Journal of Nutrition and Food Security
Shahid Sadoughi University of Medical Sciences
School of Public Health
Department of Nutrition
Nutrition & Food Security Research Center

eISSN: 2476-7425 pISSN: 2476-7417 JNFS 2017; 2(3): 185-193 Website: jnfs.ssu.ac.ir

Correlation of Obesity with Cardiometabolic Status among Medical University Employees in Southeast of Iran

Mansour Shahraki; PhD[1], Omid Eslami; MSc[*2] & Touran Shahraki; MD[3]

[1] *Department of Nutrition, School of Medicine & Children and Adolescent Health Research Center, Zahedan University of Medical Sciences, Zahedan, Iran.*
2 Department of Nutrition, School of Public Health, Iran University of Medical Sciences, Tehran, Iran.
[3] *Department of Pediatrics, School of Medicine & Children and Adolescent Health Research Center, Zahedan University of Medical Sciences, Zahedan, Iran.*

ARTICLE INFO

ORIGINAL ARTICLE

Article history:
Received: 7 May 2017
Revised: 31 May 2017
Accepted: 21 Jun 2017

Corresponding author:
eslami.iums@ gmail.com
Department of Nutrition, School of Public Health, Iran University of Medical Sciences, Tehran, Iran.

Postal code: 1449614535
Tel: +98-933-605-4861

ABSTRACT

Background: Employees are considered as an at-risk group for obesity and its adverse outcomes, particularly cardiovascular diseases (CVD). The present study was conducted to assess the correlation of obesity indices with CVD risk factors among a group of medical university employees in Zahedan city, southeast of Iran. **Methods**: This cross-sectional study recruited 211 healthy employees of Zahedan University of Medical Sciences during October 2015. Obesity indices including body mass index (BMI), waist circumference (WC), waist to hip ratio (WHpR), and waist to height ratio (WHtR) were measured in accordance to the standard criteria. Fasting blood glucose (FBG), blood lipids, and blood pressure were also measured. **Results**: Women had significantly higher values of weight, WC, WHpR, and FBG than men ($P < 0.05$). Bivariate analysis showed that those with BMI, WC, or WHtR higher than the cut-off-point levels had significantly higher serum levels of blood parameters and blood pressure compared to normal participants, respectively. BMI and WC had significant positive correlation with all parameters except with high density lipoprotein-cholesterol; these correlations were slightly stronger for WC compared to BMI. However, the correlation of WHpR and WHtR with metabolic parameters was weak. **Conclusions**: BMI and WC had an almost moderate correlation with CVD risk factors among the participants. Therefore, using WC along with BMI is suggested as the preferred method for assessment of CVD risk factors.

Keywords: *Obesity; Waist circumference; Blood glucose; Lipoproteins; Blood pressure*

Introduction

According to the World Health Organization (WHO) report, in 2014, almost more than one billion individuals were overweight or obese (WHO, 2016). In Iran, the prevalence of obesity in adults aged more than 18 years old is estimated 21.7%, respectively (Rahmani *et al.*, 2015). Besides the deleterious effect of obesity in reducing quality

This paper should be cited as: Shahraki M, Eslami O, Shahraki T***. Correlation of Obesity with Cardiometabolic Status among Medical University Employees in Southeast of Iran.*** *Journal of Nutrition and Food Security (JNFS),* 2017; 2 (3): 185-93.

of life, it could be lead to cardiovascular (CV) events such as coronary heart disease and heart failure. Furthermore, strong evidences have indicated that the interaction of obesity with CV events can be mediated through the negative impact of obesity on CV risk factors including hyperlipidemia, hyperglycemia or hypertension (Gaddam *et al.*, 2011, Klop *et al.*, 2013). Although the correlation of obesity with CV risk factors is well-established, the ability of indicators of obesity in prediction of above-mentioned risk factors is still unclear.

Currently, four indices including body mass index (BMI), waist circumference (WC), waist to hip ratio (WHpR) and waist to height ratio (WHtR) have been frequently applied for assessment of obesity. BMI as the general obesity index reflects simply the total body fat, but it is not able to determine body fat distribution. Since the distribution of body fat is better correlated with metabolic risk that its amount, thus, several central indicators of obesity including WC, WHpR and WHtR were developed to assess the abdominal distribution of body fat (Browning *et al.*, 2010, Huxley *et al.*, 2010).

