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Prevalence of dyslipidemia and its associated factors among Jordanian adults

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BACKGROUND: Dyslipidemia, which has been closely linked to pathophysiology of cardiovascular diseases, is a key independent modifiable risk factor for cardiovascular diseases. Estimation of the prevalence of dyslipidemia ensures proper planning of health actions for both primary and secondary prevention of cardiovascular diseases.

OBJECTIVES: To estimate the prevalence of various types of dyslipidemia and determine their associated factors among adults in north of Jordan.

METHOD: Data were analyzed from a cross-sectional study that included a random sample of 1121 Jordanians aged 25 years and older. High total cholesterol (TC) was defined as TC $\geq$200 mg/dL and hypertriglyceridemia as serum triglycerides level $\geq$150 mg/dL. Low high-density lipoprotein cholesterol (HDL-C) was defined as serum HDL-C $<$40 mg/dL. High low-density lipoprotein cholesterol (LDL-C) was defined as serum LDL-C $\geq$130 mg/dL.

RESULTS: Of a total of 1121 subjects, 48.8% had high TC level, 40.7% had high LDL-C, 40.1% had low HDL-C, 43.6% had high triglyceride levels, and 75.7% had at least one abnormal lipid level. Age was associated with high triglycerides, high LDL-C, and high TC. Men were more likely than women to have a high triglycerides level and low HDL-C. Compared with people with a body mass index $<$25, overweight and obese subjects had greater odds of having high triglycerides, high TC, and low HDL-C. Diabetes was associated with increased odds of high triglycerides only.

CONCLUSION: The prevalence dyslipidemia is high in Jordan, which necessitates appropriate the institution of community-based intervention strategies to prevent and manage cardiovascular risk factors.

The epidemic of cardiovascular diseases has been observed in developing countries.[1–3] According to Jordan Ministry of Health mortality statistics, 38.2% of deaths in 2003 were attributed to cardiovascular diseases in Jordan. Dyslipidemia, which has been closely linked to the pathophysiology of cardiovascular disease, is a key independent modifiable risk factor for cardiovascular diseases.[4,5] The prevalence of dyslipidemia is high and increasing in most developed countries[6] as well as in many developing countries as the result of the westernization of diet and other lifestyle changes.[7,8] The World Health Organization

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estimates that dyslipidemia is associated with more than half of the global cause of ischemic heart diseases.[9]

It has been shown that effective treatment of dyslipidemia reduces the rate of morbidity and mortality.[10–14] Therefore, estimation of the prevalence of dyslipidemia ensures proper planning of health actions for both primary and secondary prevention of cardiovascular diseases. The objective of this study was to estimate the prevalence of dyslipidemia and determine its associated factors in Jordan.

Methods

Study population and data collection

This survey was conducted in the town of Sarih in north of Jordan to estimate prevalence of cardiovascular disease risk factors. This town with was selected because it showed the greatest response rate in the 2002 Behavioral Risk Factor Survey. This survey did not show evidence to conclude that this town is different from other towns in the country in the prevalence of self-reported diabetes. This study was conducted during a period of 3 months between May 2006 and July 2006. The setting, sample size calculations, sampling procedure, and data collection have been described elsewhere.[15–17] In brief, a systematic sample of 550 households (every sixth house) was selected. The first house was selected at random, and then every sixth house was systematically selected. One week before the survey, a 2-member team (a male and a female investigator) visited the selected households and invited all residents aged 25 years and older who were present at the time of the study to attend the health center at a given day after an overnight fast. Subjects on regular medications were asked not to take their medications early at that day and to bring all their medications with them to the survey site. A pilot-tested structured questionnaire was administered by trained interviewers to collect information on sociodemographic factors as well as relevant information on diabetes mellitus, hypertension, hyperlipidemia, smoking habits, and potential risk factors.

Measurements and laboratory analysis

Anthropometric measurements, including weight, height, and waist circumference, were measured with the subjects wearing light clothing and no shoes. Waist circumference was measured to the nearest centimeter by the placement of a nonstretchable measuring tape in a horizontal plane around the abdomen at the level of the iliac crest. The measurement was made at the end of a normal expiration while ensuring that the tape was snug but did not compress the skin and was parallel to the floor.

