61 ± 1.96	119.70 ± 1.84	124.37 ± 3.02	127.82 ± 4.30	133.06 ± 3.82
	Female	129	104.40 ± 1.64	112.13 ± 2.38	116.64 ± 2.84	141.10 ± 8.37	157.50 ± 5.50
Diastolic BP	Male	194	60.35 ± 1.69	67.60 ± 1.63	72.62 ± 1.82	70.18 ± 2.63	69.59 ± 2.34
	Female	129	57.68 ± 1.49	64.68 ± 1.98	69.80 ± 2.10	73.60 ± 3.98	81.50 ± 2.50
Fat score	Male	180	25.74 ± 1.56	19.90 ± 1.46	16.87 ± 1.44	13.22 ± 2.10	13.25 ± 1.41
	Female	135	23.16 ± 1.25	20.66 ± 1.51	18.08 ± 2.18	20.82 ± 3.16	9.50 ± 3.50
Vegetable score	Male	183	13.08 ± 0.80	14.33 ± 0.88	13.77 ± 1.18	13.24 ± 1.01	14.44 ± 1.70
	Female	136	13.53 ± 0.80	13.89 ± 0.89	13.52 ± 1.17	13.91 ± 2.17	12.50 ± 1.50

HDL, High-density lipoprotein; LDL, low-density upoprotein; VLDL, very low-density lipoprotein; BP, blood pressure; ND, not determined.

recording 35% for men and 41% for women (Table 3). Overall, the BMI increased with age for both men and women as expected; however, a slight decline in mean BMI was recorded for men in the age group 61–70 years. As expected with age, overweight rates were the highest for women who are 51 years of age and over (Table 4), with mean BMI exceeding 30 kg/m^2, which in fact put this group in the obese category (Table 3).

Serum cholesterol levels were measured for all subjects and the results are also summarized in Table 3. Mean total cholesterol concentrations were 193 ± 2, and 186 ± 2 mg/dl for men and women, respectively. Approximately 40% of all male participants had TC >200 mg/dl, compared with 38% for females. The distribution of total cholesterol by age and gender showed that males who were 51–60 years of age had the highest (71.5%) cholesterol levels in excess of 200 mg/dl. Of males in the age range 41–50 years, 59.4% had TC >200 mg/dl. Similarly, in females, 60% of those aged 51–60 and 56.6% of the age group 41–50 years had cholesterol concentrations over 200 mg/dl. Subjects in the younger age group <30 years had normal cholesterol concentrations (<200 mg/dl). Only 16.4% of males and 24.65% of the females in this age group had total cholesterol concentration >200 mg/dl (Table 4).

Even though serum cholesterol concentrations were not as elevated as seen in the normal US population, the TC/HDL-cholesterol ratios (presently used as an index of risk when greater than 4.5) were higher in more than 50% of the subjects screened. Of those with a TC/HDL-cholesterol ratio higher than 4.5, 22.2% were 30 years or younger, 33.3% were in the 31–40 age,

Table 4. Percent of participants who are smokers, are overweight or those with total cholesterol (TC)/high-density lipoprotein (HDL) >4.5

	Gender	*n*	Age by decade					Total %
			≤30 years	31–40 years	41–50 years	51–60 years	61–70 years	
Smokers	Male	162	13	23.9	29.6	13.6	7.7	18.52
	Female	136	8.6	24.4	23.1	44.4	0	18.38
Overweight	Male	190	40	61.5	74.2	67.9	64.7	57.9
	Female	134	41.1	60	60	90	100	55.2
TC >200 mg/dl	Male	200	17.4	37	59.4	71.4	52.9	40.4
	Female	140	24.6	37.5	71.4	60	45.5	38.25
TC/HDL >4.5	Male	194	40	75.5	77.4	92.3	70.6	65.5
	Female	136	23.3	51.3	43.5	63.6	50	39

18.9% in the 41–50 age, 17.25% in the 51–60 age, and 7.2% in the 61–70 age group. Males on average had higher TC/HDL-cholesterol ratios than females. In fact, 65.5% of the males had a TC/HDL-cholesterol >4.5 compared with 39% of the females. It was observed that TC/HDL-cholesterol ratios greater than 4.5 were not only prevalent in males, but the number of individuals within subgroups increased with age and in the following order: ages 61–70 > 51–60 > 41–50 > 31–40 > 30 or younger. Thus, the percent representation for each age group was 92.3%, 77.4%, 70.6%, 66.7% and 65% for the respective age groupings (Table 4).