Results of several studies showed a positive correlation between BMI with dyslipidemia and hypertension (Ouyang *et al.*, 2015, Ugwuja *et al.*, 2013). While other studies reported that central obesity indices including WC and WHpR were better predictors of CV risk factors than BMI (Li and McDermott, 2010, van Dijk *et al.*, 2012). Even among the central obesity indices, the predictive power of CV risk factors was differed significantly for each index , as it was reported that WC or WHtR were stronger predictors of CV risk factors compared to WHpR in adult population (Shahraki *et al.*, 2008, Tseng *et al.*, 2010). In contrast, some researchers reported an equal predictive power of metabolic risk for both BMI and WC and using them in combination were suggested as the preferred option (Du *et al.*, 2010, Lara *et al.*, 2012). Moreover, some studies indicated that the predictive values of obesity indices for CV risk factors were different in men and women (Bi *et al.*, 2016, Yu *et al.*, 2016).

With respect to the inconsistent findings reported by previous researches, the present study was conducted to assess the correlation of obesity indices with cardiometabolic parameters among a group of medical university employees in southeast of Iran.

Materials and Methods

Study participants: The present cross-sectional study was conducted during October 2015. Participants consisted of clinically healthy employees of Zahedan University of Medical Sciences in Zahedan city, southeast part of Iran. Those medical university employees who referred to the nutrition consultation pavilion in the health exhibition for assessment of nutritional status and received nutritional recommendations from dietitians participated in this study. The health exhibition is held annually in Zahedan city under the patronage of Zahedan University of Medical Sciences. Exclusion criteria were included 1) having any acute, chronic, or inflammatory diseases as well as taking medications related to any current and past disorders, 2) having secondary obesity, such as hypothyroidism or cushing's syndrome, 3) following weight loss or restrictive diets during the last two months, and 4) being pregnant or lactating women . A total of 211 participants took part in this study and rendered written informed consent.

Measurements: At the beginning, all participants completed a questionnaire containing demographic information (age, gender, academic degree, marital status, and physical activity level)

Weight and height were measured in standing position, without shoes, and with light clothes by a digital scale and a stadiometer. BMI was calculated through the following formula: weight (kg)/(height (m))^2. People with a BMI of less than 18.50 are considered underweight, in the range of 18.50-24.99 as normal, in the range of 25-29.99 as overweight, and individuals with BMI of more than or equal to 30 kg/m^2 were defined as obese. WC and hip circumference were measured by a non-elastic tape according to WHO guidelines (WHO, 2011). Based on these measurements, the

[DOR: 20.1001.1.24767417.2017.2.3.7.5]

ratios of WHpR and WHtR were calculated. In men, WC of higher than 102 cm and WHpR of more than 0.90 were considered as cut-off values, while these values for women were WC higher than 88 cm and WHpR of more than 0.85. Moreover, the cut-off values for WHtR was higher than 0.50 in both genders (Chan. R and J, 2010).

Systolic and diastolic blood pressure (SBP and DBP) were measured twice from the left arm after 10 minutes of rest by a mercury sphygmomanometer (OMRON Healthcare, Germany) then the average of two measurements was used for analysis. For the measurement of fasting blood glucose (FBG) and lipids, 5 ml of venous blood was taken while participants were at fasting state (10 to 12 hours fasting). All measurements were done in the laboratory of educational University hospital (Ali Ibn Abi Talib Hospital) by using the commercial kits (ParsAzmoon kits, Tehran, Iran). Enzymatic methods were applied using cholesterol esterase, cholesterol oxidase, and glycerol phosphate oxidase for total cholesterol (TC) and triglyceride (TG) and glucose oxidase for FBG. High density lipoprotein-cholesterol (HDL-c) measurement was based on precipitation process of the apolipoprotein B-containing lipoproteins with phosphotungstic acid and magnesium chloride fluid. Low density lipoprotein-cholesterol (LDL-c) was later calculated indirectly by the Friedewald formula (Friedewald *et al.*, 1972).

