

Neck circumference is as good an indicator of obesity as waist hip ratio

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International Journal of Science and Technology Research Archive, 2022, 03(02), 203–206

Publication history: Received on 14 October 2022; revised on 06 December 2022; accepted on 08 December 2022

Article DOI: <https://doi.org/10.53771/ijstra.2022.3.2.0138>

Abstract

Introduction: BMI (Body mass index), Waist Hip ratio (WHR) and even body fat percentage (BF %) or fat mass are indicators that are commonly used for assessment and grading of obesity. Of late researchers are exploring the possibility of using neck circumference as another indicator of obesity. Neck circumference (NC) is found in many studies to reflect central obesity. Our study however aims at comparing the correlation between Neck circumference, BMI and body fat percentage with the correlation between Waist Hip Ratio, BMI and body fat percentage in both lean and obese adults, to find out whether Neck circumference or waist hip ratio is a better indicator of obesity.

Materials and Methods: This is an analytical observational preliminary study which is a part of a larger study. Sample study consists of 36 participants who are adults in the range of 18 to 60 years old of both genders, which comprises of 19 lean and 17 obese research participants. Anthropometric data of the research participants such as age, sex, weight, height, waist circumference, and hip circumference were measured. BMI was calculated using Adolphe Quetelet metric BMI formula. Body fat percentage was measured using DEXA (Dual X-ray Absorbtiometry) scan.

Results: The overall group, NC showed strong positive correlation with BMI whereas WHR showed moderate correlation with BMI. There is also a moderate correlation between NC, WHR and BF%. In lean adults it is observed that the moderate correlation between neck circumference (NC) and BMI is similar to the correlation between WHR and BMI. Again in lean adults, the correlation between NC and BF% is a weak positive and the correlation between WHR and BF% is towards a strong positive side. It is observed that in obese adults the NC, WHR demonstrate moderate correlation with BMI, while a negative correlation exists between NC, WHR and BF%.

Conclusion: According to the results of our study, it is obvious that neck circumference like WHR do correlate with BMI in all the three groups that is, in the overall, lean and obese research participants. And that neck circumference is as good an indicator as WHR in identifying adults with obesity.

Keywords: Neck circumference; Body mass index; Body fat percentage; Indicator of Obesity

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1 Introduction

BMI (Body mass index), Waist Hip ratio (WHR) and even body fat percentage (BF %) or fat mass are indicators that are commonly used for assessment and grading of obesity. It is a universally accepted method to determine and grade obesity by determining the BMI. Waist hip ratio and fat mass on the other hand can also help in determining the type of obesity, that is if obesity is an android or gynoid type. Of late researchers are exploring the possibility of using neck circumference as another indicator of obesity. Neck circumference (NC) is found in many studies to reflect central obesity [1]. Our study however aims at comparing the correlation between Neck circumference, BMI and body fat percentage with the correlation between WHR, BMI and body fat percentage in both lean and obese adults and to find out whether Neck circumference or waist hip ratio is a better indicator of obesity.

2 Material and methods

This is an analytical observational preliminary study which is a part of a larger study that was cleared by the Institutional ethics committee. Written informed consent was obtained from each participant in a language best understood by them. Consecutive sampling method was followed. The Sample study consisted of 36 participants meeting the inclusion criteria.

2.1 Inclusion criteria

Adults in the range of 18 to 60 years old of both genders, which comprises of 19 lean and 17 obese research participants. The lean weight adults with BMI of less than 25 kg/m² were included in the study. The obese weight adults were those with BMI of more than 30 kg/m².

2.2 Exclusion Criteria

Female participants who were pregnant and lactating mothers were excluded from this study.

BMI and Body fat Measurement Calculation: Anthropometric data of the research participants such as age, sex, weight, height, waist circumference, and hip circumference were measured. BMI was calculated using Adolphe Quetelet metric BMI formula. To estimate the body fat percentage a DEXA (Dual X-ray Absorbtiometry) scan was done. The DEXA machine is a Hologic Discovery W. USA Machine. Participants were asked to wear light clothing and to remove any metals from their bodies and clothing before scanning. DEXA scan in females was done only after ensuring that they were not pregnant by conducting pregnancy test within 48 hours period before scan.

2.3 Statistical analysis

Results of 36 samples were analyzed and presented as means with standard deviations (SD) for variables that are normally distributive variables. Statistical significance was determined as p - value (<0.005) between variables of different categories or groups in the population. Pearson's correlation was applied to correlate variables and find their association.

3 Results

Table 1 Anthropometric Variables in All Groups

Category	Overall	Lean (19)	Obese (17)
BMI	25.96± 6.88	19.76± 2.19	32.89 ± 2.06
NC	36.32 ± 4.42	33.25±2.48	39.78±3.48
WHR	0.93± 0.07	0.89±0.06	0.97±0.05
BF%	34.19± 10.91	25.29±7.43	43.17±5.48

According to Table: 1 we can see a huge difference in the neck circumference between the lean and the obese adults which strongly support the idea that neck circumference is another obvious indicator in predicting or determining obesity. When we compare the difference between Lean and Obese group as in Table: 2, we can see that there is significant differences in the anthropometric variables between the lean and the obese adults which is indicative by the p value which is less than 0.05. Looking at Fig.1 we see the correlations of variables in the different categories. We

observe that the overall group, NC showed strong positive correlation with BMI whereas WHR showed moderate correlation with BMI. There is also a moderate correlation between NC, WHR and BF%.

