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Association between newly developed body indices and body mass index in young adults in a Nepali setting: a cross-sectional study

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Abstract

Introduction: New indices to predict adiposity, including 'a body shape index' (ABSI), and the 'body roundness index' (BRI) for assessment of adiposity and health risk. This study aims to explore the association between already in use 'body mass index' (BMI) and these new indices to enhance obesity assessment and risk stratification.

Method: An observational cross-sectional study was done among 150 medical and dental students at National Medical College, Birgunj from 01 Nov 2021 to 30 Mar 2022. Ethical clearance was taken from the Institutional Review Committee. Simple random sampling was applied. Waist circumference (WC) was measured in cm. The BMI, ABSI and BRI were calculated. Correlation between different parameters was determined.

Result: Out of 150 participants, a very high positive correlation was observed between WC and BRI in males (r=0.919, p<0.001) and in the total population (r=0.875, p<0.001). In females, a very high positive correlation was found between WC and ABSI (r=0.935, p<0.001). Negative correlations were seen between BMI and ABSI in both males (r=-0.166) and females (r=-0.106), as well as in the total population (r=-0.071).

Conclusion: Study showed a strong positive correlation between BMI and BRI. Also, WC correlated strongly with BRI and ABSI; highlighting the potential utility of BRI and ABSI as complementary tools alongside BMI for more accurate assessment of obesity an health risks in the Nepali young population.

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Introduction

The global rise in overweight and obesity has become a major public health concern, with increasing prevalence observed even in low- and middle-income countries such as Nepal. Among young adults, changing lifestyles, urbanisation, and dietary transitions have contributed to a growing burden of adiposity-related health risks.[1,2] Due to this reason, obesity is itself termed as a non-communicable disease these days.[3]

Body Mass Index (BMI) and waist circumference (WC) are widely used adiposity indices identifying overweight and obesity. However, BMI has well-recognised limitations—it does not differentiate between fat and lean mass, nor does it capture body fat distribution, which is a critical factor in cardio-metabolic risk.

To address these limitations, newer body indices such as the Body Roundness Index (BRI) and A Body Shape Index (ABSI) have been developed. The BRI estimates body fat and visceral adiposity by incorporating waist circumference and height, providing a more direct assessment of body shape and fat distribution.[4,5] The ABSI, on the other hand, adjusts waist circumference for BMI and height, offering an improved measure of abdominal obesity and associated health risks beyond what BMI alone can capture.[6-8] Existing studies in Nepal primarily rely on BMI, which may underestimate the true prevalence of health risks related to central adiposity. This study aims to evaluate the relationship between BRI, ABSI, and BMI in young adults in Nepal. Understanding these relationships will provide insights into the utility of these indices and enhance anthropometric assessment for better health risk stratification.

Method

This was an observational cross-sectional study from Nov 2021 to Mar 2022 among first and second-year medical and dental students in the National Medical College, Birgunj, Nepal. Ethical clearance was taken from the Institutional Review Committee (Reference number: FNMC/559/078-079). The sample size was calculated to be 75 using formula $n=2[(Z_{\alpha}+Z_{1-\beta})/q]^2+3$ through G*Power software, where, n=required sample size, Z_{α}=threshold probability for rejecting the null hypothesis= 1.96 at 5% level of significance, z_{β}=probability of failing to reject the null hypothesis under the alternative hypothesis=0.842 at 80% power, q=effect size, r_1=correlation coefficient for male =0.6, r_2=correlation coefficient for female=0.22.[9] We aimed to compare findings in males and females for fat distribution pattern as well as fat storage. So, a total of 150 students, 75 males and 75 females, were included in the study.

Simple random sampling was done. The roll numbers of the students of different years were listed in the Excel sheet. With the help of Excel, random roll numbers were selected until each male and female participant had 75. Both verbal and written consent were taken from the subjects, and findings were recorded in a data collection sheet.