Data analysis: Data were expressed using descriptive statistics including frequency, percentage, mean, and standard deviation. Metabolic parameters between subgroups of obesity indices were compared with independent sample *t*-test, one way ANOVA, and LSD post hoc. Pearson correlations were performed to evaluate the degree of correlation between obesity indices and metabolic parameters. All statistical analyses were conducted with $SPSS_{22}$ (IBM Corp., USA) software and a P-value of less than 0.05 was regarded as statistically significant**.**

Ethical considerations: The study protocol was in accordance to the ethical principles of the Declaration of Helsinki. All participants were informed form the study procedure and signed written informed consent.

Results

Data in **Table 1** represents participants' demographic characteristics. The age range of study population (111 men and 100 women) was between 23 to 63 years. Majority of participants had Bachelor's degree and were married. One-third of them reported two to three days of physical activity per week.

Table 2 compares the mean values of obesity indices, blood lipids, FBG, and blood pressure between men and women. The average values of weight ($P < 0.001$), WC ($P = 0.04$), WHpR ($P < 0.001$), and FBG ($P = 0.03$) were significantly higher in women than men. However, there were no significant differences in other parameters between men and women.

The relationships between different categories of obesity indices and metabolic parameters are shown in **Tables 3, 4,** and **5**. In terms of BMI and metabolic parameters, those participants with overweight and obesity had significantly higher values of TC, LDL-c, FBG, SBP, and DBP than the normal weight people. Additionally, normal weight and overweight individuals had significantly elevated levels of TG and FBG compared to underweight ones. The serum levels of TC were significantly higher in overweight than underweight individuals, too. Moreover, the mean values of SBP were significantly higher in obese than overweight individuals. Regarding WC and metabolic parameters, those men and women with respective WC of equal to or higher than 102 cm and 88 cm had significantly higher values of FBG, SBP, and DBP than normal people. The serum levels of TC, TG, and LDL-c were significantly higher in women with WC of equal to or higher than 88 cm compared to normal-WC individuals. While the serum levels of HDL-c were significantly lower in high-WC versus normal-WC women. For WHpR, those women with WHpR of equal to or higher than 0.90 had significantly elevated levels of LDL-c compared to normal ones. For WHtR, the average levels of blood lipids except for HDL-c as well as

SBP and DBP were significantly higher in those with WHtR of equal to or higher than 0.50 compared to normal individuals.

Table 6 presents the degree of correlation between each obesity index and metabolic parameters. BMI and WC had significant positive correlation with all parameters except for HDL-c and these correlations were slightly stronger for WC than BMI. However, the correlation between WHpR and metabolic parameters did not reach a significant level. WHtR had only a significant positive correlation with FBG and SBP.

Table 1. Participants' characteristics

Variables	n (%)
Gender	
Men	111 (52.6)
Women	100 (47.4)
Academic Degrees	
Associates Degree	54 (25.6)
Bachelor's degree	116 (55.0)
Master’s degree	41 (19.4)
Marital status	
Single	32 (15.2)
Married	177 (83.9)
Divorced	2 (0.9)
Physical activity(days per week)	
Never	65 (30.8)
1	62 (29.4)
2-3	69 (32.7)
4-6	15 (7.1)
Age (year)	37.12 ± 8.75 (36.00, 23-63)[a]

[a]: Mean± SD (Median,Min-Max)

Table 2. Mean (± SD) of obesity indices and cardiometabolic parameters between men and women

	Total	Men	Women	P-value[a]
Weight (kg)	72.57 ± 11.94	69.15 ± 11.75	76.37 ± 11.02	<0.001
BMI (kg/m^2)	25.99 ± 5.61	26.60 ± 7.13	25.32 ± 3.07	0.08
WC (cm)	85.91 ± 10.34	84.58 ± 10.40	87.38 ± 10.12	0.04
WHpR	0.88 ± 0.06	0.86 ± 0.06	0.91 ± 0.06	<0.001
WHtR	0.53 ± 0.34	0.52 ± 0.08	0.55 ± 0.49	0.56
TC (mg/dL)	188.92 ± 42.23	188.55 ± 42.96	189.34 ± 41.62	0.89
TG (mg/dL)	192.00 ± 64.36	187.60 ± 60.31	196.87 ± 68.56	0.29
HDL-c (mg/dL)	49.72 ± 20.54	51.58 ± 26.99	47.65 ± 8.82	0.16
LDL-c (mg/dL)	105.82 ± 25.47	108.01 ± 24.91	103.38 ± 25.99	0.18
FBG (mg/dL)	116.84 ± 30.81	112.55 ± 26.07	121.60 ± 34.86	0.03
SBP (mmHg)	117.50 ± 12.11	117.59 ± 12.99	117.39 ± 11.12	0.90
DBP (mmHg)	71.81 ± 9.78	71.47 ± 8.87	72.19 ± 10.74	0.59

