Original Article

Obesity Indices in relation to Lipid Abnormalities among Medical University Students in Zahedan, South-East of Iran

Abstract

Background: There is no statement on the ability of obesity indices in prediction of lipid abnormalities among young adults. The present study was conducted to determine the ability of obesity indices as predictors of lipid abnormalities among a group of young adults. **Materials and Methods:** A total of 353 medical university students aged 18–25 years (188 males and 165 females) participated in this cross-sectional study in 2014. Weight, height, waist circumference (WC), and hip circumference were measured to calculate obesity indices including body mass index (BMI), waist-to-hip ratio, and waist-to-height ratio (WHtR). Serum total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), and triglycerides (TG) were measured by commercially available kits and were applied to calculate low-density lipoprotein cholesterol (LDL-C) and atherogenic parameters including LDL-C/HDL-C ratio, TC/HDL-C ratio, non-HDL-C, and atherogenic index of plasma (AIP). **Results:** Subjects with BMI ≥25 kg/m² had a greater value of all lipid profiles and atherogenic parameters ($P < 0.05$) except for HDL-C ($P > 0.05$) compared to subjects with BMI <25 kg/m². In logistic regression model, BMI ≥25 kg/m² was significantly associated with the highest odds for elevated TC (odds ratio [OR] = 7.67, $P = 0.003$), LDL-C (OR = 3.24, $P = 0.01$), TC:HDL-C (OR = 4.98, $P = 0.01$), and non-HDL-C(OR = 4.32, $P = 0.001$) in males, as well as high values of TG (OR = 8.80, $P = 0.002$), LDL-C:HDL-C (OR = 3.64, $P = 0.01$), and AIP (OR = 9.65, $P < 0.001$) in females. In terms of central obesity indices, males with WC ≥102 cm and females with WC ≥88 cm had the highest odds of increased LDL-C:HDL-C (OR = 6.71, $P = 0.01$) and TC:HDL-C (OR = 3.25, $P = 0.050$), respectively. In addition, females with WHtR ≥0.50 had the highest odds of high TC (OR = 3.56, $P = 0.02$) and non-HDL-C (OR = 2.70, $P = 0.02$). **Conclusions:** Overall, the findings of the present study showed that BMI was a stronger index for prediction of classical lipid parameters and atherogenic parameters than central obesity indices in medical students.

Keywords: *Body mass index, dyslipidemia, obesity, young adults*

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Introduction

Over the last two decades, obesity has emerged as a serious concern among health professionals, as it related to some of chronic diseases including cardiovascular disease (CVD) and type 2 diabetes.[1] According to the definition of overweight and obesity by the World Health Organization, it is estimated that two billion adults suffer from overweight or obesity.[2] Moreover, the annual rate of global death for CVD, a well-known outcome of obesity, is expected to reach to 23.6 million by 2030.[3] This alarming trend has prompted health professionals to seek modalities for early identification of overweight and obesity as well as prevention of its adverse outcome in the general population. Among these methods, anthropometric measurements have gained a great popularity for using in community health setting. Body mass index (BMI), the most applicable anthropometric index, is an indicator of general adiposity, while waist circumference (WC), waist-to-hip ratio (WHpR), and waist-to-height ratio (WHtR) have been developed as the indicators of abdominal adiposity. In addition to total amount of body fat, central distribution of fat is strongly correlated with metabolic abnormalities.[4] Although these indices have frequently used for detection of adiposity, they have different predictive values for obesity-related disorders such as dyslipidemia.

The role of dyslipidemia which is manifested as rising total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), and triglycerides (TG) or reduction in high-density lipoprotein cholesterol (HDL-C), in pathogenesis of

How to cite this article: Eslami O, Shahraki M, Shahraki T. Obesity indices in relation to lipid abnormalities among Medical University students in Zahedan, South-East of Iran. Int J Prev Med 2019;10:15.

