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A Body Shape Index (ABSI) - Is It Time to Replace Body Mass Index?

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ABSTRACT

Obesity has been typically quantified in terms of Body Mass Index (BMI) and waist circumference (WC) is used as a risk indicator supplementary to BMI, but the high correlation of WC with BMI makes it hard to isolate the added value of WC. Though, BMI is widely used as a measure of overweight and obesity, it underestimates the prevalence of the two, leading to the underdiagnosis of patients at risk and there are data questioning BMI reliability and indicating that it provides a false diagnosis of body fatness. In such a scenario, the importance of including central adiposity in quantifying the cardiovascular risk was highlighted and a new anthropometric measure, the A Body Shape Index (ABSI) was developed which outperformed former standard measures of abdominal obesity in predicting mortality risk.

Substantial research on ABSI has been carried out both nationally and globally. In the current article, we provide an overview of the standard measures of abdominal obesity which have been employed for over the years. Extensive Medline, Web of Science and Pubmed search was adopted to congregate research pertaining to ABSI and was later penned down to compile this review. The authors have highlighted the role of BMI and its major limitations in the first part of this writing. Then the growing significance and advantages of ABSI in clinical context have been briefly described, followed by the discussion on the earlier and currently accepted opinions for ABSI based on the studies in the past and recent times. The prospective aspect of ABSI has also been delved into, with reference to findings or recommendations of exploration already done. The rationale behind this review was to provide a thorough quintessence of the research carried out in the field of surrogate markers of adiposity with an attempt to summarize the previous concepts as well as recent perspective about the value of ABSI. To enable a nippy glance for the readers, we have also tabulated a chronological account of researches on BMI and ABSI conducted across the globe over a period of 18 years! To sum up, we lay down prospective research directives related to ABSI as well as offer perspectives to stimulate further research inquiry into its potential usefulness as an anthropometric measure for a better and accurate assessment of cardiovascular risk. So the authors here have made an attempt to present a robust Review on ABSI and tried to thrust upon the contention that it is high time to replace BMI with ABSI.

Keywords: Body Shape Index, Body Mass Index, obesity, Waist Circumference

INTRODUCTION

World Health Organization (WHO) states that overweight and obesity are increasing in prevalence and is the fifth worldwide cause of death among risk factors, behind high blood pressure, tobacco use, high blood glucose, and physical inactivity. In high and middle-income countries, the prevalence of overweight and obesity among the adult population already exceeds 50%, and occupies third place as risk factors causing death, behind high blood pressure and tobacco use.[1] Guidelines published by the USA National Institutes of Health considered overweight and obesity as the second leading cause of preventable death in the USA, behind smoking.[2] Obesity is defined as an excess accumulation of body fat, with the amount of this excess fat actually being responsible for most obesity-associated health risks.[3] Obesity is known to increase the risk of cardiovascular diseases and type 2 diabetes at the same time as imposing functional limitations in a number of subjects translating into a reduced quality of life as well as life expectancy.[4-5] Obesity is typically quantified in terms of Body Mass Index (BMI), on exceeding threshold values, it is considered a leading cause of premature death worldwide.[6] Waist circumference (WC) is used as a risk indicator supplementary to BMI, but the high correlation of WC with BMI makes it hard to isolate the added value of WC.

A Body Shape Index (ABSI) is an anthropometric parameter calculated by dividing waist circumference (WC) by its estimate obtained from allometric regression of weight and height.[7] ABSI was designed to be minimally associated with weight, height and body mass index (BMI) so that it can be used together with BMI to unscramble the independent contribution of WC and BMI to cardio-metabolic outcomes. Waist circumference (WC) has been used to indicate the presence of abdominal obesity, with WC above threshold forming one criterion for diagnosis of metabolic syndrome.[8,9] However, there was found a high correlation (0.8–0.9) between BMI and WC or WC-derived measures such as WC/H ratio and body roundness index bound the utility of these measures beyond BMI.[10-14]

BODY MASS INDEX (BMI) - ROLE AND LIMITATIONS

Body mass index (BMI) is the most frequently used diagnostic tool in the current classification system of obesity. It has the advantage that a subject's height and weight are easy and inexpensive to measure. World Health Organization (WHO), the US Preventive Services Task Force and the International Obesity Task Force[15] define overweight as a BMI between 25.0 and 29.9 $kg\,m^{-2}$ and obesity as a BMI$\geqslant$30.0 $kg\,m^{-2}$. These cutoffs are very useful in epidemiological studies. Despite its wide use, BMI is only a proxy measure of body fatness and does not provide an accurate measure of body composition. These BMI-based obesity guidelines have been accompanied by doubt as to the validity of BMI as an indicator of dangerous obesity. Muscle and fat accumulation are not distinguished by BMI.[16]

