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Correlation of Middle Upper Arm Circumference With Other Anthropometric Indictors and Cardiovascular Disease Risk Factors in Young Adults of Urban Areas of Hyderabad, Pakistan

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Abstract: Introduction: Middle Upper Arm Circumference (MUAC) is used to assess nutritional status particularly under nutrition. Recently, the use of MUAC has been suggested as a novel anthropometric marker to assess the condition of obesity among the children, adolescents, and young adults. We, therefore, setup / study to evaluate the correlation of MUAC for the assessment of various CVD risk factors. **Methodology:** The study was carried out from April 2021 to March 2022. Total 366 participants were randomly selected, out of which 190 were male participants and 176 were female participants. The data was collected using interview based questionnaire; middle upper arm circumference was measures using a non stretchable measuring tape. Statistical analysis was done using SPSS ver 23. **Results:** The mean age of participants was 24.04±4.04, the mean values of WC, WHR, SBP, DBP, and LDL were significantly higher ($P< 0.05$) in males, the mean values of HDL were significantly higher in females($p< 0.05$). Non-significant difference in the mean values of BMI, FBG, Cholesterol and Triglycerides ($P> 0.05$) were observed between male and female participants. MUAC showed strong positive correlation with BMI, WC and WHR ($P<.001$). Except HDL all other CVD risk factors showed significant positive correlation with MUAC ($P<.001$), however, MUAC showed a significantly negative correlation with HDL (r = -.370, $P<.001$) in males, no correlation of MUAC with HDL (r = -.028, $P<.001$) was observed in females. **Conclusion***:* Except HDL significant correlation was observed between MUAC and various CVD risk factors.

Keywords: Middle Upper Arm Circumference, Cardiovascular Disease, Young Adults

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Introduction

Cardiovascular diseases (CVDs) are the major cause of public health concern due to its increase in morbidity and mortality around the world.[1-3].It is estimated that majorityof all deaths each year are due CVDs, and this number is likely to increase in coming years[4]. CVDs are the major burden on healthcare expenditure across the globe, particularly affecting the economy of underdeveloped countries particularly Pakistan [1, 5, 6]. CVDs develop as a consequence of change in lifestyle leading to obesity and other cardiovascular risk factors. Cardiovascular risk factors are characterized as modifiable risk factors and non-modifiable[7]. Modifiable cardiovascular risk factors can be prevented, controlled and treated[8]. Modifiable CVD risk factors includeobesity, high blood pressure, hyperglycemia and hyperlipidemia[7, 8]. Non-modifiable risk non-modifiable CVD risk factors include, age gender, ethnic affiliation and family history.[8].

Cardiovascular diseases risk factors including obesity and other modifiable risk factors are assessed using various anthropometric parameters. Commonly used anthropometric parameters are BMI[9], Waist Circumference (WC)[10] and waist to hip ratio (WHR)[10]. BMI has been reported as the most common indicator for the assessments of obesity and other CVD factors[9]. Several studies indicate BMI as the clinically important anthropometric indicator, since it has a strong correlation with total body fat and predictability to assess the cardiovascular related morbidity and mortality[9, 11]. However, studies revealed that BMI is not a reliable indicator for the measurement of body composition in older and young adults[12]. Moreover, the measurement of weight and height for the assessments of BMI is time taking and is not that much practical in resource poor settings. Both WC and WHR are a good anthropometric indicator for the assessment of visceral fat, however, both WC and WHR are time consuming and problematic in a society where removing the cloths for accurate measurements of WC and hip circumference are not culturally accepted, moreover, WC and WHR are difficult to screen central obesity in pregnant women.

Recently MUAC has been used as screening indicator for the assessment of obesity and other CVD factors in children, adolescents and young adults[13]. MUAC is widely used for assessment of nutrition status in children and pregnant women [14, 15]. Several studies report use of MUAC for the assessment of under nutrition particularly in children less than five year of age[14]. Growing evidence indicate the use of MUAC for assessing obesity and CVD risk factors[16, 17]. These studies collectively suggest MUAC as an alternative anthropometric indicator for the assessment of CVD risk factors.