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Access this article online
Website: www.ijpvmjournal.net/www.ijpm.ir
DOI: 10.4103/ijpvm.IJPVM_177_17
Quick Response Code:

CVD, has been well established.[5] In addition to lipoprotein components, several atherogenic parameters including LDL-C/HDL-C ratio, and TC/HDL-C ratio and atherogenic index of plasma (AIP) comprise both atherogenic and protective lipoproteins. The current evidence have suggested that these indices have a greater predictive value of CVD risk than classical lipid parameters.[6,7] While the relationship of adiposity with dyslipidemia has been well established,[8] findings on correlation of adiposity indices with lipoprotein and atherogenic parameters are still inconsistent. Several researches reported that indicators of central obesity particularly WC and WHtR had a greater correlation with blood lipids and atherogenic parameters than BMI.[9-11] On the other hand, others indicated that BMI was a better predictor of dyslipidemia compared to central obesity indices.[12] In contrast, some studies found no significant correlation between BMI and atherogenic parameters.[13]

Individuals within the ages of 18–25 years are generally considered as "young adults" who are in a life period between adolescence and adulthood. Recent studies have demonstrated that this group has high prevalence of overweight and obesity which might be a result of an interaction between adverse socioeconomic status, unhealthy dietary choices, and high-risk behaviors such as physical inactivity and smoking. It is well documented that obesity in young ages could lead to adverse outcome on metabolic and vascular health during adulthood.[14-16] Therefore, early assessment of metabolic risk particularly lipid abnormalities using obesity indices with acceptable predictive value seems to be a good approach to prevent such an adverse outcome. With this regard, this study aimed to determine the ability of obesity indices in prediction of lipid abnormalities among a sample of medical students in South-East of Iran.

Materials and Methods

Study design and participants

This cross-sectional study was performed during April–June 2014 among undergraduate students of Zahedan University of Medical Sciences located in Zahedan, center of Sistan and Baluchestan province, South-East of Iran. The minimum sample size for the study was calculated as 310 individuals based on 28% prevalence of metabolic abnormalities among Zahedanian adults reported by a previous study.[17] Individuals of this study were all healthy students aged 18–25 years who were recruited from five university schools including school of medicine, public health, nursing and midwifery, rehabilitation, and paramedical school. Each school rendered list of all students. Students were chosen by a random sampling method which was proportional to the number of students in each school. Students with the following conditions were not included in the study: having any chronic or acute disease, taking any medication including but not limited to lipid-lowering agents or weight-loss drugs, as well as any nutritional supplements during the last 3 months, following any special diets during previous 3 months and changes in body weight >5% during the last 6 months. The research staff distributed advertisement posters throughout the university campus and invited individuals to participate in the study. Students were informed of nature of the study and those who desired to participate signed an informed consent. The Ethics Committee of Zahedan University of Medical Sciences and Research Center for Children and Adolescent Health approved the study protocol (Research project no. 6751).

Measures

A trained dietitian performed anthropometric measurements according to the WHO standards.[18] Weight was measured to the nearest 0.1 kg by Seca digital scale as individuals were barefoot with light clothes. Height was measured to the nearest 0.5 cm by Seca stadiometer at the standing position and without shoes. WC was measured by a nonelastic tape at the midpoint of last rib margin and iliac crest. Furthermore, hip circumference (HC) was measured by the same tape at the widest portion of the buttocks. Other anthropometric indices were calculated based on the following formulas: BMI (Kg/m^2) = weight (kg)/height (m^2); WHpR = WC (m)/HC (m); and WHtR = WC (m)/height (m). In this study, the cut-off-points for obesity indices were defined as following: (i) BMI ≥25 kg/m^2 (overweight or obese) and WHtR ≥0.50 in both genders, (ii) WC ≥102 cm and WHpR ≥0.90 in men, and (iii) WC ≥88 cm and WHpR ≥0.85 in women.[18,19]