Though, BMI is widely used as a measure of overweight and obesity, but underestimates the prevalence of both conditions, defined as an excess of body fat leading to the underdiagnosis of patients at risk. A study established that 29% of subjects classified as lean according to BMI (BMI<25.0 kg m−2) and 80% of subjects classified as overweight according to actual BMI (BMI⩾25.0 kg m−2 and <30.0 kg m−2), had a Body Fat percentage (BF%) well within the obesity range. However, 0.2 and 1.0% of the subjects with a BF% in the lean or overweight range, respectively, was misclassified as obese according to the BMI values which indicates that there is a high degree of misclassification in the diagnosis of obesity in clinical practice, which results in the underdiagnosis of patients at risk and, therefore, missed opportunities to treat this life-threatening condition.[17]

There are data questioning BMI reliability and indicating that it provides a false diagnosis of body fatness.[18,19] There is also data indicating that regional fat distribution, but not total body fat stores, are related to metabolic disturbances and health risks[20]. It has however been demonstrated that WHO standards of BMI are not suitable for the evaluation of body fat with based on ethnicity. Similar has been found with respect to associations between BMI and mortality. Suppose BMI provides reliable information concerning body fatness and taking into account detrimental effects of fat excess on health and mortality, it is not yet clear why the BMI-mortality relationship is U-shaped, suggesting high mortality in both lean and obese humans. [21-23]

There is evidence that whereas higher fat mass is associated with greater risk of premature death, higher muscle mass reduces risk and BMI does not distinguish between muscle and fat accumulation nor does it distinguish between fat locations, when central or abdominal fat deposition which is thought to be particularly death-defying. Waist circumference (WC) has emerged as a leading complement to BMI for indicating obesity risk. Several studies showed that WC predicted mortality risk better than BMI. WHO report summarized evidence for WC as an indicator of disease risk suggesting that WC could be used as an alternative to BMI. [24-25] For a given height and weight, high ABSI may correspond to a greater fraction of visceral fat compared to peripheral tissue. It is also important to note that individuals with high ABSI had a smaller fraction of mass as limb muscle; lean tissue mass and limb circumference have been shown to have strong negative correlations with mortality risk.[26]

A study examined BMI and WC together and found that they were both negative predictors of mortality, but when BMI and WC were examined simultaneously, BMI was found to be a negative predictor of mortality and WC was a positive predictor of mortality. After controlling for WC, mortality risk decreased 21% for every standard deviation increase in BMI. After controlling for BMI, mortality risk increased 13% for every standard deviation increase in WC. The patterns of associations were consistent by sex, age, and disease status.[27] A mortality outcome analysis in elderly showed that including both BMI and WC as continuous variables in a Cox proportional hazard model for mortality gives a direct correlation between WC and mortality and an inverse correlation between BMI and mortality. Numerous other studies investigated the relationship between body fat and stature-adjusted body mass with a view to obtain a simple index to identify the overweight or obese members of the community[28]. In such studies, BMI emerged as the overpowering favorite as despite its convenience and popularity, some researchers still consider BMI a relatively crude index of adiposity, predominantly due to the fact that it fails to quantify body composition.

Healthy adults indeed can be misdiagnosed by BMI as overweight or obese, if fat mass is verified by a criterion method.[29] For instance, a slender-framed female with significant excess fat may appear as a false negative, and a muscular male as a false positive. A multination European cohort, stratifying by BMI category transformed the curve of mortality risk as a function of WC from U-shaped to more linear.[30]

There appears to be little research into whether BMI is a valid and reliable proxy for adiposity across athletic and nonathletic populations. Including the body composition measurements with morbidity evaluation in routine medical practice for diagnosis as well as decision making for instauration of the most appropriate treatment of obesity is desirable.

A BODY SHAPE INDEX (ABSI): A PROMISING FITNESS PARAMETER UNLEASHED YET TO BE EXPLORED

A Body Shape Index (ABSI), has been derived from waist circumference which is independent of BMI and is said to be a better index than using either WC or BMI independently. ABSI determines whether abdominal obesity has an analytical ability independent of BMI .[31] It is a new anthropometric measure, introduced by Krakauer et al, which considers WC and BMI concurrently and is, therefore, considered to be more inclusive than other traditional anthropometric measures. It is based on WC, weight and height, where high ABSI indicates that WC is higher than expected for a given height and weight and corresponding to a more central concentration of body volume. ABSI along with BMI as a predictor variable show to disconnect the influence of the body shape component measured by WC from that of body size. A higher ABSI in a study predicted mortality hazard was quite analogous to the outcome of analyses which had adjusted WC for BMI without invoking ABSI. The findings regarding the association of ABSI with total mortality confirmed the results. Furthermore, the study showed that increase in ABSI was associated with a higher risk for cardiovascular mortality in men and cancer mortality in women in populations over the age of 55 years. Linear associations were observed between ABSI with total and cause-specific mortality which were more clearly demonstrated among men.[32]

