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Association of Body Mass Index with Dyslipidemia among the Government Staff of Kermanshah, Iran: A Cross-Sectional Study

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Abstract

Background: There is some evidence suggesting that Body Mass Index (BMI) may increase plasma lipoprotein levels.
Objectives: This study aimed to evaluate the possible association between BMI and dyslipidemia among the government staff of Kermanshah.
Methods: This descriptive-analytical cross-sectional study was performed on the staff of 13 governmental organizations in Kermanshah (a city located in the west of Iran) in 2012. The staff was recruited using census method. We obtained information of 1496 staff aged 22 - 69 through the standardized stepwise questionnaire for NCDs risk factor surveillance. The staff was then physically examined by trained persons. Finally, their blood samples were obtained.
Results: The prevalence of dyslipidemia was 16.6% in the study group, with the prevalence of 18.2% in men and 7.9% in women. There were also 53% (55.8% in men and 7.9% in women) and 17.8% (17.6% in men and 38.1% in women) prevalence rates for overweight and obesity, respectively. Dyslipidemia was significantly associated with factors such as BMI (P value = 0.004), gender (P value < 0.001), marital status (P value = 0.01), cigarette smoking (P value = 0.008), and hookah smoking (P value = 0.002), but not with passive smoking, age, education level, physical activity, FBS (fast blood sugar), WHR (waist to hip ratio), hypertension, waist size, and hip size. In the adjusted model, there was a link merely between obesity and dyslipidemia while no statistically significant association was found between dyslipidemia and overweight. Moreover, a non-linear dose-response association was observed between dyslipidemia and BMI.
Conclusions: Since dyslipidemia was significantly prevalent among men, fat people, and smokers, a particular attention is crucial to be paid to these groups.

Keywords: Dyslipidemia, Body Mass Index, Staff, Kermanshah, Iran

1. Background

Cardiovascular diseases have been accounted for a remarkable rate of mortality and disability especially in societies with low/moderate economic status. Although developed countries have successfully controlled risk factors related to cardiovascular diseases (1), nowadays, hyperlipidemia is a key contributing factor to these disorders (2). Through preventing hyperlipidemia, we will be able to reduce the mortality caused by cardiovascular diseases. Notably, a reduction of 2% - 3% in coronary diseases' risk has been reported following a 1% decrease in serum levels of lipids (3). However, the reduced serum lipid mainly depends on the identification of etiological factors, like obesity (4, 5). One of the frequently used tools to measure obesity is body mass index (6). This factor may result in elevated (not necessarily in a linear mode) levels of serum lipids (7). A remarkable relationship has been reported between BMI and hyperlipidemia in various studies. Nonetheless, when conducting multivariate analysis, BMI in these studies had been converted into a categorical variable (8).

In this study, we attempted to investigate the dose-response link between the BMI continuous variance and the frequency of hyperlipidemia among the government staff of Kermanshah.

2. Methods

This study was a part of a project entitled "investigation of risk factors related to uncommunicable diseases in staff of Kermanshah, Iran". This descriptive-analytical cross-sectional study was performed on the staff of 13 governmental organizations in Kermanshah (a city located in the west of Iran) in 2012. The staff was recruited using census method. We obtained information of 1496 staff aged between 22 and 69 years. All individuals who previously filled an informed consent form voluntarily participated in this study. In addition, this study gave an ethical code numbered KUMS.ARBC.1394.245. The details of study process have been published elsewhere (9).

2.1. Data Collection and Measurements

The standardized stepwise questionnaire for NCDs risk factor surveillance, suggested by the world health organization, was used. The validated questionnaire was utilized by Meysamie et al. in a national study (9). In addition, reliability of the questionnaire was determined as 0.85 using Cronbach's alpha. The subjects were weighted on a calibrated scale while wearing light clothes and no shoes. The height of the subjects was measured using a tape measure while they were standing on a smooth and flat surface. Subsequently, the measurement of waist size in the narrowest part and hip size in the widest part was conducted using a tape measure, while wearing minimum clothes. In addition, blood pressure of all participants was measured after 5 min rest using a mercury pressure-meter mounted on their right hand. Venous blood samples of fasting subjects were collected to measure fast blood sugar (FBS), as well as blood lipid profile including total cholesterol (TC), high-density cholesterol (HDL), low-density cholesterol (LDL), and triglycerides (TG).