The height of the subjects was measured using a stadiometer; participants were barefoot, heels together, back straight, and head in Frankfort plane. The headpiece was lowered to the crown of the head with enough pressure to compress hair and the height to the nearest 0.1 cm. Weight was measured using OMRON BF14, the participants stood barefoot with each foot on the sensors and the weight was recorded to the nearest 0.1Kg. Non-stretchable tape was used to measure the WC; the measurement was taken at the narrowest point of the abdomen between the lower costal border (10th rib) and the top of the iliac crest.

The BMI was calculated using Quetelet's formula, $\text{weight in kg}/\text{height in meter}^2$ and classified using the category listed by the World Health Organisation.[10] The BRI was calculated using the formula 365.2−365.5×√(1− (((wc/2π)2)/[(0.5 × height)]^2))[4] and ABSI was calculated using the formula WC/[(BMI)^(2/3) × (height)^(1/2)].[8]

The data was then transferred into Excel 2013. Statistical analysis was done using SPSS 16 software. The continuous data were expressed in mean±standard deviation. Pearson correlation was used to see the relationship of BMI with BRI and ABSI. A p-value of 0.05 or less at 95% confidence interval was considered significant.

Result

Out of 150 student participants, the mean age of the total participants was 20.11±1.29 years. The mean BMI, BRI and ABSI for male participants were 21.92±2.71 kg/m^2, 2.54±0.79 and 0.076±0.0048 $m^{11/6}/kg^{2/3,}$ respectively. And that for female participants was 21.06±2.71 kg/m2, 2.44±1.09 and 0.073±0.0055 $m^{11/6}/kg^{2/3,}$ respectively, Table 1.

A very high positive correlation (r=0.919) was seen between WC and BRI among the male participants, which was highly significant (p<0.001). Negative correlation was seen between BMI and ABSI (r=-0.166), which was not statistically significant, Table 2.

A very high positive correlation (r=0.935) was seen between WC and ABSI among the female participants, which was highly significant (p<0.001). Negative correlation was seen between BMI and ABSI (r=-0.106) which was not statistically significant, Table 3.

Among the total population very high correlation was seen between WC and BRI (r=0.875) which was statistically significant (p <0.001). Among the total population negative correlation was seen between BMI and ABSI (r=-0.071), which was not statistically significant, Figure 1.

Table 1. Characteristics of medical and dental students in a study of new body indices and BMI, n=150

Characteristics	Male (n=75) Mean±SD	Female (n=75) Mean±SD	Total Mean±SD
Age (years)	20.44±1.38	19.77±1.11	20.11±1.29
Systolic BP (mmHg)	114.88±7.21	107.41±10.45	111.15±9.69
Diastolic BP (mmHg)	76.48±5.96	71.24±7.59	73.86±7.29
Heart rate (beats/min)	75.83±7.99	77.84±8.39	76.83±8.23
Height (cm)	171.75±7.01	157.10±6.27	164.42±9.89
Weight (Kg)	64.64±8.62	51.99±8.03	58.32±10.45
WC (cm)	77.51±7.22	69.69±9.43	73.60±9.25
BMI (Kg/m^2)	21.92±2.71	21.06±3.01	21.49±2.89
BRI	2.54±0.79	2.44±1.09	2.49±0.95
ABSI ($m^{11/6}/kg^{2/3}$)	0.08±0.01	0.07±0.01	0.07±0.01

WC=West Circumference , BMI=Body Mass Index, BRI=Body Roundness Index, ABSI=A Body Shape Index

Table 2. Correlation of different adiposity indices among male participants, n=75

Variables	BMI	WC	ABSI
BMI	-	-	-
WC	r=0.713 p<0.001	-	-
ABSI	r=-0.166 p=0.366	r=0.587 p=<0.001	-
BRI	r=0.756 p<0.001	r=0.919 p<0.001	r=0.538 p<0.001

Table 3. Correlation of different adiposity indices among female participants, n=75