[a]: Independent sample *t*-test. BMI: body mass index, WC: waist circumference, WHpR : waist to hip ratio, WHtR: waist to height ratio, TC: total cholesterol, TG: triglyceride, HDL-c: high density lipoprotein- cholesterol, LDL-c: low density lipoprotein- cholesterol, FBG: fasting blood glucose, SBP: systolic blood pressure, DBP: diastolic blood pressure.

[DOR: 20.1001.1.24767417.2017.2.3.7.5]

Table 3. Comparison mean (± SD) of cardiometabolic parameters in term of body mass index classification

Variables	Body mass index (kg/m²) categorization Group I <18.50 (Underweight)	Group II 18.50-24.99 (Normal)	Group III 25-29.99 (Overweight)	Group IV ≥ 30 (Obese)	P-value[a]
n (%)	4 (1.9)	98 (46.4)	84 (39.8)	25 (11.8)	
TC (mg/dL)	160.00 ± 79.98 †	173.32 ± 39.84	206.95 ± 37.90	194.16 ± 33.53	<0.001[b]
TG (mg/dL)	123.25 ± 72.16	175.17 ± 58.10	214.68 ± 62.90	192.72 ± 67.28	<0.001[c]
HDL-c (mg/dL)	56.25 ± 9.74	50.36 ± 8.72	50.20 ± 30.86	44.52 ± 6.45	0.54
LDL-c (mg/dL)	99.00 ± 38.49	95.45 ± 20.09	115.37 ± 26.14	115.44 ± 25.18	<0.001[d]
FBG (mg/dL)	81.50 ± 13.91	108.59 ± 31.35	123.39 ± 24.75	132.80 ± 35.91	<0.001 [e]
SBP (mmHg)	115.00 ± 10.00	113.32 ± 9.25	120.00 ± 13.04	125.88 ± 13.01	<0.001f
DBP (mmHg)	70.00 ± 11.54	69.11 ± 10.25	74.06 ± 8.71	75.12 ± 8.65	0.002[g]

[a]:One-way ANOVA,[b] group I and III (0.02) , group II and III (<0.001)and IV (0.01),[c:] group I and III (0.004) and IV (0.03) and group II and III (<0.001), [d:] group II and III (<0.001) and IV (<0.001), [e:] group I and III (0.006) and IV (0.001) and group II and III (0.001) and IV (<0.001), [f:] group II and III (<0.001) and IV (<0.001) and group III and IV (0.02), [g:]group II and III (0.001) and IV (0.005), TC: total cholesterol, TG: triglyceride, HDL-c: high density lipoprotein- cholesterol, LDL-c: low density lipoprotein- cholesterol, FBG: fasting blood glucose, SBP: systolic blood pressure, DBP: diastolic blood pressure.

Table 4. Comparison mean (± SD) of cardiometabolic parameters and blood pressure in term of waist circumference and waist to hip ratio