In a 22 years of follow-up study, 3675 deaths from all-causes, 1195 from cardiovascular disease, and 873 from cancer occurred. In the multivariable model, ABSI showed a stronger association with mortality compared with BMI, WC, WHtR and waist-hip ratio (WHR). Prediction of total mortality the model including ABSI was more informative ($\chi2=26.4$) in men and provided improvement in risk. Among different anthropometric measures, ABSI showed a stronger association with total, cardiovascular and cancer mortality.[33] Being independent of BMI, ABSI could shed light on elucidating the predictive ability of abdominal obesity that cannot be attributed to BMI alone.

Another study suggests ABSI is better correlated to changes in circulating insulin than BMI in young sedentary men. Additionally, considering the health deteriorations due to changes in biochemical parameters, it could be tentatively postulated that ABSI may be of importance in risk prognosis of type 2 diabetes and/or atherogenesis. It should also be stressed that ABSI validity in the prognosis of cardiovascular disease (CVD) is far from being elucidated since Maessen et al [34] did not find ABSI capable of determining the presence of the disease in middle-aged subjects. A systematic review tested the performance of A Body Shape Index (ABSI) in predicting hypertension, cardiovascular disease, type 2 diabetes and all-cause mortality and compared the differential predictability between ABSI and two other common anthropometric measures – body mass index and waist circumference. A keyword and reference search conducted in the PubMed and Web of Science for articles published until 1 November 2017. Thirty-eight studies were included in the review, 24 retrospective cohort studies and 14 cross-sectional studies conducted in 15 countries. The meta-analysis found that a standard deviation increase in ABSI was associated with an increase in the odds of hypertension by 13% and type 2 diabetes by 35% and an increase in cardiovascular disease risk by 21% and all-cause mortality risk by 55%. ABSI has shown to outperform body mass index and waist circumference in predicting all-cause mortality but underperformed in predicting chronic diseases. However, ABSI is highly clustered around the mean with a rather small variance which makes it difficult to define a clinical cutoff for clinical practice.[35]

The importance of WC measurements in diagnosis of health risk has been suggested by many authors since it has been postulated that WC provides indirect information about visceral fat accumulation.[36,37] At present it is well documented that visceral fat due to its location and metabolic characteristics contributes to distorted metabolism to a much greater extent than subcutaneous fat.[38,39] Difference reported in metabolic profiles of subjects selected according to lower and upper quartiles of ABSI may suggest that ABSI, but not BMI, depicts variability in circulating insulin and lipoproteins in participants of our study mostly characterized by normal body fat according to BMI standards. Thus, it seems feasible that ABSI allows diagnosis of slight metabolic disturbances observed in otherwise healthy subjects.[40] In addition, assuming that lower and upper quartiles of BMI varied by 41% (28.2 versus 20.0) and ABSI quartiles differ by 11.6% (0.077 versus 0.069) it seems that even minor changes in ABSI provided information about variability in metabolic risk. Thus, in young and otherwise healthy sedentary men ABSI is a better predictor than BMI of variability in biochemical parameters, which may indicate disturbed metabolic processes. [41] Similarly, other authors have suggested that both BMI and WC contribute to the prediction of body adiposity in white men and women. In addition to WC, inverse hip circumference, or waist to hip ratio, have been suggested as alternative measures of body shape that predict mortality better than BMI.[42]

A chronological account of researches on BMI and ABSI conducted across the globe from the year 2000 to 2018 has been tabulated in Table 1.