Body mass index (BMI) was calculated as the ratio of weight (kilograms) to the square of height (meters). Two readings of systolic and diastolic blood pressure were taken from the left arm with the subject seated and the arm at heart level, after at least 5 minutes of rest, by the use of a standardized mercury sphygmomanometer. The mean of the two readings was taken as the individual's blood pressure. For laboratory analysis and all biochemical measurements, two sets of fasting blood samples were drawn from a cannula inserted into the antecubital vein into sodium fluoride potassium oxalate tubes for glucose and lithium heparin vacuum tubes for lipids. Samples were centrifuged within 1 hour at the survey site, and plasma was transferred to separate labeled tubes and transferred immediately in cold boxes filled with ice to the central laboratory of the Jordan University Hospital. All biochemical measurements were carried out by the same team of laboratory technicians and the same method throughout the study period. Fasting plasma glucose was measured by the glucose oxidase method by use of a Cobas Analyzer (Roche). Total cholesterol (TC), high-density lipoprotein (HDL-C), low-density lipoprotein (LDL-C), and triglycerides were assayed by the automated spectrophotometer and enzymatic colorimetric method with the use of Roche Cobas Integra.

Definition of variables

According to the World Health Organization guidelines, obesity for men and women was defined as BMI $\geq$30 kg/m^2, whereas overweight was defined as BMI between 25 and 29.9 kg/m^2.[18] Obesity, on the basis of waist circumference, was defined as waist circumference $>$102 cm (40 in) in men and $>$88 cm (35 in) in women. A subject was defined as affected by diabetes mellitus if this diagnosis was known to the patient or, according to the American Diabetes Association definition. Lipid disorders were defined according to Third Report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) final report.[19] High TC was defined as TC $\geq$200 mg/dL (5.2 mmol/L) and hypertriglyceridemia was defined as serum triglycerides level $\geq$150 mg/dL (1.69 mmol/L). Low HDL-C was defined as serum HDL-C $<$40 mg/dL (1.04 mmol/L). High LDL-C was defined as serum LDL-C $\geq$130 mg/dL (3.1 mmol/L).

Statistical analysis

Age-specific prevalence rates of abnormal lipids were obtained. Data were described by the use of means, standard deviations, and percentages and analyzed with the *t* test or chi-square test wherever appropriate. Factors associated with abnormal lipids were analyzed by the use of binary logistic regression analysis. Separate binary logistic regression analysis was conducted to determine factors associated with each outcome variable (high triglycerides, high LDL-C, high TC, and low HDL-C). A backward stepwise method was selected. All possible predictor variables were entered into the model and then, at each step, the variable with a significance level equal to or larger than 0.05 was removed until the final model was obtained. The final

model for each outcome variable included significant variables only. Data were analyzed by the use of the Statistical Package for Social Sciences software (SPSS), version 15. A *P* value of less than .05 was considered statistically significant.

Results

Participants' characteristics

A total of 1121 participants (394 men and 727 women) aged 25 years and older were included in this study. Age of the subjects ranged from 25 to 85 years with a mean of 46.2. About 52% of the subjects had less than a high school education. Fifty four percent (54%) were married, and 43% were single. The mean plasma concentration of cholesterol, LDL-C, HDL-C, and triglycerides according to sex and age groups are presented in Table 1. Men had statistically significant lower mean values for TC and HDL-C and greater mean values for triglyceride concentrations compared with women. The mean concentration for LDL-C was not different between men and women.

Prevalence of dyslipidemia

Of a total of 1121 subjects, 48.8% had high TC, 40.7% had high LDL-C, and 40.1% had low HDL-C, 43.6% had high triglycerides concentrations. Of these measures, at least one abnormal lipid concentration was recorded in 75.7% of this population. Compared with women, men had a significantly greater prevalence of high triglycerides (52.3% of men and 38.9% of women) and low HDL-C (62.7% of men and 27.9% of women). The difference in the prevalence of high TC level and high LDL-C between men and women was not statistically significant. Table 2 shows the prevalence rates of abnormal lipid levels for both sexes according to age, and Table 3 shows the prevalence rates according to sociodemographic and other important characteristics.

Factors associated with dyslipidemia

Table 4 shows multivariate analysis of factors associated with high triglycerides, high LDL-C, high TC, and low HDL-C. Age was associated with high triglycerides, high LDL-C, and high TC. Compared with subjects 25 to 29 years of ages, only those who were 40 to 49 years of age had a greater prevalence of high plasma triglycerides. The odds increased significantly with age for high LDL-C and high TC. Men were more likely than women to have high triglyceride levels (odds ratio = 2.91; 95% confidence interval = 2.09−4.04) and low HDL-C (odds ratio = 5.60; 95% confidence interval = 4.14−7.58). Compared with people with a BMI <25, overweight and obese subjects had greater odds of having high triglycerides, high TC, and low HDL-C. Diabetes was associated with increased odds of high triglycerides only.

