Correlation of neck and wrist circumference with waist circumference

B B Karki*, M D Bhattarai, M R Bajracharya, S Karki, A R Devkota

National Academy of Medical Sciences, Bir Hospital, Kathmandu, Nepal

ABSTRACT

Background and aims: Body mass index, waist and hip circumference have been using for measurement of obesity, however practically it's difficult to get these measures accurately because of the various reasons, so an alternativeto this could be neck and wrist circumference measurement. As there is scarce report on such anthropometric studies from Nepal, we aimed to find out the correlation between neck and wrist circumference with waist circumference for obesity measure.

Method: A cross sectional observational study of total 297(147 male and 150 female) participants, aged above 18 years conducted on 2013 at Kathmandu valley. Anthropometric markers of obesity were measured, including body weight, height, waist, hip, neck and wrist circumferences.

Results: A strong positive Pearson correlation of neck circumference with waist circumference was found in both male and females(r=0.64 in male and r=0.86 in female). Neck circumference had strong positive correlation with waist circumference in obese female than in male(r=0.5 in male and r=0.82 in female).Similarly, neck circumference had positive correlation with body mass index(r=0.53in male and r=0.79 in female),hip(r=0.54in male and r=0.76in female), weight(r=0.59in male and r=0.77in female) except waist hip ratio(r=0.59in male and r=0.10in female). Neck circumference cutoff for abnormal waist (≥90cm for male and ≥80cm for female) was 34.4cm for male and 32.5 cm for female. Similarly wrist circumference had also positive correlation with waist circumference(r=0.58 and r=0.64 in female) and with weight(r>0.6) in both sexes.

Conclusion: Neck circumference which can be relatively easily measured has shown strong correlation with waist.

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INTRODUCTION

Obesity is rapidly growing in both developed and developing country.[1]Visceral obesity is linked with insulin resistance, hypertension and dyslipidemia and is related to increased risk of type 2 diabetes and cardiovascular diseases.[2,3]

BMI has been adopted by most health professionals for obesity surveys, as it is easy to perform on a large scale. However, it does not depict the true body composition. Furthermore, visceral obesity, which closely relates to cholesterol levels in the body and its association with coronary artery disease, is better defined by measuring the waist circumference.[4]Waist circumference is considered as an important component for the diagnosis of metabolic syndrome.[5]But practically it's difficult to get the accurate measurement of waist because of the various reasons like: inadequate exposure of body

*Corresponding author
Dr Budda Bahadur Karki
National Academy of Medical Sciences, Bir Hospital, Kathmandu, Nepal
Email: buddabdrkarki@gmail.com

especially in winter, in busy, everyday primary care practice, site of measurement etc. so alternative to this measurement for a practical point of view is needed.

Some studies demonstrated that NC (neck circumference) is an index of upper body fat distribution that can be used to identify obese patients. [6- 10]In some studies, NC is also found to be related to cardiovascular risk factors in severely obese men and women. [6]There is not enough data in the literature evaluating the eligibility of wrist circumference as an obesity parameter.[11] Marco Capizzi et al found a close relationship among wrist circumference, its bone component, and insulin resistance in overweight/obese children and adolescents, opening new perspectives in the prediction of cardiovascular disease.[12]Measurement of neck circumference has recently been used to identify overweight and obesity and is observed to have good correlation with age, weight, waist and hip circumferences, waist-to-hip ratio, and BMI for both genders.[13]

Nepal belongs to the south Asian region where the non-communicable diseases like diabetes mellitus, metabolic disorders and cardio vascular disorders are increasing in number day by day.

Increment of problem of diabetes in Nepal was also shown by the clustered-sampled population-based study of the urban areas of Nepal conducted between 2001 to 2002 where out of the total population, 30.5% (37.8% of men and 25.3% of women) had some abnormality of glucose tolerance.[14]As the obesity is preventable condition which in future can lead to diabetes and cardio vascular diseases, anthropometry can be one of the useful and easy tools for its early recognition. Measurement of neck circumference may improve prediction of incident diabetes over traditional adiposity measures such as BMI and waist circumference.[15]

As there is scarce report on the anthropometric measurements of Nepalese population, we decided to perform anthropometric evaluation of Nepalese population.In this study we aimed to determine wrist and neck circumference as alternatives for measurement for diagnosis of obesity and correlate them with waist circumference in different BMI categories.

METHOD

An observational cross-sectional study of 297 healthy participants above 18 years of age conducted on 2013. Participants were recruited as convenient sample from different parts of Kathmandu valley.Written informed consent was obtained from all participants and clearance was taken from the Institutional review board of National academy of medical sciences. All the participants were examined for the presence of confounding variables like abdominal distension, neck fullness or swelling, and wrist deformity or fracture and, if found positive, were excluded from the study.