The elevated TC/HDL-cholesterol ratios observed in males were due, in part, to lower concentrations of HDL-cholesterol. Males had a mean total HDL-cholesterol concentration that was, on average, 10 mg/dl lower than those for women of the same age group. Mean serum HDL for both men and women were lowest for age groups 31–40 and 51–60 years compared with all other age groups (Table 3).

Serum TG levels obtained from fasting subjects are also summarized in Table 3. Men and women aged 51–60 years had mean TG levels of greater than 200 mg/dl. All other age groups had mean TG levels <200 mg/dl.

Three hundred and forty subjects were screened for serum glucose concentration as an index for diabetes. Mean glucose levels for all age groups were below 140 mg/dl, and both genders had comparable mean glucose levels for all age groups.

Subjects (n = 331) were screened for hypertension by measuring systolic and diastolic blood pressure (Table 3). Systolic blood pressure was higher for men than for women for all age groups except for those aged 51–60 years, where the mean systolic blood pressure was 15 mmHg higher for women in that age group. In men, the mean systolic blood pressure rose with age, with a steep increase in those 51–60 years of age. Diastolic blood pressure was higher for men of all ages except for those 51–60 years of age.

Dietary assessment using a modified food frequency questionnaire was aimed at understanding the frequency of fatty foods, and fruit and vegetable consumption. The frequency of fatty foods or fruit and vegetables consumption was translated into scores that were then categorized into four levels of intake, as detailed in Table 5. Fat consumption was highest among younger participants and tended to decline with age for both men and women. Fruit and vegetable consumption, on the contrany, was equally distributed among all age groups, with a mean score that ranged between 13 and 15 (Table 3). A score of 13–15 implied that fruit and vegetable consumption in this population met the recommended daily serving. On the contrary, a fatty food consumption score greater than 14 implies that total fat intake far exceeds current dietary recommendation and represents about 35–50% of calories from fat (Table 5). A positive correlation between fatty foods and fruit and vegetable consumption was observed ($r = 0.215$, $P < 0.001$). The data clearly show that those with a higher fat score tend to have a higher fruit and vegetable score as well. Therefore, although regression analysis showed that serum cholesterol levels correlated negatively ($r = -0.251$) with fat, no correlation was observed with the

Table 5. Caloric intake from fatty foods and serving of fruit and vegetable consumption

Fat and meat		*Fruit and vegetables*	
Score	*Average**	*Score*	*Average***
0–7	<25	0–11	<3
8–14	30–35	11–12	4
15–22	35–40	15–22	<5
>23	40–50	>23	5

*Average (%) of the total caloric intake.
**Average of the total number of servings.

consumption of fruits and vegetables. This paradoxical observation could be attributed to higher consumption of fatty foods among the younger generation, which negated the effect of fruit and vegetable consumption.

Smoking was common in the lower income class when compared with those in the higher income bracket. Greater than 70% of those who smoke reported an income of less than $15,000/year, while only 20% of those who smoke reported higher incomes. A negative effect of smoking is its influence on HDL. Mean HDL-cholesterol was 10 mg/dl lower for smokers compared with non-smokers. Thus, the TC/HDL ratio was raised from 4.7 for non-smokers to 6.2 in smokers (Figure 2).

Correlation among CVD risk factors is summarized in Table 6. In general, BMI was significantly and positively correlated with age ($r = 0.203$, $P < 0.05$), blood glucose concentration ($r = 0.192$, $P < 0.05$), systolic blood pressure ($r = 0.294$, $P < 0.01$) and diastolic blood pressure ($r = 0.211$, $P < 0.05$). Body fat correlated positively with age ($r = 0.193$, $P < 0.05$), glucose ($r = 0.231$, $P < 0.01$), TC/HDL-cholesterol ($r = 0.236$, $P < 0.01$), TC concentration ($r = 0.227$, $P < 0.01$), systolic blood pressure ($r = 0.269$, $P < 0.01$) and diastolic blood pressure ($r = 0.286$, $P < 0.01$). There was a negative correlation between percent body fat and HDL-cholesterol concentration. Also, blood glucose was positively correlated with age ($r = 0.268$, $P < 0.01$), TC/HDL-cholesterol ($r = 0.220$, $P < 0.01$), systolic blood pressure ($r = 0.404$, $P < 0.01$) and diastolic blood pressure ($r = 0.219$, $P < 0.05$). Both systolic ($r = 0.301$) and diastolic ($r = 0.590$) blood pressure independently correlated with total cholesterol ($P < 0.01$).