MUAC is comparatively simple, easy and inexpensive screening parameter for the assessment of CVD risk factors. The use of MUAC demands the measuring tape and does need calculations compared to BMI and WHR. The purpose of present study was to determine the correlation of MUAC with anthropometric indicators and other modifiable CVD risk factors in young adults residing in the urban areas of Hyderabad, Pakistan

Methodology

Study design and data collection

This cross-sectional study was carried out from March 2021 to April 2022 on randomly selected apparently healthy participants from different areas of Hyderabad city. The data was collected through interview based structured questionnaire. Questionnaire was comprised of different sections such as basic characteristics, anthropometric measurements, and biochemical analysis, each section was further divided into elements, which include age, gender, weight, height, waist circumference, Middle upper arm circumference and lipid profile. Total 390 participants were randomly selected from various areas of Hyderabad. Informed verbal consent was obtained before collection of data. Participants were briefed about the objectives of the study. Those participants who showed agreement were included in data collection. Out of 390 only 366 agreed to participate in the study, giving response rate of 93.84%. These participants were selected from the different localities of urban areas of Hyderabad, Pakistan. Sample size was calculated using online sample size calculator. Out of 366, 190 were males and 176 were females. The age range of participants was 18 to 30 years, any one below the age of 18 years or above the age of 30 year was not included in the study. Participants having diabetes, infection or any co-morbidity were excluded from study. Pregnant women, physically handicapped person or using drugs were excluded from this study. The participants who were hesitant to provide information were also not included in the study.

Anthropometric measurements

Weight in kilograms was obtained while participants were wearing light cloths, and height in centimetres was measured while participants were standing without shoes. BMI was calculated as

weight in kilograms divided by height in square meters. WC was measured and for this purpose we used a measuring tape, which was non-stretchable, all this was done at the level of the uppermost edge of the hip bone. The WC was divided with HC for obtaining the WHR. MUAC was measured by first obtaining the middle of upper arm, and then with the help of non-stretchable tape the circumference was measured in centimetres.

Biochemical analysis and Blood pressure measurement

Venous blood sample was collected from 8 am to 9 amin the early hours of the morning. All the participants were fasting and have not eaten anything for the last 8 to 10 hours. Serum was collected by centrifuging the blood sample at 5000 rpm; the serum was stored at 4C^{o} for the assessment of lipid profile using technique already defined by Farzana et al [18]Blood pressure of the participants was recorded using sphygmomanometer, before measurements of blood pressure, the participants were asked to be seated on comfortable chair.

Statistical analysis

SPSS ver 23 was used for statistical analysis. The data was edited for the extreme values and errors before statistical analysis. The t-test was used for the comparison of quantitative data. Pearson correlation method was used for obtaining the relationship between variables. *P* values was set as $P<0.05$ and $P<0.01$ as statistically significant, P value <0.001 was set as highly significant.

Ethical Approval

Ethical approval was obtained by Institutional Review Board of, University of Sindh, Jamshoro.

Results

Total 366 healthy volunteers participated in the study out of 366, 190 were males and 176 were females. Table 1 shows the overall and gender wise mean values of the participants. Male had significantly higher mean values of height, WC, WHR and MUAC ($P< 0.001$). No significant difference was observed in the mean values of BMI and age ($P>0.05$) table1. No significant difference was observed in the mean values of Fasting blood glucose ($P> 0.05$) between male and female participants. Males had significantly higher systolic and diastolic blood pressure (P <0.001). The LDL-C values were significantly higher in males ($P< 0.05$) and HDL-C values were significantly higher in females (P <0.001). No significant difference was observed in the mean values of cholesterol and Triglyceride between male and female participants ($P> 0.05$) table1.

Table 2 shows the correlation of MUAC with height, weight, BMI, WC and WHR. Both BMI and WC were strongly correlated with MUAC both in males (r= 0.842, P <0.001) and female gender (r= 0.871, P <0.001). Comparatively weaker correlation was observed between MUAC and WHR in males (r= 0.272, P <0.001) and stronger correlation of MUAC with WHR was observed in males (r= 0.583, P <0.001). Except HDL-C, all other cardiovascular risk factors FBG (r = 0.421), SBP (r = 0.555), DBP (r = 0.637), Cholesterol (r = 0.549), TG (r = 0.572), LDL-C(r = 0.481) showed significant correlation with MUAC (P <0.001) in males, HDL-C showed a significantly negative correlation with MUAC (r =-.360, P <0.001) in males. In female participants MUAC was significantly correlated (P <0.001) with all cardiovascular risk factors FBG (r = 0.497), SBP (r = 0.514), DBP (r = 0.615), Cholesterol (r = 0.527), TG (r = 0.484) and LDL-C (r = 0.267) however, no correlation was observed between MUAC and HDL-C in females (r = -.028, P >0.05) table2.

Discussion

The data presented here indicate that males have elevated values of various cardiovascular diseases risk factors; these results are consistent with previous studies. Our study and previously published studies suggest males have higher risk of suffering from cardiovascular diseases.

