Association of Waist Circumference and Body Mass Index among the Students of a Medical College

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Citation

Sharma K, Mansur DI, Shakya R, Maskey S, Shrestha A, Nepal O. Association of Waist Circumference and Body Mass Index among the Students of a Medical College. *Kathmandu Univ Med J.* 2023;83(3):293-7.

ABSTRACT

Background

Obesity and overweight have emerged as significant public health concerns on a global scale. In the pursuit of evaluating body composition and identifying potential health risks, two widely utilized measures are Body Mass Index and waist circumference. These anthropometric indicators are considered economical, practical, and also crucial for screening, monitoring the individual's nutritional status, and anticipating future disease risk.

Objective

To explore the correlation between waist circumference and Body Mass Index and find out its significance as indicators of health and nutritional status in young adults.

Method

The study comprises 260 healthy young adults, aged 18-25 years from pre-clinical sciences, Kathmandu University School of Medical Sciences (KUSMS). Anthropometric measurements of height (m), weight (kg), and waist circumference (cm) were recorded. Body Mass Index was calculated by using the formula as body weight (kg) divided by the square of body height (m2). Demographic factors such as age, sex, obesity, and life style factors like smoking, alcohol consumption, and physical activity were noted.

Result

The study found a positive correlation between Body Mass Index, waist circumference (WC) and weight. However, no association was found between waist circumference and height. The findings also indicated a notably high percentage of 17.69% participants, who were categorized as overweight, while a 9.23% fell into the underweight category. The study confirms that 83.08% of the students have moderate physical activity whereas 14.62% have insufficient and 2.31% have heavy physical activity.

Conclusion

The study shows a positive correlation between body mass index (BMI) and waist circumference (WC) in young adults aged 18-25 years.

KEY WORDS

Anthropometric measurement, Body mass index , Obesity, Waist circumference

INTRODUCTION

Obesity and overweight are considered major public health problems worldwide. According to the WHO, more than 1.9 billion adults aged 18 years and older were overweight in 2016. Nowadays, most of the world's population faces challenges related to obesity than underweight. Obesity has been known as the excessive accumulation of fat,which may impair the health of an individual.[1] Obesity along with a lack of physical activity puts up the body at risk of many diseases such as cardio-vascular, hypertension, diabetes mellitus, metabolic syndromes, osteoarthritis, and some types of cancer.[2-4] Body Mass Index (BMI) and waist circumference (WC) are commonly used measures to assess body composition and determine the risk of various health conditions.[5] BMI is calculated by dividing an individual's weight (in kilograms) by the square of their height (in meters). It is widely used as a screening tool to assess whether a person has a healthy body weight for their height. However, BMI has some limitations for monitoring the occurrence of obesity in the population as it fails to provide a distribution of abdominal fats. WC is considered as an important tool for the measurement of abdominal obesity. WC is a measurement taken around the narrowest part of the waist. It is a simple and practical way to assess abdominal fat distribution.[6] Elevated WC is associated with a higher risk of metabolic disorders such as type 2 diabetes, cardiovascular disease, and certain cancers.[7] Moreover, it has been suggested that the combination of measurements of BMI and WC is useful to assess the health status of an individual.[8]

Anthropometric measurements are useful for monitoring the health of an individual, as they provide valuable information about body composition and can be indicators of various health conditions. It is a non-invasive, inexpensive, and easily applicable method for the measurement of body parts. It is also considered an economical, reasonable and sensitive indicator for the measurement of different body parts.[6] Measurements of height, weight, waist circumference, and calculation of BMI have been widely used in screening and monitoring programs to assess nutritional status and future disease risk.

There has been no current study or update in information regarding waist circumference and BMI predicting the health and nutritional status of young adults in a medical school at the University. Therefore, our aim was to determine the association between WC and BMI to assess the nutritional status and future health risk of young adults within the students of Kathmandu University School of Medical Sciences (KUSMS).

METHODS

The study included 260 participants from pre-clinical sciences, Kathmandu University School of Medical Sciences (KUSMS). Eligible participants for the study were healthy young adults aged between 18 to 25 years. Anthropometric measurements of height (m), weight (kg) and waist circumference (cm) were recorded from February to May 2023. BMI was calculated by using the formula as body weight (kg) divided by the square of body height (m^2). Demographic factors such as age, sex, obesity and life style factors like smoking, alcohol consumption and physical activity was noted.

Height was measured by standing barefooted in an upright position using a portable stadiometerwith the individual standing erect with shoulder blades, buttocks and heels against a wall and straight fixed gaze. Weight was measured by wearing the light clothes without shoes using the digital balance.[9] Waist circumference was measured to the nearest 0.5 cm, at the approximate midpoint between the lower margin of the last palpable rib and the highest point of the iliac crest using a normal tailoring tape.[10,11] The measurement accuracy of height and weight was required to be 0.1 m and 0.1 kg, respectively.