An important observation was a negative but significant correlation between serum TG and HDL ($r = -0.460$, $P < 0.01$). This suggests that high levels of serum TG are likely to have a negative effect on serum HDL in this population, which is depicted graphically in Figure 1, in which serum HDL is plotted against serum TG. Interpretation of the relationship between

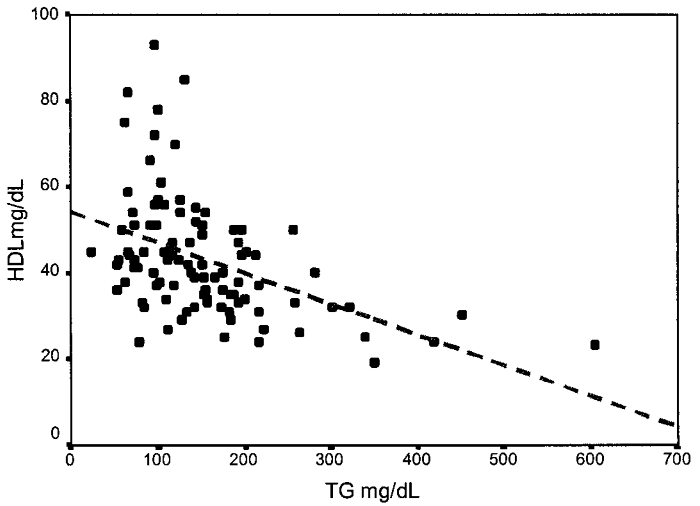

Figure 1. Correlation between triglyceride (TG) and high-density lipoprotein (HDL). Serum HDL-cholesterol was plotted against serum TG concentrations. The data shows a negative correlation ($r = -0.460$, $P < 0.001$), suggesting that high levels of serum TG are likely to have a negative impact on serum HDL.

Table 6. Correlation between all the risk factors for cardiovascular disease

	Age	*BMI*	*Fat*	*Glucose*	*HDL*	*TC*	*Systolic BP*	*Diastolic BP*
Age	1.000	0.203*	0.192*	0.268*	−0.054	0.278**	0.561**	0.455**
BMI	0.203*	1.000	0.724**	0.192*	−0.111	0.14	0.294**	0.211*
% Body fat	0.193*	0.724**	1.000	0.231**	−0.165*	0.227**	0.286**	0.286**
Glucose	0.286**	0.192*	0.231**	1.000	−0.138	0.105	0.404**	0.219*
TC	0.287**	0.140	0.277**	0.105	0.078	1.000	0.301**	0.329**
HDL	−0.045	−0.111	−0.165*	−0.138	1.000	0.078	−0.185*	0.186*

*Correlation is significant at the 0.05 level.
**Correlation is significant at the 0.01 level.
BMI, Body mass index, HDL, high-density lipoprotein, TC, total cholesterol; BP, blood pressure.

HDL-cholesterol and TG as a function of age shows that mean values for TG are directly opposite to that for HDL-cholesterol.

Discusion

The objective of this study was to evaluate the prevalence of risk factors to CVD among AA. To ensure that the sample was representative, designed interviews and screenings were scheduled during weekdays and during the early hours of weekends at locations where the target population obtained healthcare or participated in other social activities, as well as at local Mosques where most, if not all, AA of the Moslem faith meet regularly. More females than males came to the clinic to get screened for cholesterol, blood pressure, and diabetes. Males, on the contrary, preferred to participate only at the Mosque on Saturday mornings. The sex and age distribution of all participants is reflective of the role that gender plays in the attitude of this community toward medical and health issues. Taking care of the health of