However, studies contradict each other and there is an increased inconsistency in findings related with comparison of mean values of CVD risk factors in males and females [16, 17]. Inconsistency in the findings is mainly due to the fact that these studies and our study have used a different age group, we have used healthy volunteers and other study has included diabetic population [17]
MUAC has been used for the assessment of under nutrition in children [14], adolescents [19] and pregnant women [20] particularly in resource-poor settings. However, recent studies put a new insight into the use of MUAC for the assessment of obesity, CVD risk factors and metabolic syndrome [21-23]. The use of MUAC foe the assessment of CVD risk factors in young adults is scarce. We have shown here that MUAC has strong positive correlation with BMI, WC and WHR; our findings are consistent with several others recently published studies[16, 23]. All these studies establish the fact that MUAC can be used an alternative anthropometric indicator for the assessment of CVD risk factors.
The data, we present here suggest that cardiovascular risk factors such as FBG, SBP, DBP, Cholesterol, TG, and LDL-C, HDL-C are significantly correlated with MUAC. In female all other CVD risk factors showed significant correlation except HDL-C which showed no correlation with MUAC. These findings are consistent with previously published studies [16]. Our results are not consistent with the study which show no significant correlation of SBP, DBP with MUAC [24]. The inconsistency might be since other study has used only small sample size. Our findings provide strong evidence that MUAC can be used as screening index for assessments of cardiovascular disease risk factors. This study will put a new insight into understanding the use of MUAC for the assessment of CVD risk factors in the areas with resource-poor settings

Conclusion

MUAC is strongly correlated with BMI, WC and WHGR, which make it an alternative indicator for the assessment of CVD risk factors. MUAC which has been ignored for the long time can be used a anthropometric indicator for the assessments of CVD risk factors, MUAC is an easy and simple anthropometric indicator in comparison with BMI, WC and WHR.

"Table 1. General characteristics of study subjects

Parameters	All (N= 366)	Men (N=190)	Women	t-value	*P* - Value
Age (years)	24.04±4.04	24.14±3.87	23.94±4.22	0.470	Ns
Height (cm)	160.66±8.0	163.77±7.19	157.31±7.46	8.843	<0.001
Weight (kg)	63.47±14.39	65.17±14.26	61.63±14.35	2.367	<0.05
BMI (kg/m^2)	24.47±5.11	24.18±4.77	24.79±5.44	-1.149	Ns
WC (cm)	81.50±13.86	85.17±12.55	77.53±14.15	5.475	<0.001
WHR	0.87±0.07	0.91±0.05	0.82±0.08	11.687	<0.001
MUAC (cm)	26.59±3.95	27.78±3.37	25.30±4.12	6.319	<0.001
FBG (mg/dl)	93.19±19.43	94.74±20.89	91.51±17.62	1.596	Ns
SBP (mmHg)	115.39±16.33	118.27±12.88	112.27±18.92	3.568	<0.001
DBP (mmHg)	78.69±9.03	80.72±7.15	76.49±10.27	4.589	<0.001
Cholesterol (mg/dl)	165.93±50.79	168.09±50.17	163.60±50.14	0.854	Ns
TG (mg/dl)	135.01±77.33	143.53±87.58	125.81±63.43	2.202	Ns
HDL-C (mg/dl)	38.20±9.32	36.42±7.40	40.13±10.72	-3.880	<0.001
LDL-C (mg/dl)	136.38±46.11	141.38±47.94	130.98±43.53	2.168	<0.05

Table 2. Relationship between MUAC and other anthropometric indices and CVD risk factors by gender

Variables	**MUAC (cm)**	
	Males	**Females**

	r	***p*-value**	**r**	***p*-value**
Height (cm)	0.088	Ns	-.008	Ns
Weight (kg)	0.825	<0.001	0.757	<0.001
BMI (kg/m^2)	0.864	<0.001	0.824	<0.001
WC (cm)	0.842	<0.001	0.871	<0.001
WHR	0.541	<0.001	0.625	<0.001
FBG (mg/dl)	0.421	<0.001	0.479	<0.001
SBP (mmHg)	0.555	<0.001	0.514	<0.001
DBP (mmHg)	0.637	<0.001	0.615	<0.001
Cholesterol (mfg/dl)	0.549	<0.001	0.527	<0.001
TG (mg/dl)	0.572	<0.001	0.484	<0.001
HDL-C (mg/dl)	0-.370	<0.001	-.028	Ns
LDL-C (mg/dl)	0.481	<0.001	0.267	<0.001

Abbreviations

BMI	Body Mass Index
WC	Waist Circumference
WHR	Waist Hip Ratio
MUAC	Middle Upper Arm Circumference
FBG	Fasting Blood Glucose
SBP	Systolic Blood Pressure
DSB	Diastolic Blood Pressure
TG	Triglyceride
HDL-C	High Density Lipoprotein Cholesterol
LDL-C	Low Density Lipoprotein Cholesterol

Consent for Publication

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Conflict of Interest

The author confirm that this article content has no conflict of interest.

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