All the measurements were made with the participants standing upright in an anatomical position with the eyes looking forwards, both arms by the side of body and both feet together.

The study approval was received from Kathmandu University School of Medical Sciences, Institutional Review Committee (KUSMS-IRC). All 260 participants provided the written informed consent for the study.

All statistical analysis was performed by using the SPSS version 27 (IBM Corporation, Armonk, NY, USA). Mean values, standard deviation and 95% confidence interval was determined for all the measures. Chi-square test was used to compare the differences in WC and BMI among different ages and gender. Pearson's linear correlation coefficient and linear regression analysis was used to find out the correlation and association between the waist circumference and BMI. A p-value < 0.05 was considered as statistically significant.

RESULTS

Sample description and demographic data

The study comprised 260 participants, of whom 121 were male and 139 were female, aged between 18 and 25 years, and enrolled at the Kathmandu University School of Medical Sciences (KUSMS). The majority of the participants hailed from Nepal (90%), with the remaining 10% from India. The mean ± SD values for age were 21 ± 1.02 years for males and 20.38 ± 1.24 years for female, height was 1.68 ± 0.06 meters for males and 1.56 ± 0.05 meters for females, weight was 64.23 ± 10.59 kg for males and 53.12 ± 8.52 kg for females, waist circumference was 85.55 ± 7.81 cm for males and 81.03 ± 7.51 cm for females, and BMI was 22.74 ± 3.31 for males and 21.86 ± 3.20 for females, as shown in table 1.

Table 1. Characteristics of the participants from the study group

	Mean ± SD		95% CI	
	Male	Female	Male	Female
Height (cm)	1.68±0.06	1.56±0.05	1.66,1.69	1.55,1.56
Weight (kg)	64.23±10.59	53.12±8.52	62.32, 66.15	51.69, 54.55
WC (cm)	85.55±7.81	81.03±7.51	84.14, 86.96	79.77, 82.29
BMI (kg/m^2)	22.74±3.31	21.86±3.20	22.14, 23.34	21.33, 22.40
Age (years)	21±1.02	20.38±1.24	20.81, 21.19	20.17, 20.59

SD: Standard Deviation, CI: Confidence Interval, WC: Waist circumference, BMI: Body mass index

Life style and physical activity

In the study, lifestyle factors such as alcohol consumption, smoking habits, and physical activity were assessed in the 260 participants (Table 2). Among the participants, it was noted that alcohol consumption and smoking habits were not regular. The majority of participants, 216 individuals (83.08%), engaged in moderate physical activity, while 38 participants had insufficient physical activity, and 6 participants reported heavy physical activity. Based on BMI calculations, the participants were categorized into three groups: 190 (73.08%) were classified as having a normal BMI, 24 (9.23%) were underweight, and 46 (17.69%) were found to be overweight (Table 2).

Table 2. Life style and physical activities of the participants

Characteristics	Total participants (n=260)	Male (n=121, 46.4%)	Female (n=139, 53.3%)
Place of birth	Nepal -250 (96.1%) India -10 (3.8%)		
Alcohol consumption	None - 237(91.15%), Regular - 0, Irregular - 23		
Smoking habits	None- 259, Regular – 0, Irregular- 1		
Physical activity	Heavy - 6 (2.31%), Insufficient - 38 (14.62%), Moderate - 216(83.08%)		
BMI	Normal -190(73.08%),Underweight- 24(9.23%), Overweight - 46 (17.69%)		

n: Total number of participants, BMI: Body mass index

Association between BMI, WC, Weight and Height

Table 3 shows the relation between the waist circumference and BMI with gender and ages. There was a significant relation between the waist circumference and gender (p-value 0.000).

Table 3. Showing the Chi-square test between WC, BMI, Gender and Ages

	x^2	p-value
WC and gender	201.91	0.000
WC and ages	392.62	0.923
BMI and gender	279.08	1.000
BMI and ages	1605.49	0.381

x^2: Chi-square test, WC: Waist circumference, BMI: Body mass index

Table 4 presented a correlation of BMI, waist circumference, weight and height. There was significant positive correlation between waist circumference and BMI (r=0.632) and waist circumference and weight (r=0.697) whereas no association was found between waist circumference and height.

Table 4. Correlation table for BMI, waist circumference, weight and height

	r (Pearson correlation)	p-value
WC vs. Height	0.347	0.000
WC vs. Weight	0.697	0.000
WC vs. BMI	0.632	0.000

r: Pearson correlation, WC: Waist circumference,

Table 5 shows the correlation between BMI and waist circumference. The BMI and waist circumference was positively correlated (r=0.632), where correlations was moderate and significant (p-value 0.000). There was positive linear regression between BMI and waist circumference (r^2 = 0.400).