Variables/sex	Men		P-value	Women		P-value
WC (cm)	<102	≥ 102		< 88	≥ 88	
n (%)	106 (95.5)	5 (4.5)		57 (57)	43 (43)	
TC (mg/dL)	188.30 ± 43.65	193.80 ± 26.45	0.78	175.86 ± 39.79	207.21 ± 37.40	< 0.001
TG (mg/dL)	188.84±61.13	161.40 ± 32.02	0.32	173.79 ± 58.69	227.47 ± 69.33	< 0.001
HDL-c (mg/dL)	51.84 ± 27.58	46.00 ± 4.18	0.63	50.75 ± 7.67	43.53 ± 8.62	< 0.001
LDL-c (mg/dL)	107.56 ± 24.85	117.60 ± 27.09	0.38	91.56 ± 16.74	119.05 ± 27.88	< 0.001
FBG (mg/dL)	110.81 ± 24.81	149.40 ± 27.37	0.001	113.51 ± 27.76	132.33 ± 40.37	0.007
SBP (mmHg)	116.82 ± 12.74	134.00 ± 5.47	0.003	113.86 ± 9.63	122.07 ± 11.33	< 0.001
DBP (mmHg)	71.16 ± 8.92	78.00 ± 4.47	0.02	69.86 ± 11.98	75.28 ± 7.97	0.01
WHpR	**< 0.90**	**≥ 0.90**		**< 0.85**	**≥ 0.85**	
n (%)	81 (73.0)	30 (27.0)		11 (11.0)	89 (89.0)	
TC (mg/dL)	191.33 ± 45.05	181.03 ± 36.36	0.26	170.82 ± 43.39	191.63 ± 41.07	0.11
TG (mg/dL)	192.86 ± 64.31	173.40 ± 45.85	0.13	206.64 ± 126.62	195.66 ± 58.77	0.78
HDL-c (mg/dL)	52.58 ± 31.33	48.87 ± 6.65	0.52	47.91 ± 9.39	47.62 ± 8.80	0.91
LDL-c (mg/dL)	109.68 ± 25.76	103.50 ± 22.21	0.24	85.36 ± 16.97	105.61 ± 26.10	0.01
FBG (mg/dL)	110.84 ± 24.54	117.17 ± 29.76	0.25	132.55 ± 39.37	120.25 ± 34.26	0.27
SBP (mmHg)	116.89 ± 13.74	119.50 ± 10.69	0.34	120.00 ± 10.00	117.07 ± 11.26	0.41
DBP (mmHg)	70.59 ± 9.18	73.83 ± 7.62	0.08	69.27 ± 21.99	72.55 ± 8.58	0.63

[a]: Independent sample *t*-test. TC: total cholesterol, TG: triglyceride, HDL-c: high density lipoprotein- cholesterol, LDL-c: low density lipoprotein- cholesterol, FBG: fasting blood glucose, SBP: systolic blood pressure, DBP: diastolic blood pressure, WC: waist circumference, WHpR : waist to hip ratio.

[DOR: 20.1001.1.24767417.2017.2.3.7.5]

Table 5. Comparison mean (± SD) of cardiometabolic parameters and blood pressure in term of waist to height ratio

WHtR	< 0.50	≥ 0.50	P-value[a]
n (%)	92 (43.6)	119 (56.4)	
TC (mg/dL)	175.65 ± 44.00	199.18 ± 37.92	<0.001
TG (mg/dL)	175.58 ± 59.81	204.69 ± 65.13	0.001
HDL-c (mg/dL)	51.28 ± 7.60	48.50 ± 26.52	0.33
LDL-c (mg/dL)	93.98 ± 19.87	114.97 ± 25.62	<0.001
FBG (mg/dL)	108.93 ± 26.61	122.95 ± 32.51	0.001
SBP (mmHg)	114.09 ± 9.43	120.13 ± 13.28	<0.001
DBP (mmHg)	69.09 ± 10.79	73.92 ± 8.38	<0.001

[a]: Independent sample *t*-test. TC: total cholesterol, TG: triglyceride, HDL-c: high density lipoprotein- cholesterol, LDL-c: low density lipoprotein-cholesterol, FBG: fasting blood glucose, SBP: systolic blood pressure, DBP: diastolic blood pressure, WC: waist circumference, WHtR : waist to height ratio.

Table 6. Pearson's correlation coefficient between obesity indices and cardiometabolic parameters and blood pressure

Obesity indices	TC (mg/dL)	TG (mg/dL)	HDL-c (mg/dL)	LDL-c (mg/dL)	FBG (mg/dL)	SBP (mmHg)	DBP (mmHg)
BMI (kg/m2)	0.22 [b]	0.14 [a]	-0.11	0.25 [b]	0.24 [b]	0.35 [b]	0.22 [b]
WC (cm)	0.31 [b]	0.27 [b]	-0.13	0.37 [b]	0.34 [b]	0.39 [b]	0.30 [b]
WHpR	0.01	-0.03	-0.02	-0.005	0.09	0.03	0.09
WHtR	0.06	0.02	-0.01	0.06	0.16 [a]	0.19 [b]	0.11

. [a]: Significant level <0.05, [b]: Significant level <0.01, TC: total cholesterol, TG: triglyceride, HDL-c: high density lipoprotein- cholesterol, LDL-c: low density lipoprotein- cholesterol, FBG: fasting blood glucose, SBP: systolic blood pressure, DBP: diastolic blood pressure, WC: waist circumference, WHtR : waist to height ratio.