Variables	BMI	WC	ABSI
BMI	-	-	-
WC	r=0.735 p<0.001		-
ABSI	r=-0.166 p=0.366	r=0.935 p=<0.001	-
BRI	r=0.781 p<0.001	r=0.520 p<0.001	r=0.458 p<0.001

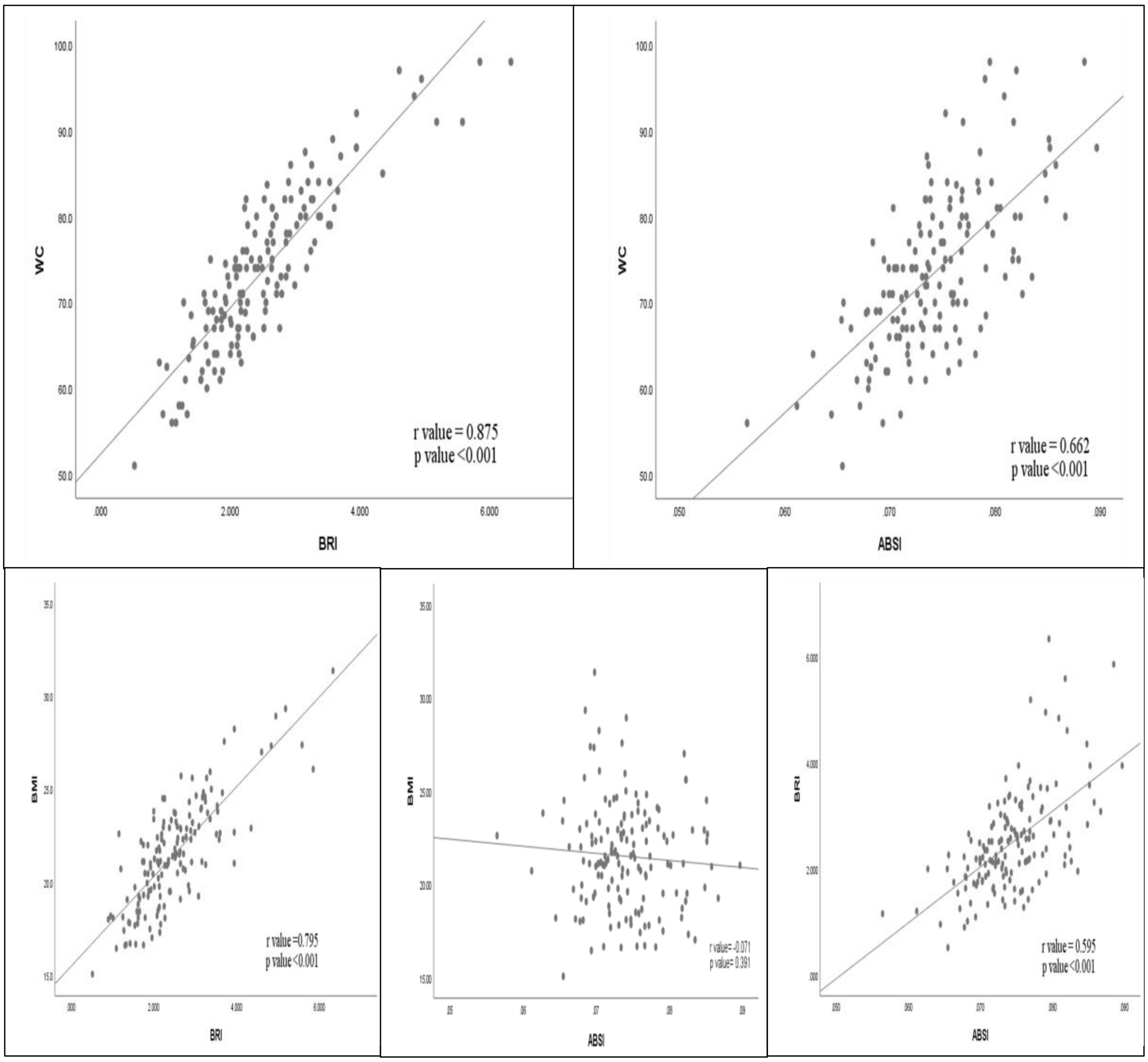

Figure 1. Scatterplot between different adiposity indices among the study population, n=150 1A. Scatterplot between BRI and WC, 1B. Scatterplot between ABSI and WC, Figure 1C. Scatterplot between BRI and BMI, Figure 1D. Scatterplot between ABSI and BMI, Figure 1E. Scatterplot between ABSI and BRI.

Discussion

This study on traditional and newly developed body indices (BMI, WC, BRI, and ABSI) among young medical and dental students in a Nepali setting found that mean BMI (21.49±2.89 kg/m²) was generally within the normal weight range, consistent with previous studies in young South Asian populations.[1,11,12] The observed mean WC (73.60±9.25 cm) and the newer indices BRI (0.074±0.0053) and ABSI (2.49±0.950 $m^{11/6}/kg^{2/3}$) provide additional insight into body fat distribution beyond BMI.

A very high and statistically significant positive correlation (r=0.875, p<0.001) was observed between WC and BRI in the total population. This strong association aligns with the conceptual basis of BRI, which incorporates waist circumference and height to estimate body roundness and visceral fat accumulation.[8] Similar findings have been reported in diverse populations, indicating that BRI is a reliable proxy for central adiposity.[13–15] Given that WC is a well-established predictor of cardiometabolic risk, the strong correlation suggests that BRI could serve as an effective and practical anthropometric marker in the Nepali young adult population.[16]

The study found a weak negative correlation between BMI and ABSI (r=-0.071), which was not statistically significant. This finding is consistent with the original design of ABSI, which aims to be independent of BMI by adjusting waist circumference for height and weight.[4] The lack of significant correlation indicates that ABSI reflect body shape and fat distribution better than BMI, and may better predict cardiometabolic risk.[17] The negative trend, although not significant, suggests that individuals with similar BMI may have different ABSI and abdominal obesity.