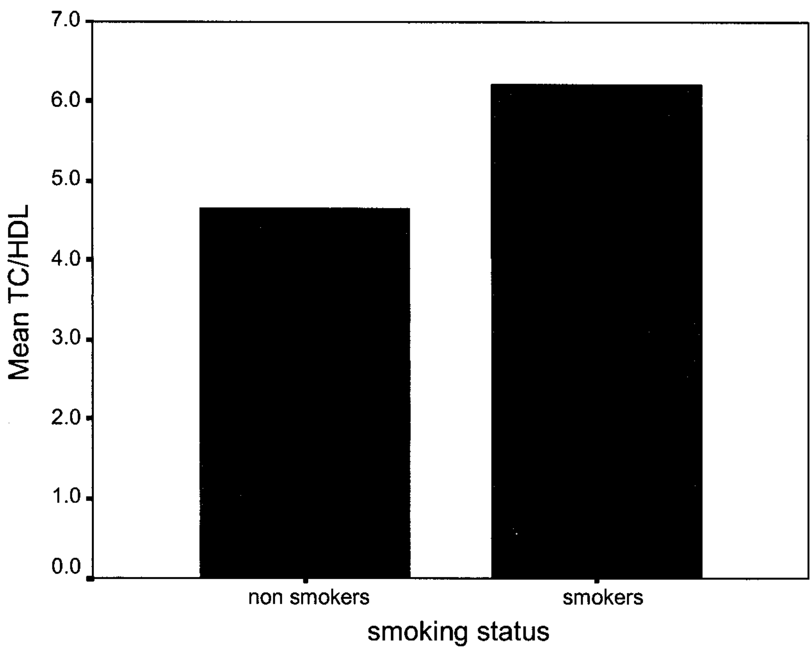

Figure 2. Effect of smoking on total cholesterol (TC)/high-density lipoprotein (HDL)-cholesterol ratio. Smokers had higher TC/HDL-cholesterol ratios than non-smokers ($P < 0.001$). This is probably the effect of smoking on serum HDL.

children in the family is generally part of the women's responsibilities, a role that makes them more understanding of the importance of medical and health related issues.

In general, participants in the current study were much more receptive than anticipated, in part because of the less invasive technique used to obtain blood samples. With the finger prick method, only microliter volumes of blood are obtained and this appeared less threatening when compared with standard venal blood draws. We assert that this method was a reason behind the high turnout rate. However, many complained about the long questionnaire.

Very few participants reported alcohol usage. This could be attributed to Islamic teachings prohibiting alcohol consumption. However, the data obtained were few and unreliable, and were thus not included in the analyses. Difficulties were encountered in quantifying two important variables associated with health status, physical activity and family history, factors that are important in the determination of CVD risk. Few participants actively engaged in regular exercise and, because the cause of death (postmortem or autopsies) is not always an issue in the 'old country', many do not know if their relatives may have died from CVD-related illnesses. Some of the difficulties encountered in the assessment of these factors may also be due to the existence of a language barrier. Most of the subjects, particularly those who were older and may not have been born in the US, were monolingual and spoke only Arabic.

The reported income of many families or individuals in this population was extremely low. This could be due to the large numbers of immigrants; many of whom, although highly educated, do not communicate well in English, and lack some of the necessary skills needed for better paying jobs. Some immigrants may be dependent on the government welfare programs. In addition, some who are refugees may still be traumatized by war and carry a burden of psychological problems, limiting their ability to work.

Compared with data obtained in a preliminary screening conducted by ACCESS, the prevalence of smoking was less than expected. However, an earlier study by Rice & Kulwicki (1992) showed that smoking was more common, especially among a similar immigrant population. The decrease in the prevalence of smoking in the current population may be attributed to concentrated efforts by many organizations (including ACCESS) to educate people about the adverse effects of smoking on the overall health. Smoking behavior was evenly distributed among men and women, a finding that has never been previously reported in any Arab population. In fact, Al-Nuaim *et al.* (1996) reported that smoking was almost a male practice, and was not common among females. The increase in smoking of females observed in this study might be due to the transition into a new culture and environment where smoking by females is socially acceptable. Overall, smoking was common mostly in the older age groups, and less so in the younger population. This may be, in part, the result of growing awareness about the adverse effects of smoking among the younger generation. In fact, the percentage of smokers among those younger than 30 years did not exceed 6%.

AA women, on average, had higher BMI (26.9 ± 0.6) than AA men (25.7 ± 0.3). This finding is in agreement with Al-Nuaim *et al.* (1996) for Arabs in the Middle East. These observations are opposite to observations in the US showing that Caucasian American men have a higher prevalence of being overweight than women (National Center for Health Statistics, 2001). The current observation that being overweight is more prevalent in AA females than males may be explained, in part, by differences in culture. Middle-Eastern Arabs have a different attitude toward being overweight than Americans. In addition, most AA women are yet to join the workforce, a fact that can contribute to reduced energy expenditure. Obesity was prevalent in the over 30 age group, where the number overweight exceeded 60% of the total population. Being overweight, as a health concern, was even more serious in 90% of women aged between 51 and 60 years. This group was also identified as those with the highest smoking rates. Although the BMI increases with age for most ethnic groups living in the US, it should not be considered a normal sequel of aging, particularly in a population that is adopting a lifestyle associated with an increase in chronic diseases. Instead, we should emphasize the importance of maintaining an energy balance and normal body weight for all groups in order to improve the serum lipid profile (Nicklas *et al.*, 1997).