For the assessment of lipid and atherogenic parameters, blood samples were taken from participants after 10–12 h overnight fasting. Serum level of TC and TG was determined with enzymatic colorimetric assay using cholesterol esterase, cholesterol oxidase, and glycerol phosphate oxidase. These measurements were done by Pars Azmoon kits (Pars Azmoon Co., Tehran, Iran). The interassay coefficient of variation of these kits was <2%. HDL-C concentrations were assayed by precipitation of the apolipoprotein (apo) B-containing lipoproteins with phosphotungstic acid and magnesium chloride fluid. Other lipid parameters and atherogenic parameters were calculated using the following formulas:[6,20,21]

LDL-C = TC − HDL-C – TG/5 (as referred to Friedewald equation); non-HDL-C = TC-HDL-C; TC:HDL-C ratio = TC/HDL-C; LDL-C:HDL-C ratio = LDL-C/HDL-C; AIP = Log (TG/HDL-C ratio). TC ≥200 mg/dL, TG ≥150 mg/dL, and LDL-C ≥130 mg/dL in all students, in addition to HDL-C <40 mg/dL in men and <50 mg/dL in women, were regarded as abnormal lipid parameters. The cutoffs for LDL-C:HDL-C ratio and TC:HDL-C ratio were >3.50 and >5 in men and >3 and >4.50 in women, respectively. In addition, abnormal values of non-HDL-C and AIP were defined as ≥130 mg/dL and >0.50, respectively.[6,21,22]

Data analysis

Data analysis was performed using SPSS software version 22 (IBM Corp., Armonk, NY, USA). The normality of data was determined using the Kolmogorov–Smirnov test. Univariate analysis was conducted using independent sample *t*-test or Mann–Whitney U-test as appropriate. To determine the ability of obesity indices in prediction of lipid abnormalities, a logistic regression model was employed and lipid and atherogenic parameters were included as the dependent variables in the model adjusted for age. The goodness-of-fit of the logistic regression model was checked with the Hosmer and Lemeshow test. The results were reported as means ± standard deviations (SDs), frequencies, percentages, odds ratios (ORs), and 95% confidence intervals (CIs). $P < 0.05$ was considered statistically significant.

Results

A total of 353 eligible students (188 males and 165 females) with mean (±SD) age of 20.93 (±1.46) years participated in the study. Table 1 compares the mean value of anthropometric indices, lipid, and atherogenic parameters in men and women. Men had significantly higher mean values of weight (P = <0.001), WC (P = <0.001), and WHpR (P = <0.001), as well as LDL-C:HDL-C (P = <0.001), TC:HDL-C (P = <0.001), and AIP (P = <0.001) than women. However, mean values of HDL-C (P = <0.001) were significantly higher in women compared to men.

Relationship of obesity indices with lipid and atherogenic parameters in men and women is presented in Tables 2 and 3. Among men, significant differences between those with high value of obesity indices compared to normal controls were found as following: (1) high BMI and high WHtR with higher values of all lipid and atherogenic parameters except for HDL-C, (2) high WC with higher values of TC and LDL-C, and (3) high WHpR with higher values of LDL-C, LDL-C:HDL-C, and TC:HDL-C. In women, a similar pattern was observed for BMI. Also, individuals with high WHtR had significantly higher values of TC, TG, LDL-C, and non-HDL-C compared to normal-WHtR ones. In comparison to normal controls, those with high WC as well as high WHpR had significantly increased values of TG and AIP.

Tables 4 and 5 have provided ORs (95%CIs) for the association of general and central obesity with lipid abnormalities in the study population. Men with BMI ≥25 kg/m² had the highest odds of having high TC (OR = 7.67, P = 0.003), LDL-C (OR = 3.24, P = 0.01), TC:HDL-C (OR = 4.98, P = 0.01), and non-HDL-C (OR = 4.32, P = 0.001). However, those with WC ≥102 cm had the highest odds for LDL-C:HDL-C > 3.50 (OR = 6.71, P = 0.01). In women, those with BMI ≥25 kg/m² had the highest probability of having elevated TG (OR = 8.80, P = 0.002), LDL-C:HDL-C (OR = 3.64, P = 0.01), and AIP (OR = 9.65, P < 0.001). The highest odds for having TC:HDL-C ≥4.50 (OR = 3.25, P = 0.050) was observed in women with WC ≥88 cm. In addition, those with WHtR ≥0.50 had the highest odds of high TC (OR = 3.56, P = 0.02) and non-HDL-C (OR = 2.70, P = 0.02).