Discussion

The burden of dyslipidemia is alarming in terms of morbidity, mortality, and medical costs. Dyslipidemia is one of the four established conventional risk factors for coronary heart diseases besides cigarette smoking, diabetes, and hypertension.[20–23] Interestingly such conventional risk factors and their associated clinical manifestations are largely preventable by a healthy lifestyle.[24] Our study showed a high prevalence of dyslipidemia in a typical Jordanian town. Almost half of the participants (48.8%) had

Table 1 Mean (SD) of total cholesterol, LDL, HDL, triglyceride concentrations, and body mass index according to sex and age groups

Sex/age	Total	Total cholesterol		Triglycerides		LDL cholesterol		HDL cholesterol		Body mass index	
Male	N	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
25−29	32	154.8	33.3	121.4	70.5	95.5	27.9	39.8	7.8	24.5	4.0
30−39	94	186.1	36.3	169.6	103.9	113.7	30.4	38.9	9.5	27.3	4.6
40−49	106	198.6	44.3	211.9	125.6	122.1	35.7	37.0	6.7	29.2	5.5
50−59	59	212.1	39.8	210.6	125.5	131.9	35.8	37.2	6.5	28.9	4.5
≥60	103	212.9	36.6	179.3	113.0	133.7	32.1	39.0	8.7	29.6	4.8
Total	394	197.8	42.2	185.7	116.1	122.4	34.7	38.2	8.1	28.4	5.1
Female											
25−29	74	179.4	34.1	99.8	55.1	107.1	34.3	53.6	19.9	26.8	5.2
30−39	192	194.7	37.6	129.0	77.8	119.0	31.8	47.8	11.3	29.8	5.3
40−49	204	206.4	41.9	164.9	85.4	127.6	36.8	45.1	10.7	32.7	5.5
50−59	140	216.2	40.5	178.6	122.5	133.3	35.9	46.6	10.4	34.0	5.6
≥60	112	223.1	45.7	173.5	101.5	141.8	40.8	45.5	11.1	33.2	5.2
Total	722	205.0	42.4	152.6	95.5	126.5	37.1	47.1	12.4	31.6	5.8
P value (men vs. women)		.007		<.0005		.074		<.0005		<.0005	

HDL, high-density lipoprotein; LDL, low-density lipoprotein.

Table 2 The prevalence of high total cholesterol, high LDL, low HDL and high triglyceride concentrations according to sex and age (%)

Age, year	Total	High triglycerides	High total cholesterol	Low HDL cholesterol	High LDL cholesterol
Male					
25−29	32	10 (31.3)	2 (6.3)	17 (53.1)	4 (12.5)
30−39	94	44 (46.8)	30 (31.9)	60 (63.8)	24 (25.5)
40−49	106	65 (61.3)	52 (49.1)	72 (67.9)	42 (39.6)
50−59	59	36 (61.0)	28 (47.5)	41 (69.5)	26 (44.1)
≥60	103	51 (49.5)	65 (63.1)	57 (55.3)	59 (57.3)
Total	394	206 (52.3)	177 (44.9)	247 (62.7)	155 (39.3)
Female					
25−29	76	12 (15.8)	15 (20.3)	12 (15.8)	14 (18.4)
30−39	192	45 (23.4)	82 (42.7)	45 (23.4)	64 (33.3)
40−49	204	100 (49.0)	105 (51.5)	70 (34.3)	80 (39.2)
50−59	141	70 (49.6)	88 (62.9)	44 (31.2)	73 (51.8)
≥60	114	56 (49.1)	78 (69.6)	32 (28.1)	70 (61.4)
Total	727	283 (38.9)	368 (51.0)	203 (27.9)	301 (41.4)
P value (men vs. women)		<.005	.053	<.005	.502

HDL, high-density lipoprotein; LDL, low-density lipoprotein.

Table 3 The prevalence of elevated total cholesterol, high LDL, low HDL and high triglyceride concentrations adjusted for sociodemographic, anthropometric, and clinical characteristics (%)