Table 5. Pearson correlation and linear regression between waist circumference and BMI

	Pearson correlation (r)	Linear regression (r^2)
Waist circumference VS BMI	**0.632**	**r2 = 0.400**

Correlation is significant at the 0.01 level

DISCUSSION

The study investigated the correlation between BMI and waist circumference in young adults aged between 18-25 years. The study found the positive correlation between BMI, WC, and weight. However, no association was found between waist circumference and height. Further, the results highlighted a significant prevalence of overweight participants, comprising 17.69%, and a noteworthy 9.23% falling under the underweight category. Additionally, the data affirms that a majority of the students, totaling 83.08%, engage in moderate physical activity, while 14.62% exhibit insufficient activity levels and only 2.31% maintain a heavy level of physical activity.

Research has consistently shown a positive correlation between WC and BMI, particularly in adults. In general, as BMI increases, WC tends to increase as well. This relationship is not surprising because both measures are associated with body fat. Higher BMI values typically reflect higher levels of total body fat, while an increased WC suggests greater central or abdominal fat accumulation.

The result of the current study extends the findings from Chinedu et al. in 2013 of 489 healthy adults from Iyesi and Ilogbo communities in Ota, Nigeria, aged between 20 and 75 years.[6] The study showed strong associations between BMI, weight and waist circumference in healthy subjects. The study also concluded the anthropometric measurements of height, weight, and WC are important

indicators for the prediction of future health risks.[6] Further, the study by German et al. in 2020 using data from the ACCORD trial of 10,251 participants found the association between BMI and WC where the risk was associated with type 2 diabetes.[12] It was also stated by American Diabetes Association (ADA) that measurement of WC act as the important marker for the identification of central abdominal obesity.[12]

In 2018, Yadav et al. conducted a study on 50 university boys aged 18-25 years, revealing a significant positive correlation between waist circumference (WC) and body mass index (BMI).[13] Moreover, the study demonstrated an additional correlation between BMI, WC, and random blood sugar levels. The findings led the researchers to conclude that measuring WC is a crucial non-invasive approach to assess abdominal obesity.[13]

Several studies have investigated the relationship between waist circumference and BMI in different populations. Moreover, combination of BMI and WC evaluate the better fat distribution of the body.[5] A study conducted by Ashwell et al. in 2012 examined data from over 300,000 participants across various countries and found a strong positive correlation between waist circumference and BMI, indicating that as BMI increased, waist circumference also tend to increase.[14] This relationship was observed in both men and women across different age group.[14] Also, a study by Berentzen et al. in 2010 in 26,625 healthy men and women from the Danish Diet, Cancer and Health study found the correlation between BMI and WC which strongly predicts all-cause mortality in middle-aged individuals.[15]

Another study by Feller et al. in 2010 analyzed data from a large sample of 27,548 participants in the European prospective investigation into cancer and nutrition (EPIC) postdam study and found a significant correlation between BMI and WC.[16] Further, the study investigated the BMI and WC are associated with risk of type 2 diabetes.[16] The study by Ning et al. in 2012 showed the association between BMI and WC in Chinese children. Moreover, the study concluded that genetic factors played a significant role in the associations between BMI and WC in both males and females during childhood development.[17]

It is important to note that while waist circumference and BMI are correlated, they capture different aspects of body composition and health risks. BMI is a simple and practical measure that can be easily calculated using weight and height, but it does not distinguish between fat mass and lean mass. In contrast, WC provides information about central adiposity, which is linked to a higher risk of metabolic syndrome and cardiovascular diseases.

The current study has some limitations. The anthropometric measurements were performed in the, Kathmandu University School of Medical Sciences, Chaukot, in a single premise, and the results may not be applicable to the large population. Further, the cross-sectional study collects data at specific time points, which may not capture the changes over time and make it difficult to establish causality or determine the sequence of events. Cross-sectional studies primarily focus on examining associations or relationships between variables at a specific time.

CONCLUSION

There was a positive association between waist circumference and BMI in the population. Higher BMI values are generally accompanied by larger waist circumferences, indicating an increase in overall adiposity and central obesity. These measures provide valuable information for assessing body composition and the associated health risks in individuals and populations. However, it is important to consider other factors, such as genetics, lifestyle, and individual variations, when interpreting the results.

ACKNOWLEDGEMENT

We extend our heartfelt gratitude to the students of, Kathmandu University School of Medical Sciences for their dedication and active participation in this study. Their valuable contributions have been instrumental in advancing our research and fostering a deeper understanding of the subject matter.

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