Table 1: The mean values and standard deviations of obesity indices, lipid parameters, and atherogenic indices in students

Variables	Total	Gender		P*
		Males (*n*=188; 53.3%)	Females (*n*=165; 46.7%)	
Age (year)	20.93±1.46[†]	21.17±1.44	20.65±1.43	0.002
Weight (kg)	63.96±11.42	67.38±11.61	60.07±9.86	<0.001
BMI (kg/m²)	23.18±3.51	22.90±3.53	23.50±3.47	0.07
WC (cm)	83.74±8.50	86.37±8.60	80.74±7.34	<0.001
WHpR	0.84±0.06	0.88±0.05	0.81±0.04	<0.001
WHtR	0.50±0.04	0.50±0.05	0.50±0.04	0.49
TC (mg/dL)	153.13±30.05	150.66±29.21	155.94±30.83	0.13
TG (mg/dL)	103.34±31.78	103.59±32.70	103.07±30.79	0.97
HDL-C (mg/dL)	50.61±13.57	46.06±10.79	55.79±14.56	<0.001
LDL-C (mg/dL)	103.10±20.12	103.71±20.04	102.40±20.24	0.54
LDL-C:HDL-C	2.17±0.67	2.34±0.62	1.97±0.68	<0.001
TC:HDL-C	3.19±0.95	3.40±0.92	2.96±0.92	<0.001
AIP	0.30±0.17	0.34±0.16	0.26±0.17	<0.001
non-HDL-C (mg/dL)	102.52±29.87	104.60±28.29	100.15±31.51	0.08

*P for LDL-C and AIP was derived by Independent sample *t*-test. While for other variables, it was derived by Mann–Whitney U-test. [†]Mean±SD. BMI=Body mass index, WC=Waist circumference, WHpR=Waist-to-hip ratio, WHtR=Waist-to-height ratio, TC=Total cholesterol, TG=Triglycerides, LDL-C=Low-density lipoprotein-cholesterol, HDL-C=High-density lipoprotein-cholesterol, AIP=Atherogenic index of plasma, SD=Standard deviation

Table 2: The relationship between obesity indices, blood lipids, and atherogenic indices in male students

Obesity indices	*n* (%)	TC (mg/dL)	TG (mg/dL)	LDL-C (mg/dL)	HDL-C (mg/dL)	LDL-C: HDL-C	TC: HDL-C	AIP	non-HDL-C (mg/dL)
BMI (kg/m²)									
<25	149 (79.3)	146.36±28.34*	100.58±32.18	100.91±19.51	46.34±10.31	2.26±0.57	3.26±0.85	0.32±0.16	100.02±26.69
≥25	39 (20.7)	167.08±26.83	115.08±32.52	114.41±18.55	44.97±12.52	2.68±0.66	3.91±1.02	0.40±0.16	122.10±27.69
P†		<0.001	0.01	<0.001	0.15	<0.001	<0.001	0.007	<0.001
WC (cm)									
<102	168 (89.4)	149.31±29.11	102.55±32.61	102.58±19.61	46.10±10.59	2.31±0.59	3.36±0.88	0.33±0.16	103.21±27.64
≥102	20 (10.6)	162.00±28.25	112.25±33.00	113.20±21.60	45.75±12.62	2.62±0.75	3.75±1.16	0.38±0.17	116.25±1.62
P†		0.04	0.17	0.02	0.60	0.07	0.08	0.22	0.06
WHpR									
<0.90	133 (70.7)	149.60±28.96	102.41±32.01	101.86±19.60	46.98±11.40	2.27±0.62	3.32±0.93	0.32±0.17	102.62±28.04
≥0.90	55 (29.3)	153.22±29.90	106.42±34.46	108.16±20.56	43.84±8.85	2.53±0.57	3.58±0.88	0.37±0.15	109.38±28.57
P†		0.30	0.50	0.05	0.11	0.01	0.01	0.12	0.06
WHtR									
<0.50	115 (61.2)	145.73±28.64	99.09±30.87	100.69±20.18	46.18±10.27	2.25±0.55	3.26±0.82	0.32±0.16	99.55±26.71
≥0.50	73 (38.8)	158.42±28.58	110.67±34.43	108.47±18.99	45.86±11.62	2.49±0.685	3.62±1.02	0.37±0.16	112.56±29.04
P†		0.002	0.02	0.009	0.51	0.02	0.005	0.03	0.001