In lean adults the correlation between neck circumference (NC) and BMI is similar to the correlation between WHR and BMI, which is moderate in both cases. However we observe a difference when we compare the correlation between NC and BF% with the correlation between WHR and BF%. The correlation between NC and BF% is weak. The correlation between WHR and BF% is towards a strongly positive side. Again from Table: 2 we can that in obese, the NC, WHR demonstrate moderate correlation with BMI, but there is a negative correlation between NC, WHR and BF%.

Table 2 Comparisons between Lean and Obese of Body Mass Index (BMI, Neck Circumference, Waist Hip Ratio and Body Fat Percentage

VARIABLES	LEAN (19)	OBESE (17)
BMI	19.76± 2.19	32.89 ± 2.06
NC	33.25±2.48	39.78±3.48
WHR	0.89±0.06	0.97±0.05
BF%	25.29±7.43	43.17±5.48

P. Value = < 0.0001***

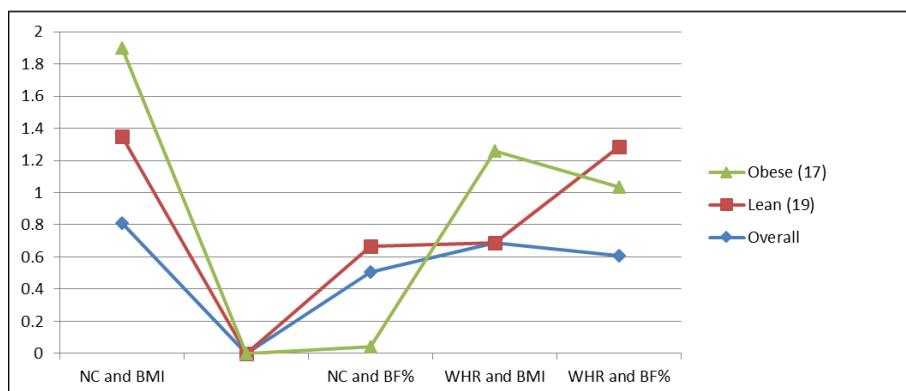


Figure 1 Pearson's Rank Correlation of Neck Circumference (NC), BMI, Waist Hip Ratio and Body Fat Percentage (BF %)

4 Discussion

The result demonstrate that neck circumference do increase in obese adults when compared to lean adults. Neck circumference in obese of this study is 39.89 ± 2.06 which is beyond the cut off value for obesity derived by the Department of Endocrinology and Diabetes in Dhaka, Bangladesh which is ≥ 35.25 cm in men and ≥ 34.25 in women [2]. A study in Thailand, which is our neighbor country and the place of origin of the Khasi people that forms 90% of this study sample, found that the cut off value for NC in female is ≥ 32 cm and male is ≥ 38 cm to identify adults with central obesity [3]. When we study the correlation of variables, we observe that the overall group, NC showed strong positive correlation with BMI whereas WHR showed moderate correlation with BMI. There is also a moderate correlation between NC, WHR and BF%. Our study also revealed a similar degree of correlation between Neck circumference and BMI or WHR and BMI in lean adults. WHR shows a strongly positive correlation with BF% whereas NC shows a weak correlation with BF%. In the obese adults we however see a different result in which we observe a moderately positive correlation between Neck circumference, WHR and BMI, but a negative correlation between NC, WHR and body fat percentage. According to the results of our study, it is obvious that neck circumference do correlate with BMI in all the three groups that are the overall, lean and obese research participants. So we can possibly predict BMI and obesity by looking at the neck circumference because of the presence of a positive correlation in all the groups. The negative correlation between NC, WHR and BF % however requires further investigation.

A study that was done in Bahrain showed a weak, positive correlation between NC and BMI and a moderate, positive correlation between WHR and BMI in obese adolescents and has concluded that NC can only be used as an adjunct

screening tool for weight status in obese adolescents [1]. The study that was done in Bangladesh also demonstrated positive correlation between NC, WHR and BMI [2]. In Saudi obese of the same age group as in our study it is found that again NC is positively correlated with BMI and waist circumference. The study from the Kingdom of Saudi Arabia has even concluded that NC can be used as a marker to predict cardio-metabolic risks [4]. A study conducted in Thailand found correlation between NC and waist circumference and have considered that NC can be used as an alternative to waist circumference in screening central obesity (3). Even in children of age between 13-16 years, a study has shown the existence of positive correlation between NC, WHR and BMI [5]. Our study appears to be in agreement with all these studies except that correlation studies between NC, WHR and BF% do not seem to exist which our study have highlighted.

This study being a preliminary study with a small sample size is revealing only a tip of the iceberg of the truth. An in depth study with an adequate sample size will probably shed better knowledge that is even closer to the truth. Hence further investigation into this matter is required, more so in the areas that correlate different patterns of fat accumulation in the body with NC and WHR.

5 Conclusion

According to the results of our study, it is obvious that neck circumference like WHR do correlate with BMI in all the three groups that is, in the overall, lean and obese research participants. And that neck circumference is as good an indicator as WHR in identifying adults with obesity.

Compliance with ethical standards

Acknowledgments

Shapborlang Mawlong and Arky Jane Langstieh for data entry and clerical assistance.

Disclosure of conflict of interest

There is no conflict of interest.

Statement of ethical approval

This is an analytical observational preliminary study which is a part of a larger study that was cleared by the Institutional ethics committee.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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