Among females, a very high positive correlation between WC and ABSI (r=0.935, p<0.001) was observed, indicating that ABSI closely tracks waist circumference in females. This is reflected in gender differences in fat distribution, where females tend to accumulate more subcutaneous and visceral fat around the abdomen.[18] A negative but non-significant correlation between BMI and ABSI in females (r=-0.106) further shows that ABSI is a better tool in assessing central obesity among females.

The findings highlight the limitations of BMI as a sole indicator of obesity and related health risks, especially in ethnically diverse populations like Nepal and India, where body composition and fat distribution patterns vary.[11] The strong correlation between WC and BRI supports the use of BRI as a practical tool for assessing central adiposity in young adults. Meanwhile, ABSI's independence from BMI and its strong association with WC in females suggest it could be valuable for identifying individuals at risk who might be overlooked by BMI-based screening.

The cross-sectional design of present study limits causal inference, and the young, healthy population may not represent older groups. Future longitudinal studies should evaluate the predictive value of BRI and ABSI for metabolic syndrome, cardiovascular diseases, and mortality in Nepal. Additionally, exploring ethnic and regional variations within Nepal could refine the applicability of these indices.

Conclusion

Our study showed a strong positive correlation between BMI and BRI. Also, WC correlated strongly with BRI and ABSI. Hence, BRI and ABSI offer valuable improvements over BMI for assessing obesity-related health risks in young Nepali adults. Integrating these new indices into clinical and public health practice could enhance risk stratification and support more effective prevention strategies.

Author contribution

Concept design: All; Literature search: VA, AM; Data collection: VA, AM; Data analysis: VA, PB, DRM; Draft manuscript: VA, PB; Final manuscript and accountability: All

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Conflict of interest
None

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Supplementary material
The data and supplementary material that support the findings of this study are available from the corresponding author upon reasonable request.

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