Anthropometric markers were measured, including body weight, height, waist, hip, neck and wrist circumferences using standard techniques[16] as: Body weight and height were measured while wearing light clothing and without shoes and BMI were calculated.Waist circumference (cm) was taken horizontally to within 1 mm, using plastic tape measure at midpoint between the costal margin and iliac crest in the mid-axillary line, with the subject standing and at the end of normal expiration. Hip circumference was measured at the level of greater trochanters, with the legs close together. The WHR was calculated by the division of waist circumference to hip circumference as an index of central obesity.The neck circumference (cm) was taken in a plane as horizontal as possible, at a point just below the larynx (thyroid cartilage) and perpendicular to the long axis of the neck (the tape line in front of the neck at the same height as the tape line in the back of the neck). Wrist circumference was measured from both right and left wrists at the wrist crease distal to the styloid processes and an average was taken. All circumferences were taken in fasting state with the subjects standing upright and shoulders relaxed. The tape rests firmly on the skin without compressing the skin. The circumference was measured to the nearest 0.1 cm .The average of the two measures was used for the analysis. The participants were categorized in two group normal BMI and abnormal BMI group. Normal BMI was considered if it is in the range of 18 to 22.9 kg/m2 and abnormal BMI if it is ≥23kg/m2 or <18kg/m2 and abnormal waist cutoff (≥80cm for female and ≥90cm for male) as specified for Indian Asian population.[5]

Statistical analyses were performed using SPSS 17.0. All results were expressed as mean standard deviation (SD) or frequency (n %) or range where appropriate. Pearson's correlation coefficient was performed between neck circumference and waist circumference in normal and abnormal BMI males and females separately. A p value <0.05 was considered to be significant.

RESULTS

Out of 297 Participants, 147(49.4%) were males and 150(50.6%) were females. Normal range BMI of 18 to 22.9 kg/m2 was found in 40% of participants, BMI of <18kg/m2 (underweight) in 1.68%,BMI of ≥23kg/m2(overweight) in 18.5% and BMI of ≥25kg/m2(obesity) in 39.7% participants. Mean age of male and female participants were 31.6±10.3years and 34.4±9.9 years respectively. Other general characteristics of participants were shown in table 1. Statistical significant difference was noted in BMI, height, waist circumference and wrist circumference between male and female where female had

relatively higher BMI, and waist circumference but height and wrist circumference was higher in male participants.

Table 1. General Characteristics of the subjects

Parameters	Male (Mean (±SD) (n=147)	Female (Mean (±SD) (n= 150)	P value
Height(m)	1.67 ±0.08	1.55±0.09	<0.001
Weight(kg)	67.78 ±13.30	64.11±13.13	0.018
BMI(kg/m2)	24.28 ±4.46	26.56±4.68	<0.001
Waist circumference(cm)	84.30±11.08	89.48±11.10	<0.001
Neck circumference(cm)	34.61±5.49	35.21±3.47	0.262
Hip circumference(cm)	94.09±7.03	96.73±8.91	0.005
Waist hip ratio	0.89±0.06	0.90±0.09	0.197
Wrist circumference(cm)	16.44±0.97	15.71±0.93	<0.001

A strong positive correlation of neck circumference was found with waist circumference and BMI in both males and females and positive correlation was found with hip circumference and weight (Table 2).

Table 2. Pearson Correlation of neck circumference (cm) with other anthropometric measures

Variables	Male(n=147)		Female(n=150)	
	Pearson coefficient (r)	P value	Pearson coefficient (r)	P value
Waist circumference(cm)	0.64	<0.001	0.86	<0.001
BMI (kg/m2)	0.53	<0.001	0.79	<0.001
Hip circumference(cm)	0.54	<0.001	0.76	<0.001
Weight(kg)	0.59	<0.001	0.77	<0.001
WHR	0.59	<0.001	0.10	0.228
Height(m)	0.18	0.025	0.17	0.039

Wrist circumference had positive correlation with weight, BMI waist and hip circumference in both males and females (Table 3). Figure.1 showed a correlation of neck circumference with waist in different BMI categories (≤22.9 kg/m2 and ≥ 23kg/m2) where a strong positive correlation was found between neck circumference and waist in females with BMI ≥23kg/m2(r=0.82) than in males(r= 0.57) with same BMI.

Table 3. Pearson Correlation of wrist circumference (cm) with other anthropometric measures

Variables	Male(n=147)		Female(n=150)	
	Pearson coefficient (r)	P value	Pearson coefficient (r)	P value
Weight(kg)	0.75	<0.001	0.83	<0.001
BMI (kg/m2)	0.62	<0.001	0.60	<0.001
Waist circumference(cm)	0.58	<0.001	0.64	<0.001
Hip circumference(cm)	0.56	<0.001	0.66	<0.001
WHR	0.44	<0.001	0.13	0.101
Height(m)	0.36	<0.001	0.55	<0.001