2.2. Definitions

Dyslipidemia: An abnormal body condition in which the amount of total cholesterol is $\geq$ 240 mg/dL and/or triglycerides $\geq$ 200 and/or low-density lipoprotein $\geq$ 140, and/or high-density lipoprotein cholesterol $\leq$ 35 (10). BMI: An index in which the individual's weight in kilograms is divided by the square of height (per meters). Our study described normal weight with 18.5 $\leq$ BMI $\leq$ 24.9 kg/m^2, overweight with 25 $\leq$ BMI $\leq$ 29.9 kg/m^2, and obese with BMI $\geq$ 30 (11). Abdominal obesity (WHR) was defined as the waist circumference (cm) divided by hip circumference based on cm. The WHR of < 0.95 in men and < 0.80 in women was considered normal (12). People who had a legal spouse were considered as married, while those who were not married, got divorced, or whose spouse had died were considered as singles. Active smoker: a person who consumes at least one cigarette a day. Hookah smoker: a person with hookah consumption, at least once a day. Passive smoker: non-smoker persons who are exposed to the smoke of cigarettes, hookah, and pipe at their office or their house at least 5 minutes a day (13). Physical activity was determine according to the frequency and the amount of body activity at the time of working and break (metabolic scale/min) expressed as an adjusted standard unit. Finally, a physical activity less than 600 MET- minutes/week was regarded as low level. High blood pressure: Persons who mentioned a history of high blood pressure or had a recent blood pressure. An FBS of $\geq$ 126 was considered abnormal (14, 15).

2.3. Statistical Analysis

We used the STATA and SPSS to analyze our data. Distribution of demographic characteristics among participants with/without hyperlipidemia was calculated by Chi-square test, evaluating categorical variables, and logistic regression, evaluating quantitative variables. We used the adjusted logistic regression model to check the correlation of BMI with dyslipidemia. Furthermore, restricted cubic spline method was utilized to evaluate potential nonlinear relationship between BMI and hyperlipidemia. Variables with a P value less than 0.05 entered into the multivariable regression. The level of significance of all 2-tail statistical tests was considered < 0.05.

3. Results

The prevalence of dyslipidemia was 16.6% (18.2% in men and 7.9% in women). There was also a BMI-based prevalence of 53% (55.8% in men and 38.1% in women) and 17.8% (17.6% in men and 19.2% in women) for overweight and obesity, respectively. Tables 1 and 2 illustrate demographic features of staff working in Kermanshah province. These tables show a statistically significant association between dyslipidemia and gender, cigarette smoking, hookah smoking, marital status, and BMI, while such association was not found for age, education level, FBS, waist size, hip size, WHR, hypertension, physical activity, and passive smoking.

Table 3 indicates the relationship of dyslipidemia with BMI in crude and adjusted models. With regard to this table, in both models, there was a link between obesity and dyslipidemia, as in the crude model the rate of dyslipidemia in fat people was two-times higher than that of normal cases. In model I and II, the possibility of dyslipidemia occurrence was 0.93 higher compared to normal persons.

The dose-response relationship between BMI and dyslipidemia is shown in Figure 1. This figure implies a significant nonlinear dose-response association between BMI and increased risk of dyslipidemia (P value: 0.023), regarding the reference, the ORs were 1.01 (0.86 - 1.17) for BMI at 25.39 kg/m^2, 1.05 (0.67 - 1.65) for BMI at 28.04 kg/m^2, and 0.93 (2.37 - 2.79) for BMI at 33.05 kg/m^2 (Figure 1).