Discussion

The present study showed that BMI and WC are almost moderately correlated with cardiometabolic parameters; the correlation was weak for WHtR and WHpR. The degree of correlation was slightly higher for WC compared to BMI. Similarly, several studies had reported that WC was a better predictor of CV risk factors than other obesity indices, particularly BMI. A study among a group of Chinese working population reported that WC was the best predictor for CV risk factors including hyperglycemia, dyslipidemia, and hypertension in women, while BMI was the best and only predictor of dyslipidemia in men (Ouyang *et al.*, 2015). Likely, a study on Taiwanese adults showed that WC was a better predictor of CV risk factors than BMI (Tseng *et al.*, 2010). Moreover, results of a meta-analysis among Caucasian individuals showed that WC, in comparison to BMI had a stronger correlation with all metabolic parameters, except for DBP in women and HDL-c in men (van Dijk *et al.*, 2012). In contrast, in a cohort study, Zhang et al. reported that BMI was better correlated with hypertension risk than WC in Chinese adults (Zhang *et al.*, 2016). However, another study by Lara et al. showed that both BMI and WC had almost equal predictive values for high levels of blood lipids, blood pressure, and insulin resistance in a sample of Chilean adults (Lara *et al.*, 2012). Further, a study on Chinese adults showed that having BMI or WC values above the cut-off-points were significantly related with higher possibility for metabolic abnormalities than normal individuals. The authors suggested that applying these two indices together would be more useful for prediction of CV risk factors (Du *et al.*, 2010).

In this study a poor correlation was observed for WHpR and WHtR compared to other indices.

[DOR: 20.1001.1.24767417.2017.2.3.7.5]

A study among Taiwanese adults reported that WHpR was the weakest index for prediction of all CV risk factors, while, WC and WHtR with a similar predictive power were better predictors than BMI (Tseng *et al.*, 2010). Similar findings were also reported by Guasch-Ferré et al., they showed similar predictive values for WHtR and WC which were higher than BMI for metabolic abnormalities among Spanish adults (Guasch-Ferre *et al.*, 2012). Another study by Li et al. indicated that WHpR was the most powerful predictor of CV risk factors and inversely, BMI was the weakest one in indigenous Australian adults (Li and McDermott, 2010).

Gender differences on the obesity indices were also reported in the literature; Yu et al. showed that WC in men and WHtR in women were superior indices for prediction of CV risk factors among a large group of Chinese individuals (Yu *et al.*, 2016). Another study on Chinese adults reported that BMI in men and WHtR in women were the best predictors of dyslipidemia (Cai *et al.*, 2013). Beside gender, efficiency of obesity indices might be affected by age. In a study among a group of Iranian women with overweight and obesity, researchers concluded that WC was a stronger predictor of high blood lipids in young and middle-age women (20 to 50 years old), while in older women (≥ 50 years old), WHpR was a superior predictor than WC (Shahraki *et al.*, 2008).

In the current study, the reported better correlation of WC with metabolic parameters than others might have some implications for public health. In comparison to other indices, WC can be easily measured simply by a tape and its cut-off-points are much simpler and more understandable than other measurements. Proportionate alterations in WC and hip circumference causes WHpR to remain unchanged which cannot reflect the body adiposity precisely. However, WC consists of only a single measurement and might reflect the body adiposity changes better in such conditions. In addition, WC does not consider the height and thus might act more precisely in prediction of CV risk factors than BMI or WHtR. It is suggested that height can independently be associated with risk of CV disease, therefore, it might impact on the power of BMI and WHtR in CV risk prediction (Lawlor *et al.*, 2004, Schooling *et al.*, 2007, Wells and Cole, 2014).