Table 1: Chronological account of researches on BMI and ABSI

Name	Year	Method	Conclusion
Gallagher D et al	2000	Adult subjects with BMIs ≤35 and without any acute or chronic illnesses were evaluated. 5 evaluations: weight, height, DXA for body fat and bone mineral mass, tritium or deuterium dilution for total body water, and hydrostatic weighing for body density and volume.	Study highlights important issues for future consideration, such as the appropriateness of increasing fatness with aging even when BMI remains constant, the causes of country or ethnicity differences in BMI–percentage body fat relations, whether misclassified subjects are more or less healthy than their counterparts with similar BMIs, and how to develop appropriate sampling strategies to prospectively develop percentage body fat ranges.
Frankenfield DC et al	2001	Fat-free mass and body fat were determined with bioelectrical impedance. Adiposity was calculated as body fat per body mass and as body fat divided by body height (m2). Obesity was defined as a BMI of at least 30 kg/m2 or an amount of body fat of at least 25% of total body mass for men and at least 30% for women.	30% of men and 46% of women with a BMI below 30 kg/m2 had obesity levels of body fat. The greatest variability in the prediction of percentage of body fat and body fat divided by height (m2) from regression equations using BMI was at a BMI below 30 kg/m2. significant numbers of people with a BMI below 30 kg/m2 are also obese and thus misclassified by BMI. Percent of body fat and body fat divided by height (m2) are predictable from BMI, but the accuracy of the prediction is lowest when the BMI is below 30 kg/m2. Therefore, measurement of body fat is a more appropriate way to assess obesity in people with a BMI below 30 kg/m2.
Jackson AS et al	2002	The Heritage Family Study cohort of 665 black and white men and women who ranged in age from 17 to 65 y. Body density determined from hydrostatic weighing. Percentage body fat determined with gender and race-specific, two-compartment models. BMI determined from height and weight, and sex and race	For the same BMI, the %fat of females was 10.4% higher than that of males. General linear models analysis of the women's data showed that age, race and race-by-BMI interaction were independently related to %fat. The same analysis applied to the men's data showed that %fat was not just a function of BMI, but also age and age-by-BMI interaction. BMI and %fat relationship are not independent of age and gender. These data showed a race effect for women, but not men.
Janssen I et al	2002	Fat distribution was measured by magnetic resonance imaging in 341 white men and women. These fat depots were also compared after a subdivision of the cohort into 3 BMI (normal, overweight, and class I obese) and 3 WC (low, intermediate, and high) categories according to the classification system used to identify associations between BMI, WC, and health risk	BMI and WC independently contribute to the prediction of non-abdominal, abdominal subcutaneous and visceral fat in white men and women. These observations reinforce the importance of using both BMI and WC in clinical practice.
Kyle UG et al	2003	fat-free mass (FFM) and body fat mass (BF) were determined in 2986 healthy white men and 2649 white women, age 15 to 98 y, by a previously validated 50-kHz bioelectrical impedance analysis equation. FFMI, BFMI, and %BF were calculated.	FFMI values were 16.7 to 19.8 kg/m2 for men and 14.6 to 16.8 kg/m2 for women within the normal BMI ranges. BFMI values were 1.8 to 5.2 kg/m2 for men and 3.9 to 8.2 kg/m2 for women within the normal BMI ranges. BFMI values were 8.3 and 11.8 kg/m2 in men and women, respectively, for obese BMI (>30 kg/m2). Normal ranges for %BF were 13.4 to 21.7 and 24.6 to 33.2 for men and women, respectively. BMI alone cannot provide information about the respective contribution of FFM or fat mass to body weight.
WHO Expert Consultation. Lancet 2004; 363:157-63	2004	Scientific evidence in the review suggests that Asian populations have different associations between BMI, percentage of body fat, and health risks than do European populations.	Proportion of Asian people with a high risk of type 2 diabetes and cardiovascular disease is substantial at BMIs lower than the existing WHO cut-off point for overweight (⩾25 kg/m2). However, available data do not necessarily indicate a clear BMI cut-off point for all Asians for overweight or obesity. The cut-off point for observed risk varies from 22kg/m2 to 25kg/m2 in different Asian populations; for high risk it varies from 26kg/m2 to