*Mean±SD, †*P* for LDL-C and AIP was derived by Independent sample *t*-test. While, for other variables, it was derived by Mann–Whitney U-test. SD=Standard deviation, BMI=Body mass index, WC=Waist circumference, WHpR=Waist-to-hip ratio, WHtR=Waist-to-height ratio, TC=Total cholesterol, TG=Triglycerides, LDL-C=Low-density lipoprotein-cholesterol, HDL-C=High-density lipoprotein-cholesterol, AIP=Atherogenic index of plasma

Table 3: The relationship between obesity indices, blood lipids, and atherogenic indices in female students

Obesity indices	*n* (%)	TC (mg/dL)	TG (mg/dL)	LDL-C (mg/dL)	HDL-C (mg/dL)	LDL-C: HDL-C	TC: HDL-C	AIP	non-HDL-C (mg/dL)
BMI (kg/m²)									
<25	117 (70.9)	151.98±29.14*	96.65±25.31	99.85±18.89	56.81±14.33	1.88±0.64	2.82±0.86	0.23±0.16	95.17±30.01
≥25	48 (29.1)	165.58±32.98	118.71±37.09	108.60±22.22	53.31±14.96	2.18±0.73	3.29±0.99	0.34±0.18	112.27±32.08
P†		0.009	<0.001	0.01	0.09	0.008	0.003	<0.001	0.002
WC (cm)									
<88	140 (84.8)	155.20±30.39	99.82±27.95	101.72±19.14	56.29±14.86	1.93±0.65	2.91±0.88	0.24±0.17	98.91±30.34
≥88	25 (15.2)	160.08±33.56	121.24±39.36	106.20±25.73	53.04±12.67	2.14±0.82	3.21±1.12	0.34±0.19	107.04±37.30
P†		0.44	0.01	0.31	0.41	0.28	0.32	0.009	0.33
WHpR									
<0.85	139 (84.2)	155.86±31.32	100.58±29.20	102.30±20.15	56.16±14.692	1.95±0.68	2.94±0.93	0.25±0.17	99.71±32.10
≥0.85	26 (15.8)	156.35±28.67	116.35±36.03	102.92±21.14	53.85±13.95	2.03±0.66	3.06±0.87	0.32±0.18	102.50±28.56
P†		0.82	0.02	0.88	0.54	0.54	0.34	0.04	0.36
WHtR									
<0.50	92 (55.8)	148.98±26.48	97.34±26.83	99.10±17.82	55.42±13.83	1.90±0.61	2.83±0.80	0.24±0.16	93.55±26.98
≥0.50	73 (44.2)	164.71±33.75	110.29±33.99	106.56±22.38	56.26±15.51	2.04±0.75	3.12±1.04	0.28±0.19	108.45±34.86
P†		0.002	0.01	0.01	0.91	0.29	0.11	0.09	0.005