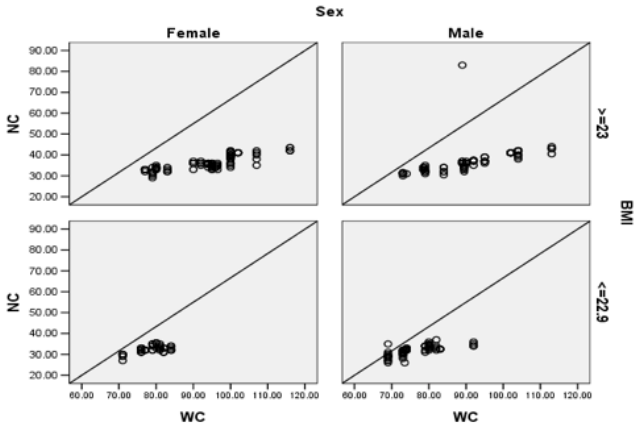

Figure 1. Scatter plot showing correlation (r) of neck circumference (cm) with waist circumference (cm) in different body mass index (BMI) in male and female participants

DISCUSSION

There is strong correlation between neck and waist circumference in present study. In our study, NC (neck circumference) cutoff for abnormal waist (≥80 cm for female and ≥90 cm for male) was found (32.5 cm for female and 34.7 cm formale). Mean neck circumference of 34.6±5.4 cm in males and 35.2±3.4 cm in females with mean waist circumference of 84.30±11 cm in male and 89.48±11.1 cm in female. Our result is comparable to the study from Pakistan where overweight defined by BMI ≥ 23 kg/m2 corresponded to waist values of 84.2 ± 1.7 cm in males and 80.7 ± 4.7 cm in females had neck circumferencevalues 35.7 ± 0.4 cm in males and 32.2 ± 0.9 cm in females and obesity defined by BMI ≥ 25 corresponded to waist of 92.8 ± 2.1 cm in males and 85.8 ± 4.8 cm in females had neck circumferencevalues 37.5 ± 0.8 cm in males and 33.5 ± 0.9 cm in females.[17]

In contrast to other studies, female from this study had higher neck circumference value than in male which could be explained by the obese BMI and abnormal waist of females.

With similar average value of neck circumference, females had higher BMI and waist than males which support the higher cutoff neck circumferencein males. This is further supported by a Chinese studywhere cutoff points of neck circumference for overweight and obesity were 35.5 cm and 37.5 cm for men and 32 cm and 33.5 cm for women.[6]But higher neck circumference cutoff for overweight and obesity was reported from Egypt.[18]This could be because they used the higher BMI and waist cutoff to define overweight and obesity.

Our results showed statistical strong positive correlation of neck circumferencewith waist(r>0.6) and positive correlation(r>0.5) with BMI, hip circumference and weight in all subjects except waist hip ratio which was applicable on males only and poor positive correlation with the height in both male and females. Similarly, neck circumferencehad strong positive correlation with waist(r>0.8) in females with high BMI (≥23kg/m2).This signify the linear correlation of neck circumferencewith waist in obese/overweight individuals. Similar significant positive correlation of neck circumferencewith BMI and waist was found by Mozaffer in Pakistan.[17]Several other studies had also reported the positive correlation of NC with waist and BMI.[6, 19-21]

There are few studies about wrist circumference in the literature. In present study, mean wrist circumference was found higher in males similar to a Turkish study[22] but they had higher value than ours. Lower value in our study could be due to different ethnic population.

We found positive correlations of wrist circumference with BMI, waist and hip circumference, but strong positive correlation was found with weight in both sexes. The positive correlation of wrist circumference with weight, waist and BMI is supported by a study from Pakistan[23] and Turkey. [22] All of these new findings attracted attention to wrist circumference as a possible risk factor for developing diabetes, metabolic syndrome and cardiovascular diseases.

In present study, Our result showed higher prevalence of obesity and overweight which is in agreement with the studies where high prevalence of overweight and obesity was found in Nepalese population.[24,25]

According to our study results, both neck and wrist circumference seemed to be useful obesity measurement parameters for both male and female subjects. The study has some limitations that need to be addressed in future research. First, the sampling was not random and sample size was small consisting of healthy adults from a selected population and, therefore, the results cannot be generalized over the whole population. Second, because of less number of participants with normal range BMI, neck circumference cutoff for normal BMI could not find out.

Despite the limitations, the study has important implications for prevention of overweight and obesity in adults as it points towards the practical usage of an easier alternative for obesity measurement. Neckand wrist circumference have been shown to independently contribute to the prediction of overweight and obesity and can be used as an initial screening tool for the purpose. It is a straightforward and inexpensive test that can be performed in any office with a tape measure without undressing.

CONCLUSION

In conclusion, neck circumference had positive correlation with waist circumference in both genders. Neck circumference cutoff for abnormal waist was 34.4 cm for male and 32.5 cm for female. It still requires further investigations for the classification of its' definite position in obesity evaluation with growing new data on its possible role predicting metabolic and cardiovascular diseases. There is some relation of wrist measurement with waist, so present study is not sufficient to conclude its utility to determine the metabolic risk, but one can think about this and plan for large scale study.

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