			31kg/m2.
Lofgren I et al	2004	Overweight or obese premenopausal women (n = 80; 74% Caucasians) were recruited from the University of Connecticut and surrounding communities. Plasma lipids, plasma glucose, insulin, leptin, LDL susceptibility to oxidation, LDL size, and plasma Apo lipoproteins were measured. Measurement of WC and calculation of BMI were done according to standard techniques and equipment.	The WC classification of the subjects from the present study revealed stronger associations with multiple risk factors for chronic disease. This finding suggests that WC can be used to screen the general population. Therefore, it is useful to combine both anthropometric measures for risk assessment with the knowledge that the inclusion of WC in the diagnosis will expand the information regarding risk factors that may be present.
Janssen I et al	2005	Five thousand two hundred men and women aged 65 and older. Measurements: BMI and WC were measured at baseline. The risks of all-cause mortality associated with BMI and WC were examined using Cox proportional hazards models over 9 years of follow-up.	When examined individually, BMI and WC were both negative predictors of mortality, but when BMI and WC were examined simultaneously, BMI was a negative predictor of mortality, whereas WC was a positive predictor of mortality. After controlling for WC, mortality risk decreased 21% for every standard deviation increase in BMI. After controlling for BMI, mortality risk increased 13% for every standard deviation increase in WC. The patterns of associations were consistent by sex, age, and disease status.
Nevill AM et al	2006	Skinfolds were measured using Harpenden calipers (British Indicators, Luton, UK) in 478 subjects. The relationship between skinfold caliper readings and body size (using either body mass (M), stature (H), or both) was explored collectively using multivariate analyses of covariance (MANCO-VAs), and individually (for each site) with follow-up ANCOVAs.	Skinfolds increase at a much greater rate relative to body mass than that assumed by geometric similarity (e.g. Mass exponents ranged from being 2-fold greater for the male front thigh to 5-fold greater for the female iliac crest).However, taller subjects had less rather than more adiposity, calling into question the use of the traditional skinfold-stature adjustment, 170.18/stature. The best body-size index reflective of skinfold caliper measurements was a stature-adjusted body mass index, similar to the BMI. However, sporting differences in skinfold thickness persisted after controlling for differences in body size (approximate BMI) and age. These results cast serious doubts on the validity of BMI to represent adiposity accurately and its ability to differentiate between populations, especially when such populations contain different proportions of athlete subjects.
Romero-Corral A et al	2008	13 601 subjects (age 20–79.9 years; 49% men) from the Third National Health and Nutrition Examination Survey. Bioelectrical impedance analysis was used to estimate body fat percent (BF%). We assessed the diagnostic performance of BMI using the World Health Organization reference standard for obesity of BF%>25% in men and>35% in women.	The accuracy of BMI in diagnosing obesity is limited, particularly for individuals in the intermediate BMI ranges, in men and in the elderly. A BMI cutoff of$\geqslant$30 kg m−2 has good specificity but misses more than half of people with excess fat.
Wildman RP et al	2008	5440 participants of the National Health and Nutrition Examination Surveys 1999-2004. Cardiometabolic abnormalities included elevated blood pressure; elevated levels of triglycerides, fasting plasma glucose, and C-reactive protein; elevated homeostasis model assessment of insulin resistance value; and low high-density lipoprotein cholesterol level.	data show that a considerable proportion of overweight and obese US adults are metabolically healthy, whereas a considerable proportion of normal-weight adults express a clustering of cardiometabolic abnormalities. Among US adults, 29.2% of obese men and 35.4% of obese women (a total of approximately 19.5 million adults) possess a healthy profile in terms of the standard cardiometabolic risk factors. In contrast, 30.1% of normal-weight men and 21.1% of normal-weight women (a total of approximately 16.3 million adults) exhibit clustering of cardiometabolic abnormalities (ie, ≥2 cardiometabolic abnormalities). High proportions of normal-weight adults with cardiometabolic clustering and overweight and obese adults who were metabolically healthy were documented when more conservative and less conservative definitions of the metabolically abnormal phenotype were used.
Flegal KM et al	2009	Body mass index (BMI), waist circumference (WC), and the waist-stature ratio (WSR) and percentage body fat (measured by dual-energy X-ray absorptiometry) were compared with percentage body fat in a sample of 12,901 adults.	WC, WSR, and BMI were significantly more correlated with each other than with percentage body fat ($P < 0.0001$ for all sex-age groups). Percentage body fat tended to be significantly more correlated with WC than with BMI in men but significantly more correlated with BMI than with WC in women ($P < 0.0001$ except in the oldest age group). WSR tended to be slightly more correlated with percentage body fat than was WC. Percentile values of BMI, WC, and WSR are shown that correspond to percentiles of percentage body fat increments of 5 percentage points.
Shah NR et al	2012	A cross-sectional study of adults with BMI, DXA, fasting leptin and insulin results were measured. Of the participants, 63% were females,	39% of the subjects were classified as non-obese by BMI but were found to be obese by DXA. BMI misclassified 25% men and 48% women. Meanwhile, a strong