*Mean±SD, †*P* for LDL-C and AIP was derived by Independent sample t-test. While for other variables, it was derived by Mann–Whitney U-test. SD=Standard deviation, BMI=Body mass index, WC=Waist circumference, WHpR=Waist-to-hip ratio, WHtR=Waist-to-height ratio, TC=Total cholesterol, TG=Triglycerides, LDL-C=Low-density lipoprotein-cholesterol, HDL-C=High-density lipoprotein-cholesterol, AIP=Atherogenic index of plasma

Discussion

Results of the current study showed BMI as a stronger predictor of atherogenic condition than central obesity indices among medical students. Also, in terms of classical lipid parameters, BMI was a strong predictor of high TC and LDL-C in male students. However, BMI and WC as well as WHtR were the strong predictors of high TG and TC in female students. Similarly, a study among Saudi male medical students aged 18–35 years and another study among healthy adults aged 21–60 years revealed a positive correlation of BMI with TC and LDL-C.[13,23] However, Bertsias *et al*. showed that in a sample of Greek medical students aged 20–40 years, WHtR was the strong predictor of high TC and LDL-C in men and high LDL-C in women.[9] In addition, in a study among Brazilian university students, BMI and WHtR had the highest correlation with TG levels.[24] In contrast to the findings

Table 4: Odds ratios (95% confidence intervals) for the association of general and central obesity with lipid abnormalities in male students.

	n (%)	BMI ≥25 kg/m²	WC ≥102 cm	WHpR ≥0.90	WHtR ≥0.50
TC ≥200 (mg/dL)	11 (5.9)	7.67 (2.00, 29.36)	2.34 (0.45, 12.11)	1.60 (0.44, 5.84)	3.66 (0.98, 13.63)
P		0.003	0.309	0.47	0.052
TG ≥150 (mg/dL)	19 (10.1)	1.73 (0.59, 5.00)	1.56 (0.40, 5.98)	1.37 (0.50, 3.75)	2.24 (0.85, 5.93)
P		0.31	0.51	0.53	0.10
LDL-C ≥130 (mg/dL)	25 (13.3)	3.24 (1.30, 8.06)	2.21 (0.70, 6.93)	1.55 (0.63, 3.78)	1.37 (0.59, 3.26)
P		0.01	0.17	0.33	0.47
HDL-C <40 (mg/dL)	71 (37.8)	1.71 (0.82, 3.56)	1.48 (0.57, 3.81)	1.49 (0.78, 2.86)	1.46 (0.79, 2.70)
P		0.14	0.41	0.22	0.21
LDL-C:HDL-C >3.50	8 (4.3)	5.20 (1.16, 23.20)	6.71 (1.40, 31.94)	2.79 (0.66, 11.79)	3.13 (0.70, 13.95)
P		0.03	0.01	0.16	0.13
TC: HDL-C ≥5	13 (6.9)	4.98 (1.46, 16.94)	3.32 (0.80, 13.76)	1.20 (0.35, 4.16)	1.60 (0.50, 5.12)
P		0.01	0.09	0.76	0.42
AIP >0.50	34 (18.1)	2.18 (0.93, 5.07)	0.77 (0.21, 2.81)	1.18 (0.53, 2.66)	1.75 (0.82, 3.73)
P		0.07	0.69	0.67	0.14
non-HDL-C ≥130 (mg/dL)	27 (14.4)	4.32 (1.77, 10.56)	2.26 (0.742, 6.90)	1.27 (0.52, 3.05)	2.28 (0.99, 5.27)
P		0.001	0.15	0.59	0.052

Logistic regression models including age as confounding factor. BMI=Body mass index, WC=Waist circumference, WHpR=Waist-to-hip ratio, WHtR=Waist-to-height ratio, TC=Total cholesterol, TG=Triglycerides, LDL-C=Low-density lipoprotein-cholesterol, HDL-C=High-density lipoprotein-cholesterol, AIP=Atherogenic index of plasma