This report demonstrated that half of the medical university employees were overweight and obese based on BMI and according to WC cut-offs, almost 22% of them had abdominal obesity. Similarly, a study among Saudi University employees and their families showed that almost 36% and 59% of them had respectively general and abdominal obesity (Alzeidan *et al.*, 2016). In addition, prevalence of general and abdominal obesity was reported 16% and 38% among Malaysian university employees, respectively (Cheong *et al.*, 2010). Moreover, in a large group of employees working in a medical company, almost 40% and 18% of them were respectively overweight and obese based on BMI measurement (Kempf *et al.*, 2013). So, employees should be regarded as an at-risk group for overweight, obesity, and metabolic disorders mainly due to the factors such as physical inactivity, exposure to work-related stressors, and unhealthy dietary habits which are characteristics of unhealthy lifestyle (Addo *et al.*, 2015, Buss, 2012). Since obesity can reduce employees' life quality and productivity as well as the fact that these people are more susceptible to several adverse conditions particularly CV diseases, screening for obesity and early identification of metabolic disorders with simple and effective tools such as obesity indices seem crucial (Lehnert *et al.*, 2013, Schulte *et al.*, 2007, Ul-Haq *et al.*, 2013).

The main limitation of this study was its small sample size that might have caused non-significant results particularly among WC-subgroups in men. Only five men had a WC equal to or higher than 102 cm which might have resulted in non-significant values in sub-group analysis. Furthermore, insulin resistance that is more informative on glycemic status and CV risk was not assessed in this study. Therefore, future studies including more participants regarding other markers of metabolic disorders are recommended on this at-risk group.

Conclusions

In conclusion, BMI and WC had an almost moderate correlation with cardiometabolic parameters among a sample of medical university employees in southeast of Iran. The correlations were slightly stronger for WC compared to BMI. However, the correlations were weak for WHtR and WHpR. Therefore, application of WC along with BMI is suggested as the preferred method for assessment of CV risk factors among this at-risk group.

Acknowledgements

Authors' thank goes to the employees of Zahedan University of Medical Sciences for their valuable cooperation in the study. This study received no funding from any public or private agencies.

Authors' contributions

Shahraki M designed the study, Eslami O Collected the data and wrote the original manuscript; Shahraki T helped in writing the paper. All authors read and approved the final manuscript.

Conflict of interest

None

References

Addo PNO, Nyarko KM, Sackey SO, Akweongo P & Sarfo B 2015. Prevalence of obesity and overweight and associated factors among financial institution workers in Accra Metropolis, Ghana: a cross sectional study. *BMC research notes.* **8**: 599.

Alzeidan R, Rabiee F, Mandil A, Hersi A & Fayed A 2016. Non-communicable disease risk factors among employees and their families of a Saudi University: An epidemiological study. *Public library of science (PLoS One).* **11 (11)**: e0165036.

Bi X, et al. 2016. Correlation of adiposity indices with cardiovascular disease risk factors in healthy adults of Singapore: a cross-sectional study. *BMC Obes.* **3**: 33.

Browning LM, Hsieh SD & Ashwell M 2010. A systematic review of waist-to-height ratio as a screening tool for the prediction of cardiovascular disease and diabetes: 0.5 could be a suitable global boundary value. *Nutrition research review.* **23 (2)**: 247-269.

Buss J 2012. Associations between obesity and stress and shift work among nurses. *Workplace health safety.* **60 (10)**: 453-458.

Cai L, Liu A, Zhang Y & Wang P 2013. Waist-to-height ratio and cardiovascular risk factors among Chinese adults in Beijing. *Public library of science (PLoS One).* **8 (7)**: e69298.

Chan. R & J W 2010. Prevention of overweight and obesity: How effective is the current public health approach. *International journal environmental research public health.* **7 (3)**: 765-783.

Cheong SM, Kandiah M, Chinna K, Chan YM & Saad HA 2010. Prevalence of obesity and factors associated with it in a worksite setting in Malaysia. *Journal of community health.* **35 (6)**: 698-705.

Du SM, et al. 2010. Relationship of body mass index, waist circumference and cardiovascular risk factors in Chinese adult. *Biomedical environmental sciences.* **23 (2)**: 92-101.

Friedewald WT, Levy RI & Fredrickson DS 1972. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. *Clinical chemistry.* **18 (6)**: 499-502.

Gaddam KK, Ventura HO & Lavie CJ 2011. Metabolic syndrome and heart failure--the risk, paradox, and treatment. *Current hypertension reports.* **13 (2)**: 142-148.

Guasch-Ferre M, et al. 2012. Waist-to-height ratio and cardiovascular risk factors in elderly individuals at high cardiovascular risk. *Public library of science (PLoS One).* **7 (8)**: e43275.