		37% were males, 75% white, with a mean age=51.4 (SD=14.2). Mean BMI was 27.3 (SD=5.9) and mean percent body fat was 31.3% (SD=9.3).	relationship was demonstrated between increased leptin and increased body fat. results demonstrate the prevalence of false-negative BMIs, increased misclassifications in women of advancing age, and the reliability of gender-specific revised BMI cutoffs. BMI underestimates obesity prevalence, especially in women with high leptin levels (>30 ng/mL).
Krakauer NY et al	2012	USA population sample of 14,105 non-pregnant adults from the National Health and Nutrition Examination Survey (NHANES) 1999–2004 with follow-up for mortality averaging 5 yr (828 deaths). A Body Shape Index (ABSI) was developed based on WC adjusted for height and weight	ABSI had little correlation with height, weight, or BMI. Death rates increased approximately exponentially with above average baseline ABSI whereas elevated death rates were found for both high and low values of BMI and WC. 22% (8% - 41%) of the population mortality hazard was attributable to high ABSI, compared to 15% (3% -30%) for BMI and 15% (4-29%) for WC.
Gómez-Ambrosi J	2012	BMI, body fat percentage (BF%) determined by air displacement plethysmography and well-established blood markers of insulin sensitivity, lipid profile and cardiovascular risk were measured.	Given the elevated concentrations of cardiometabolic risk factors reported herein in non-obese individuals according to BMI but obese based on body fat, the inclusion of body composition measurements together with morbidity evaluation in the routine medical practice both for the diagnosis and the decision-making for instauration of the most appropriate treatment of obesity is desirable.
Maessen MFH et al	2014	4627 Participants (54±12 years) of the Nijmegen Exercise Study completed an online questionnaire concerning CVD health status (defined as history of CVD or CVD risk factors) and anthropometric characteristics. Quintiles of ABSI, BRI, BMI, and WC were used regarding CVD prevalence. Odds ratios (OR), adjusted for age, sex, and smoking, were calculated per anthropometric index.	The prevalence of CVD increased across quintiles for BMI, ABSI, BRI, and WC.
Bertoli S et al	2017	a retrospective study on 6081 Caucasian adults. Subjects underwent a medical interview, anthropometric measurements, blood sampling, measurement of blood pressure, and measurement of visceral abdominal fat thickness (VAT) by ultrasound.	ABSI and BMI contributed independently to all outcomes. Compared to BMI alone, the joint use of BMI and ABSI yielded significantly improved associations for having high triglycerides (BIC = 5261 vs. 5286), low HDL (BIC = 5371 vs. 5381), high fasting glucose (BIC = 6328 vs. 6337) but not high blood pressure (BIC = 6580 vs. 6580). The joint use of BMI and ABSI was also more strongly associated with VAT than BMI alone (BIC = 22930 vs. 23479). In conclusion, ABSI is a useful index for evaluating the independent contribution of WC, in addition to that of BMI, as a surrogate for central obesity on cardio-metabolic risk.
Ji M et al	2018	Thirty-eight studies were included in the review, including 24 retrospective cohort studies and 14 cross-sectional studies conducted in 15 countries.	Meta-analysis found that a standard deviation increase in ABSI was associated with an increase in the odds of hypertension by 13% and type 2 diabetes by 35% and an increase in cardiovascular disease risk by 21% and all-cause mortality risk by 55%. ABSI outperformed body mass index and waist circumference in predicting all-cause mortality but underperformed in predicting chronic diseases. ABSI is highly clustered around the mean with a rather small variance, making it difficult to define a clinical cutoff for clinical practice.

PROSPECTIVE RESEARCH DIRECTIVES

Some conceptual advantages of introducing ABSI are that it explains the sublinear increase of WC with BMI along with the nonlinear association of WC with height, and that using it instead of WC avoids inflation of regression uncertainty associated with the near co-linearity of WC and BMI.[43] It should also be stressed that in some way ABSI agrees with the WHO recommendation concerning waist circumference inclusion into health risk evaluation.[44] However, future studies are warranted to assess ABSI's potential usefulness as an anthropometric measure in population-level health surveillance. With further detailed studies, ABSI could be an alternative to BMI for more accurate assessment of cardiovascular risk factors in apparently healthy individuals with BMI in normal range and central obesity. ABSI could prove to be more useful tool for developing control measures and prevention and prognosis of cardiac diseases.

REFERENCES

1. WHO (2009) Global health risks: Mortality and burden of disease attributable to selected major risks. Technical report,

World Health Organization. URL. http://www.who.int/entity/healthinfo/global_burden_disease/GlobalHealthRisks_report_full.pdf.