Table 5: Odds ratios (95% confidence intervals) for the association of general and central obesity with lipid abnormalities in female students

	n (%)	BMI ≥25 kg/m²	WC ≥88 cm	WHpR ≥0.85	WHtR ≥0.50
TC ≥200 (mg/dL)	18 (10.9)	1.96 (0.71, 5.40)	1.12 (0.29, 4.24)	0.58 (0.12, 2.72)	3.56 (1.20, 10.59)
P		0.18	0.86	0.49	0.02
TG ≥150 (mg/dL)	12 (7.3)	8.80 (2.24, 34.65)	4.73 (1.36, 16.37)	1.82 (0.45, 7.33)	2.65 (0.76, 9.27)
P		0.002	0.01	0.39	0.12
LDL-C ≥130 (mg/dL)	18 (10.9)	2.05 (0.75, 5.64)	2.43 (0.78, 7.57)	1.02 (0.27, 3.86)	2.73 (0.96, 7.74)
P		0.16	0.12	0.96	0.057
HDL-C <50 (mg/dL)	78 (47.3)	1.85 (0.92, 3.72)	1.27 (0.53, 3.01)	1.49 (0.63, 3.51)	1.01 (0.54, 1.90)
P		0.08	0.58	0.35	0.95
LDL-C: HDL-C >3	16 (9.7)	3.64 (1.25, 10.58)	2.92 (0.91, 9.30)	0.72 (0.15, 3.42)	3.08 (1.01, 9.38)
P		0.01	0.06	0.68	0.04
TC: HDL-C ≥4.50	15 (9.1)	2.94 (0.99, 8.72)	3.25 (1.00, 10.58)	0.74 (0.15, 3.54)	2.61 (0.84, 8.08)
P		0.052	0.050	0.71	0.09
AIP >0.50	14 (8.5)	9.65 (2.69, 34.58)	3.86 (1.15, 12.95)	4.22 (1.22, 14.58)	6.50 (1.66, 25.31)
P		<0.001	0.02	0.02	0.007
non-HDL-C ≥130 (mg/dL)	29 (17.6)	2.54 (1.09, 5.89)	2.11 (0.77, 5.76)	1.01 (0.34, 3.02)	2.70 (1.15, 6.33)
P		0.02	0.14	0.97	0.02

Logistic regression models including age as confounding factor. BMI=Body mass index, WC=Waist circumference, WHpR=Waist-to-hip ratio, WHtR=Waist-to-height ratio, TC=Total cholesterol, TG=Triglycerides, LDL-C=Low-density lipoprotein-cholesterol, HDL-C=High-density lipoprotein-cholesterol, AIP=Atherogenic index of plasma

of above-mentioned studies, a study among Chilean adults reported that BMI and WC had similar predictive values for cardiometabolic risk factors, particularly dyslipidemia.[25] Inconsistent observation among different studies might be due to the differences in sample size of studies, age range of study participants, or the cutoff points for abnormal lipid parameters and general or central obesity.

In this study, BMI was a powerful predictor of LDL-C:HDL-C and TC:HDL-C in male students. However, in female students, BMI and WHtR had the highest predictive values for LDL-C:HDL-C. On the other hand, WC was the strong predictor of TC:HDL-C. These findings highlight the importance of both general and central obesity indices as predictors of cardiovascular risk factors since strong evidence from large observational and cohort studies have shown that LDL-C:HDL-C and TC:HDL-C are more powerful predictors of cardiovascular risk factors than simple lipid parameters including TC, HDL-C, and LDL-C.[6] However, previous studies reported diverse results. In the study of Greek students, only a value of

WHpR ≥0.90 in men and WHtR ≥0.50 in women was correlated with higher odds of high TC:HDL-C (TC:HDL-C ≥4).[9] Besides the larger sample size of this study (989 students), the researchers had used an equal cutoff point for TC:HDL-C in both men and women that might justify the different results. In addition, another study comprised participants aged 5–17 years had reported that WHtR was slightly better predictor of TC:HDL-C values than BMI-for age (or BMI Z-score).[26] However, it should be noted that the authors used BMI-for-age which is the BMI adjusted for age and sex under 18-year olds and it is somehow different from BMI measured in adults.[27] Therefore, this issue might affect the power of obesity indices in prediction of lipid abnormalities.