Variable	Total	High triglycerides	High LDL cholesterol	High total cholesterol	Low HDL cholesterol
Sex					
Male	394	206 (52.3)	155 (39.3)	177 (44.9)	247 (62.7)
Female	727	283 (38.9)	301 (41.4)	368 (51.0)	203 (27.9)
Age, year					
25−29	108	22 (4.5)	18 (16.7)	17 (16.0)	29 (26.9)
30−39	286	89 (18.2)	88 (30.8)	112 (39.2)	105 (36.7)
40−49	310	165 (33.7)	122 (39.4)	157 (50.6)	142 (45.8)
50−59	200	106 (21.7)	99 (49.5)	116 (58.3)	85 (42.5)
≥60	217	107 (21.9)	129 (59.4)	143 (66.5)	89 (41.0)
Years of education					
≤12 years	397	180 (46.3)	176 (44.3)	205 (51.9)	168 (42.3)
>12 years	535	209 (53.7)	172 (32.1)	217 (40.6)	219 (40.9)
Smoking					
Current	143	74 (15.1)	58 (40.6)	66 (46.2)	91 (63.6)
Past	82	47 (9.6)	27 (32.9)	35 (43.2)	50 (61.0)
None	894	368 (75.3)	370 (41.4)	443 (49.8)	309 (34.6)
Body mass index					
Normal	188	34 (7.0)	50 (26.6)	58 (30.9)	62 (33.0)
Overweight	350	154 (31.7)	140 (40.0)	160 (46.0)	150 (42.9)
Obesity	576	298 (61.3)	261 (45.3)	322 (56.2)	237 (41.1)
Abdominal obesity					
No	554	206 (42.1)	195 (35.2)	223 (40.3)	241 (43.5)
Yes	567	283 (57.9)	261 (46.0)	322 (57.2)	209 (36.9)
Fasting plasma glucose					
Normal glucose	849	320 (65.6)	333 (39.2)	399 (47.1)	320 (37.7)
Impaired fasting glucose	91	46 (9.4)	33 (36.3)	40 (44.0)	50 (54.9)
Diabetes mellitus	180	122 (25.0)	89 (49.4)	105 (59.3)	80 (44.4)
Hypertension					
No	568	212 (43.4)	190 (33.5)	230 (40.6)	225 (39.6)
Yes	553	277 (56.6)	266 (48.1)	315 (57.3)	225 (40.7)

Table 4 Multivariate analysis of factors associated with high total cholesterol level, high LDL, low HDL and high triglycerides

	High triglycerides	High LDL cholesterol	High total cholesterol	Low HDL cholesterol
Age (year)				
25−29	1.00	1.00	1.00	
30−39	1.17 (.66−2.06)	2.18 (1.24−3.84)	2.86 (1.60−5.12)	
40−49	2.30 (1.31−4.04)	2.97 (1.70−5.20)	4.00 (2.23−7.17)	
50−59	1.67 (.89−3.13)	4.81 (2.63−8.79)	5.33 (2.83−10.04)	
≥60	1.04 (.52−2.08)	6.78 (3.57−12.88)	7.52 (3.85−14.69)	
Gender (men vs. wome)	2.91 (2.09−4.04)			5.60 (4.14−7.58)
Body mass index				
<25	1.00		1.00	1.00
25−29.9	3.63 (2.25−5.86)		1.54 (1.01−2.33)	1.85 (1.22−2.82)
≥30	5.16 (3.19−8.36)		1.97 (1.32−2.93)	2.56 (1.70−3.85)
Fasting blood glucose				
Normal	1.00			
Impaired fasting	1.22 (.71−2.08)			
Diabetes	2.47 (1.58−3.84)			

Confidence intervals shown in parentheses.

elevated TC, 40.7% had elevated LDL-C, 40.1% had low HDL-C, and 43.6% had elevated triglyceride concentrations. More than three quarters (75.7%) had at least one abnormal lipid measurement. In a study conducted in Turkey, [25] authors reported that the prevalence of high TC, high LDL-C, high triglycerides, and low HDL-C were 37.5%, 44.5%, 30.4%, and 21.1% respectively. Furthermore, the authors reported that the prevalence of dyslipidemia was greater in men than women except for TC and was significantly associated with age, male sex, and BMI. A recent survey in Pakistan[26] revealed that a large proportion of the population had lipid abnormalities. All lipid variables increased with increased age except HDL-C. Females had significantly greater values of TC, LDL-C, and triglycerides.

This study also showed that men had significantly greater prevalence rates of high triglycerides (52.3%) compared with women (38.9%) and low HDL-C (62.7% of men and 27.9% of women). There is no significant statistical difference in the prevalence of a high TC level and high LDL-C between men and women. Age, overweight, and obesity showed a positive correlation with dyslipidemia. Diabetes was associated with increased odds of high triglycerides only.

It is highly possible that the high rate of overweight (31.4%) and obesity (51.7%) in this population might account for the observation of strikingly low levels of HDL-C. The association between dyslipidemia and BMI was reported in the National Health and Nutrition Examination Survey, 1999 to 2004, which showed that the prevalence of dyslipidemia substantially increases with increased BMI.[27] The same association was reported in other studies.[28,29] A Brazilian study revealed that nearly one in every four adults had dyslipidemia (prevalence rate was 24.2%), which was positively associated with increased age, male sex, being overweight, and having diabetes. In the Brazilian study, LDL-C level was greater in women in all ages group whereas the observed triglyceride level was greater in men.[30] In contrast, a study conducted in Saudi Arabia revealed that overweight and obesity were not significant risk factors for hypercholesterolemia.[31]

In conclusion, this study highlighted dyslipidemia as a major health problem with a high prevalence in Jordan. Because there is a striking quality gap in the treatment of cardiovascular risk factors, an appropriate community-based prevention strategy emphasizing behavioral and social changes are required to prevent, detect, and treat cardiovascular risk factors.

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