2. NHLBI (1998) Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: The evidence report. Technical Report 98–4083, National Heart Lung and Blood Institute, National Institutes of Health. URL. http://www.nhlbi.nih.gov/guidelines/obesity/ob_gdlns.pdf.
3. Poirier P, Giles TD, Bray GA, Hong Y, Stern JS, Pi-Sunyer FX et al. Obesity and cardiovascular disease: pathophysiology, evaluation, and effect of weight loss: an update of the 1997 American Heart Association Scientific Statement on Obesity and Heart Disease from the Obesity Committee of the Council on Nutrition, Physical Activity, and Metabolism. Circulation 2006; 113: 898–918.
4. Sullivan PW, Ghushchyan V, Wyatt HR, Wu EQ, Hill JO . Impact of cardiometabolic risk factor clusters on health-related quality of life in the US. Obesity 2007; 15: 511–521.Return to ref 25 in article
5. Pischon T, Boeing H, Hoffmann K, Bergmann M, Schulze MB, Overvad K et al. General and abdominal adiposity and risk of death in Europe. N Engl J Med 2008; 359: 2105–2120.
6. WHO (2009) Global health risks: Mortality and burden of disease attributable to selected major risks. Technical report, World Health Organization.
7. Bertoli S, Leone A, Krakauer NY, Bedogni G, Vanzulli A, Redaelli VI, De Amicis R, Vignati L, Krakauer JC, Battezzati A. Association of Body Shape Index (ABSI) with cardio-metabolic risk factors: A cross-sectional study of 6081 Caucasian adults. PloS one. 2017 Sep 25; 12(9):e0185013.
8. K. G. Alberti, R. H. Eckel, S. M. Grundy et al. "Harmonizing the metabolic syndrome: a joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; and International Association for the Study of Obesity," Circulation, vol. 120, no. 16, pp. 1640–1645, 2009.
9. N. Y. Krakauer and J. C. Krakauer, "Expansion of waist circumference in medical literature: potential clinical application of a body shape index," Journal of Obesity & Weight Loss Therapy vol. 4, article 216, 2014.
10. S. D. Hsieh, H. Yoshinaga, and T. Muto, "Waist-to-height ratio, a simple and practical index for assessing central fat distribution and metabolic risk in Japanese men and women," International Journal of Obesity, vol. 27, no. 5, pp. 610–616, 2003.
11. M. Ashwell, P. Gunn, and S. Gibson, "Waist-to-height ratio is a better screening tool than waist circumference and BMI for adult cardiometabolic risk factors: systematic review and meta-analysis," Obesity Reviews, vol. 13, no. 3, pp. 275–286, 2012.
12. T. E. Matsha, A.-P. Kengne, Y. Y. Yako, G. M. Hon, M. S. Hassan, and R. T. Erasmus, "Optimal waist-to-height ratio values for cardiometabolic risk screening in an ethnically diverse sample of South African Urban and Rural School boys and girls," PLoS ONE, vol. 8, no. 8, article e71133, 2013.
13. D. M. Thomas, C. Bredlau, A. Bosy-Westphal et al., "Relationships between body roundness with body fat and visceral adipose tissue emerging from a new geometrical model," Obesity, vol. 21, no. 11, pp. 2264–2271, 2013.
14. M. F. H. Maessen, T. M. H. Eijsvogels, R. J. H. M. Verheggen, M. T. E. Hopman, A. L. M. Verbeek, and F. de Vegt, "Entering a new era of body indices: the feasibility of a body shape index and body roundness index to identify cardiovascular health status," PLoS ONE, vol. 9, no. 9, Article ID e107212, 2014.
15. International Obesity Task Force. 2009. Available: http://www.iotf.org.
16. Nevill AM, Stewart AD, Olds T, Holder R (2006) Relationship between adiposity and body size reveals limitations of BMI. American Journal of Physical Anthropology 129: 151–156.
17. Gómez-Ambrosi J, Silva C, Galofré JC, Escalada J, Santos S, Millán D, Vila N, Ibañez P, Gil MJ, Valentí V, Rotellar F. Body mass index classification misses subjects with increased cardiometabolic risk factors related to elevated adiposity.