Huxley R, Mendis S, Zheleznyakov E, Reddy S & Chan J 2010. Body mass index, waist circumference and waist:hip ratio as predictors of cardiovascular risk--a review of the literature. *European journal of clinical nutrition.* **64 (1)**: 16-22.

Kempf K, et al. 2013. The epidemiological boehringer ingelheim employee study--part I:

Impact of overweight and obesity on cardiometabolic risk. *Journal of obesity*. **2013**: 159123.

Klop B, Elte JWF & Castro Cabezas M 2013. Dyslipidemia in obesity: Mechanisms and potential targets. *Nutrients.* **5 (4)**: 1218–1240.

Lara M, Bustos P, Amigo H, Silva C & Rona RJ 2012. Is waist circumference a better predictor of blood pressure, insulin resistance and blood lipids than body mass index in young Chilean adults? *BMC public health.* **12**: 638.

Lawlor DA, Taylor M, Davey Smith G, Gunnell D & Ebrahim S 2004. Associations of components of adult height with coronary heart disease in postmenopausal women: The British women's heart and health study. *Heart (British Cardiac Society).* **90 (7)**: 745-749.

Lehnert T, Sonntag D, Konnopka A, Riedel-Heller S & Konig HH 2013. Economic costs of overweight and obesity. *Best practice & research clinical endocrinology & metabolism.* **27 (2)**: 105-115.

Li M & McDermott RA 2010. Using anthropometric indices to predict cardio-metabolic risk factors in Australian indigenous populations. *Diabetes research clinical practice.* **87 (3)**: 401-406.

Ouyang X, et al. 2015. Anthropometric parameters and their associations with cardio-metabolic risk in Chinese working population. *Diabetology & metabolic syndrome.* **7**: 37.

Rahmani A, et al. 2015. Investigation of the prevalence of obesity in Iran: A systematic review and meta-analysis study. *Acta medica Irannica.* **53 (10)**: 596-607.

Schooling CM, et al. 2007. Height, its components, and cardiovascular risk among older Chinese: a cross-sectional analysis of the Guangzhou Biobank Cohort Study. *American journal of public health.* **97 (10)**: 1834-1841.

Schulte PA, et al. 2007. Work, obesity, and occupational safety and health. *American journal of public health.* **97 (3)**: 428-436.

Shahraki T, Shahraki M, Roudbari M & Gargari BP 2008. Determination of the leading central obesity index among cardiovascular risk factors in Iranian women. *Food nutrition bullten.* **29 (1)**: 43-48.

Tseng CH, et al. 2010. Optimal anthropometric factor cutoffs for hyperglycemia, hypertension and dyslipidemia for the Taiwanese population. *Atherosclerosis.* **210 (2)**: 585-589.

Ugwuja E, Ogbonna N, Nwibo A & Onimawo I 2013. Overweight and obesity, lipid profile and atherogenic indices among Civil Servants in Abakaliki, south eastern Nigeria. *Annals of medical and health sciences research.* **3 (1)**: 13-18.

Ul-Haq Z, Mackay DF, Fenwick E & Pell JP 2013. Meta-analysis of the association between body mass index and health-related quality of life among adults, assessed by the SF-36. *Obesity.* **21 (3)**: E322-327.

van Dijk SB, Takken T, Prinsen EC & Wittink H 2012. Different anthropometric adiposity measures and their association with cardiovascular disease risk factors: a meta-analysis. *Netherlands heart journal.* **20 (5)**: 208-218.

Wells JC & Cole TJ 2014. Height, adiposity and hormonal cardiovascular risk markers in childhood: how to partition the associations? *International journal of obesity.* **38 (7)**: 930-935.

WHO 2011. Waist circumference and waist–hip ratio: report of a WHO expert consultation WHO: Geneva.

WHO 2016. Obesity and overweight. Available from: http://www.who.int/mediacentre/factsheets/fs311/en/

Yu J, et al. 2016. Optimal cut-off of obesity indices to predict cardiovascular disease risk factors and metabolic syndrome among adults in Northeast China. *BMC public health.* **16**: 1079.

Zhang M, et al. 2016. Body mass index and waist circumference combined predicts obesity-related hypertension better than either alone in a rural Chinese population. *Science report.* **6**: 31935.