AIP, another important atherogenic parameter, represents the balance between atherogenic and protective lipoproteins. Previous reports had shown a stronger correlation of this index with cardiovascular risk factors than classical lipid parameters alone.[28,29] Interestingly, high values of AIP were positively correlated with lower score of ideal cardiovascular health components.[30] In the present study, all obesity indices were positively correlated with higher odds for abnormal AIP values in females, while such an association was not observed for any obesity indices in male students. Likely, a study among 1000 Iranian adults reported a positive correlation of AIP with BMI and WC.[31] Nevertheless, studies on the association of obesity indices with AIP are scarce and more researches are needed to determine the best obesity indices as predictor of AIP values.

The present study revealed that BMI in men and BMI and WHtR in women were the powerful predictors of high non-HDL-C. In a similar study among Slovakian university students, a positive correlation was found between non-HDL-C and all obesity indices including BMI, WC, WHpR, and WHtR.[32] Non-HDL-C, unlike the other lipid parameters, considers the total amounts of cholesterol in all atherogenic lipoproteins including very low density lipoprotein (VLDL) and LDL-C.[21] Previous researches confirmed that non-HDL-C had a greater predictive power for cardiovascular risk factors compared to the conventional lipid parameters, particularly LDL-C.[33,34] Non-HDL-C is now considered as an important goal in both primary and secondary CVD prevention, as the European guidelines on the management of CVD, have suggested that achieving an optimal level of non-HDL-C should be regarded as the second goal of treatment in patients with hyperlipidemia.[35]

The present study is one of the first in its kind that had conclusively assessed the relationship of obesity indices with well-established atherogenic parameters alongside the traditional lipid parameters among a group of young population. However, some limitations in this study should be addressed. The serum levels of apo B, A-I, and the apo B:Apo A-I ratio were not evaluated. It is proposed that the apoB:Apo A-I ratio which reflects the amounts of circulating plasma cholesterol, may be a better predictor of cardiovascular risk factors than simple lipid parameters.[36] Although it should be noted that previous studies reported a similar predictive power for TC: HDL-C and non-HDL-C with apoB:Apo A-I.[37,38] there is still no definite agreement on the optimal cutoff points for primary and secondary prevention of CVD which might limit the ability of this ratio in routine clinical visits.[6] Another possible limitation of this study might be the lower prevalence of overweight or obesity and lipid abnormalities among study group in comparison with similar reports that should be considered at the time of interpretation. Only 25% of participants were overweight or obese. However, the lower prevalence of the above-mentioned abnormalities among medical students in this study might be the result of their more knowledge about cardiovascular health-related issues as well as their closer adherence to these issues compared to the others. In addition, dietary intakes of study participants as well as other body composition parameters such as body fat percentage and lean body mass were not measured in this study. These parameters could give more precise information on obesity status. Further researches using these parameters are highly recommended.

Conclusions

The findings of the present study confirmed an association between obesity indices with lipid and atherogenic parameters. It could be inferred generally that BMI was the stronger predictor for most of classical lipid parameters and atherogenic parameters than central obesity indices in medical students. Since obesity indices and atherogenic parameters are simple, easy to use, quick, and noninvasive, it is promising that using them routinely could increase the efficiency of programs related to primary and secondary prevention of CVD.

Acknowledgments

Our thanks go to all medical students who actively participated in this study. Also, special thanks to Omid Sabetghadam for his valuable helping in sample collecting.

Financial support and sponsorship

This study was funded by Zahedan University of Medical Sciences.

Conflicts of interest

There are no conflicts of interest.

Received: 12 Apr 17 **Accepted:** 30 Oct 17
Published: 12 Feb 19

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