Table 1. Demographic Features and Their Association with Dyslipidemia Among Government Staff of Kermanshah in 2012 (n = 1496)[a]

Variable	N	Non-Dyslipidemia (n = 1248)	Dyslipidemia (n = 248)	χ^2	P Value[b]
Gender				15.31	< 0.001
Male	1257	1028 (82.4)	229 (92.3)		
Female	239	220 (17.6)	19 (7.7)		
Educational level				1.12	0.89
Under diploma	231	192 (15.4)	39 (15.7)		
Diploma	347	287 (23)	60 (24.2)		
Associated degree	229	194 (15.5)	35 (14.1)		
BSc	561	465 (37.3)	96 (38.7)		
Msc and above	128	110 (8.8)	18 (7.3)		
Marital status				5.96	0.01
Single	177	159 (12.7)	18 (7.3)		
Married	1319	1089 (87.3)	230 (92.7)		
Smoking				6.93	0.008
No	1372	1155 (92.5)	217 (87.5)		
Yes	124	93 (7.5)	31 (12.5)		
Hookah smoking				9.27	0.002
No	1351	1140 (91.3)	211 (85.1)		
Yes	145	108 (8.7)	37 (14.9)		
Passive smoking				0.03	0.85
No	1316	1097 (87.9)	219 (88.3)		
Yes	180	151 (12.1)	29 (11.7)		
Physical activity				0.44	0.50
600 < MET- minutes/week	671	555 (44.5.9)	116 (46.8)		
600 ≥ MET- minutes/week	825	693 (55.5)	132 (53.2)		
Central obesity, (Waist Hip Ratio)				1.32	0.24
No	947	798 (63.9)	149 (60.1)		
Yes	549	450 (36.1)	99 (39.9)		
Hypertension				0.73	0.39
No	1194	1001 (80.2)	193 (77.8)		
Yes	302	247 (19.8)	55 (22.2)		
High FBS				3.69	0.05
No	1433	1201 (96.2)	232 (93.5)		
Yes	63	47 (3.8)	16 (6.5)		

[a] Values are expressed as No. (%).
[b] Significance level: P value < 0.05.

4. Discussion

With regard to the strong adverse effect of cardiovascular diseases on societies, deep consideration of risk factors is highly recommended. Particularly, abnormalities of blood lipid profile, as one of the most important risk factors, have been thoroughly investigated (16, 17). In this study, the overall prevalence of hyperlipidemia was reported as 16.6%. Muhammadbeigi et al. estimated this prevalence to be 51.8% (18). Similarly, in a meta-analysis

Table 2. Demographic Features and Their Association with Dyslipidemia Among Government Staff of Kermanshah in 2012 (n = 1496)

Variable	B	S.E.	Wald	P Value	OR (95% CI)[a]
Age, y	0.17	0.008	4.34	0.037	1.01 (1.00 - 1.03)
BMI, kg/m^2	0.05	0.018	8.20	0.004	1.05 (1.01 - 1.09)
Waist, cm	0.006	0.007	0.60	0.40	1.006 (0.99 - 1.02)
Hip, cm	-0.005	0.009	0.35	0.55	0.99 (0.97 - 1.01)

[a]The level of significance was tested by logistic regression.

Table 3. Logistic Regression Analysis for the Influence of BMI on Dyslipidemia among Government Staff of Kermanshah in 2012 (n = 1496)

Model	BMI	B	S.E.	Wald	P Value[a]	OR (95% CI)
Univariate	18.5 to 24.9					1.00
	25 to 29.9	0.29	0.17	2.93	0.08	1.34 (0.95 - 1.88)
	$\geq$ 30	0.69	0.20	11.66	0.001	2.00 (1.34 - 2.99)
Model I[b]	18.5 to 24.9					1.00
	25 to 29.9	0.20	0.17	1.45	0.22	1.23 (0.87 - 1.73)
	$\geq$ 30	0.66	0.20	10.28	0.001	1.93 (1.29 - 2.89)
Model II[c]	18.5 to 24.9					1.00
	25 to 29.9	0.22	0.17	1.66	0.19	1.25 (0.88 - 1.77)
	$\geq$ 30	0.66	0.20	10.08	0.001	1.93 (1.28 - 2.91)

[a]Significance level: P value < 0.05.
[b]Adjusted for gender.
[c]Adjusted for gender, marital status, smoking, hookah smoking.