AA men and women had mean blood cholesterol levels below 200 mg/dl. The population with TC >200 mg/dl was 40.4% and 38.25% for AA males and females, respectively, compared with more than 50% for American males and females (National Heart, Lung & Blood Institute, 2001). However, these apparent low cholesterol levels may be deceptive. Alberto *et al.* (1999) reported a high incidence of familial hypercholesterolemia (Lebanese mutation) among an Arab population living outside the Middle East. In addition, cholesterol levels observed in the current study were not evenly distributed by gender or age. Subjects 51–60 years old had the highest cholesterol levels. Our observation that men have higher serum cholesterol levels than women is not in agreement with Al-Nuaim *et al.* (1997), who reported that women had higher serum cholesterol levels than men. In the current study, women on average had higher HDL levels than men, which were reflected by a lower TC/HDL-cholesterol ratio when compared with men. In fact, the TC/HDL-cholesterol ratio was greater than 4.5 in two-thirds of the male population studied.

Although the role of the plasma TG concentration in CHD has been controversial, there is increasing evidence that high levels of TG may represent an independent risk factor, particularly when HDL levels are low. In the current study, serum TG levels were, on average, below 200 mg/dl for all age groups, with the exception of those 51–60 years who had mean fasting TG concentrations of 200 mg/dl. This is generally considered as borderline; however, with increasing evidence that TG by itself could be an independent risk factor in some individuals, these participants may be at risk considering that their HDL-cholesterol levels are also low. It is likely that these TG levels may have an influence on HDL-cholesterol concentrations in this population in light of the negative but significant ($r = -0.460$, $P < 0.01$) correlation observed between TG and HDL.

Although not all subjects were in a fasting state, mean glucose levels for all participants were below 140 mg/dl. Caution should be exercised in the interpretation of these findings however, because previous work suggested that impaired glucose tolerance was prevalent among this population (Jaber *et al.*, 1995; King & Rewers, 1993).

Data obtained on hypertension suggest that women 51–60 years old may have multiple risk factors for CVD. Women in this age group had high diastolic blood pressure, in addition to other risk factors mentioned earlier. It is also important to note that men had a higher blood pressure than women, except in those over the age of 51, where systolic blood pressure for females increased dramatically. It is important here to mention that high blood pressure is also a common health problem among Arabs living in the Middle East (Jaddou *et al.*, 2000).

The food frequency questionnaire was modified such that high-fat food items consumed by AA were also included. Food items such as yogurt were added to the dairy category and lamb was also included in the red meat category. The consumption of fat was significantly high among all age groups and reached its peak in those 30 years or younger. Fatty food consumption appeared to decline with age. This, however, may be due in part to higher intake of sweets. These traditional Arabic sweets are, in general, high in fat (Musaiger *et al.*, 2000). The fat intake represented 40–50% of total calories in the younger age groups and 30–35% of calories in the older age groups. High fatty food consumption by those 30 years of age and younger may be an indication of having been assimilated into the American lifestyle and consuming the typical American diets that are rich in saturated fatty acids, mostly consumed as fast foods.

Fruit and vegetable consumption exceeded four to five servings a day for all age groups. Fruit and vegetable consumption may reflect adherence to more traditional eating patterns. However, high intake of vegetables and fruits did not have a protective effect on cholesterol levels, in part because individuals consuming more fruit and vegetables also consumed high amounts of fatty foods, as well.

In conclusion, our results suggest that this sample population has several CVD risk factors including obesity, being overweight, low HDL-cholesterol and high TC concentrations. Moreover, large segments of this population are living a sedentary lifestyle. There were differences in risk factors between men and women and between age groups. Being overweight, and to some extent obesity, high serum lipids and hypertension, were prevalent in females who were of the 51–60 age range. Even though the prevalence of cigarette smoking was low in the population studied, it was higher among the older age groups who are already at risk. We speculate that prevalence of these risk factors may reflect, in part, changes in their lifestyle such as increased consumption of meats and saturated fatty acids, more sedentary lifestyles, or changes in their stress levels (Hattar-Pollara & Meleis 1995). In addition, easy access and availability may be responsible for the increase in smoking rates among women, particularly older women who are already at high risk for the development of CVD. Finally, these findings justify the need for more studies with a wider population and with the special focus on diet analysis and genetic implications.

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