International journal of obesity. 2012 Feb;36(2):286.
18. Kang SM, Yoon JW, Ahn HY, Kim SY, Lee KH, et al. (2011) Android fat depot is more closely associated with metabolic syndrome than abdominal visceral fat in elderly people. PLoS ONE 6: e27694.
19. Katzmarzyk PT, Barreira TV, Harrington DM, Staiano AE, Heymsfield SB, et al. (2012) Relationship between abdominal fat and bone mineral density in white and African American adults. Bone 50: 576–579.
20. Lumeng CN, Saltiel AR (2011) Inflammatory links between obesity and metabolic disease. Journal of Clinical Investigation 121: 2111–2117.
21. Simpson JA, MacInnis RJ, Peeters A, Hopper JL, Giles GG, et al. (2007) A comparison of adiposity measures as predictors of all-cause mortality: the Melbourne Collaborative Cohort Study. Obesity 15: 994–1003.
Pischon T, Boeing H, Hoffmann K, Bergmann M, Schulze M, et al. (2008) General and abdominal adiposity and risk of death in Europe. New England Journal of Medicine 359: 2105–2120.
22. Kuk JL, Ardern CI (2009) Influence of age on the association between various measures of obesity and all-cause mortality. Journal of the American Geriatrics Society 57: 2077–2084.
23. Seidell JC (2010) Waist circumference and waist/hip ratio in relation to all-cause mortality, cancer and sleep apnea. European Journal of Clinical Nutrition 64: 35–41.
24. Heymsfield SB, Scherzer R, Pietrobelli A, Lewis CE, Grunfeld C (2009) Body mass index as a phenotypic expression of adiposity: quantitative contribution of muscularity in a population-based sample. International Journal of Obesity 33: 1363–1373
25. Bray GA, Smith SR, de Jonge L, Xie H, Rood J, et al. (2012) Effect of dietary protein content on weight gain, energy expenditure, and body composition during overeating. Journal of the American Medical Association 307: 47–55.
26. Bigaard J, Frederiksen K, Tjonneland A, Thomsen BL, Overvad K, et al. (2004) Body fat and fat-free mass and all-cause mortality. Obesity 12: 1042–1049.
27. Janssen I, Katzmarzyk PT, Ross R (2005) Body mass index is inversely related to mortality in older people after adjustment for waist circumference. Journal of the American Geriatrics Society 53: 2112–2118.
28. Cole TJ. 1991. Weight-stature indices to measure underweight, overweight and obesity. In: Himes JH, editor. Anthropometric assessment of nutritional status. New York: Wiley-Liss. p 83–111.
29. Hortobagyi T, Israel RG, O'Brien KF. 1994. Sensitivity and specificity of the Quetelet Index to assess obesity in men and women. Eur J Clin Nutr 48:369–375.
30. Pischon T, Boeing H, Hoffmann K, Bergmann M, Schulze M, et al. (2008) General and abdominal adiposity and risk of death in Europe. New England Journal of Medicine 359: 2105–2120.
31. Sowmya S, Thomas T, Bharathi AV, Sucharita S. A body shape index and heart rate variability in healthy Indians with low body mass index. Journal of nutrition and metabolism. 2014 Oct 2;2014.
32. Krakauer NY, Krakauer JC. A new body shape index predicts mortality hazard independently of body mass index. PLoS One. 2012;7(7):e39504. pmid:22815707
33. Krakauer NY, Krakauer JC. An anthropometric risk index based on combining height, weight, waist, and hip measurements. Journal of obesity. 2016;2016.
34. Maessen MFH, Eijsfogels TMH, Verhaggen RJHM, Hopmn MTE, Verbeek ALM, de Vegt F. Entering a new era of body indices: the feasibility of a body shape index and body roundness index to identify cardiovascular health status. PLoS One. 2014;9:e107212.
35. Ji M, Zhang S, An R. Effectiveness of A Body Shape Index (ABSI) in predicting chronic diseases and mortality: a systematic review and meta-analysis. Obesity reviews. 2018 May;19(5):737-59
36. Pouliot M-C, Desprěs J-P, Lemieux S, Moorjani S, Bouchard C, Tremblay A, et al. Waist circumference and abdominal sigittal diameter: best simple anthropometric indexes of abdominal visceral adipose tissue accumulation and related cardiovascular risk in men and women. Am J Cardiol. 1994; 73:460–3.

37. Lofgren I, Herron K, Zern T, West K, Patalay M, Shachter NS, et al. Waist circumference is a better predictor than body mass index of coronary heart disease risk in overweight premenopausal women. J Nutr. 2004;134:1071–6.
38. Coral-Romero A, Sert-Kuniyoshi FH, Sierra-Johnston J, Orban M, Gami AQ, Davison D, et al. Modest visceral fat gain cause endothelial dysfunction in healthy humans. J Am Coll Cardiol. 2010;56:662–4.
39. Liu J, Fox CS, Hickson DA, May WD, Hirstone KG, Carr JJ, et al. Impact of abdominal visceral and subcutaneous adipose tissue on cardiometabolic risk factors: the Jackson Heart Study. J Clin Endocrinol Metab. 2010;95:5419–26.
40. Wildman RP, Muntner P, Reynolds K, McGinn AP, Rajpathak S, Rosetti Wylie J, et al. The obese without cardiometabolic risk factor clustering and the normal weight with cardiometabolic risk factor clustering. Arch Intern Med. 2008;168:1617–24.
41. Sucurro E, Marini MA, Frontoni S, Hibal ML, Andreozzi F, Lauro R, et al. Insulin secretion in metabolically obese, but normal weight, and in metabolically healthy but obese individuals. Obesity. 2008;16:1881–6.
42. WHO (2011) Waist Circumference and Waist-Hip Ratio: Report of a WHO Expert Consultation, Geneva, 8–11 December 2008. Technical report, World Health Organization.
43. Janssen I, Heymsfield SB, Allison DB, Kotler DP, Ross R. Body mass index and waist circumference independently contribute to the prediction of nonabdominal, abdominal subcutaneous and visceral fat. Am J Clin Nutr. 2002;75:683–8.
44. World Health Organization (WHO). Waist circumference and waist-to-hip ratio: Report of a WHO Expert Consultation. Geneva: WHO; 2008

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