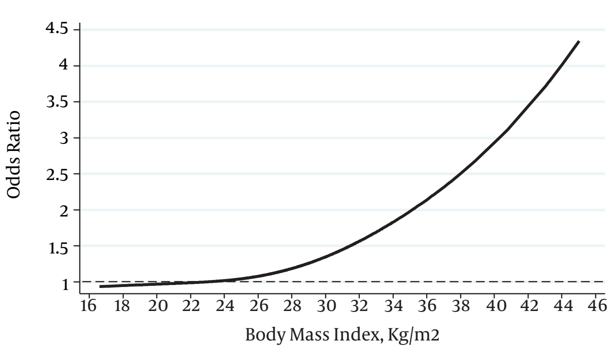

Figure 1. The Dose-Response Relationship of BMI with Dyslipidemia Based on the Restricted Cubic Spline Model (BMI Was Coded Using an RCS Function with Four Knots Located at 21.07 kg/m^2, 25.39 kg/m^2, 28.04 kg/m^2, and 33.05 kg/m^2).

study, Tabatabaei et al. reported the prevalence of different types of dyslipidemia including hypercholesterolemia, hypertriglyceridemia, and LDL as 41.6%, 46%, and 35%, respectively (19). In addition, the prevalence of hyperlipidemia in China has been reported to be 51.09%. There was also a frequency of 8.68% in rural and 5.74% in urban areas of India (8, 20).

In this study, the prevalence of obesity, according to BMI, was estimated to be 17.8%, being more than that of USA and Europe (21, 22) and less than that of South Africa (23). The reason for these differences can be due to the difference in statistical populations, race, and life style.

Dyslipidemia was found to be more common in men than in women. In contrast, in Germany and United States, women are involved more in the disease (24, 25). Most studies have reported results similar to ours (26, 27). This might be due to the higher smoking rate in men, whose physical activity is lower and overall/abdominal obesity is higher, resulting in the increased levels of blood lipids (28).

We also found a significant relationship between smoking and dyslipidemia, similar to studies conducted by Mouhamed and Brucket (29, 30). No significant association was found between dyslipidemia and exposing to smoke. Conversely, Hirata et al. found a raised level of HDL in cases exposed to smoke (31). Furthermore, a cross-sectional study conducted on children has shown a decreased level of HDL and increased level of LDL (32). Moreover, a case-control study on 164 patients with 30 - 64 years of age showed a significantly decreased level of serum lipids in people exposed to smoke, when compared to nonsmokers (14).

Our results also highlighted the capability of obesity in increasing the rate of dyslipidemia, similar to results reported by Lai et al. (33), Kenneth et al. (34) and Sullivan et al. (35). Similarly, a Chinese study showed a significant nonlinear association between BMI and raised risk of hyperlipidemia, with a significantly increased trend of odds ratio following 1 kg/m2 increase in BMI (8).

The relationship between education level and hyperlipidemia has been investigated in some studies. Mahley and Pradeepa showed that people with high education level represent a raised rate of dyslipidemia (36, 37), whereas Wang and Al-Kaabba have proposed a decreased rate of dyslipidemia with high levels of education (38, 39).

In this study, the relationship between hyperlipidemia and elevated levels of blood sugar was not significant, whereas Wang showed a significant correlation between dyslipidemia and high blood sugar (38). Similarly, Luo reported higher levels of HDL in people with high blood sugar (40). Furthermore, we did not observe any statistically significant relationship between dyslipidemia and high blood pressure, while different studies have suggested that lipids metabolism varies (41) (as also proved in prior studies) in people with high blood pressure, compared to normal cases (42). The reason for this diversity may be due to either difference in conditions wherein study conducted or difference in study cases.

Some advantages could be mentioned for this study. First, the blood samples of all staff were collected and second, dose-response analysis was conducted to understand whether there is any association between BMI and dyslipidemia. In contrast, there are some disadvantages: 1) there might be some confounders affecting our results and, 2) we just collected samples of staff, and no sample was taken from the rest of society.

4.1. Conclusions

According to the growing rate of cardiovascular diseases, paying more attention to risk factors is urgently needed to be able to decrease the incidence of these diseases. Hyperlipidemia, in particular, is an important factor that may result in serious problems if ignored. Men, obese, and smoker cases are at the highest risk. Consequently, preventive strategies should be focused mostly on these groups.

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