Anthropometric indicators and their applications for assessing population's health condition

Wskaźniki antropometryczne i ich zastosowania w ocenie stanu zdrowia ludności

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Pomiary antropometryczne odnoszące się do wysokości i masy ciała są ważnym narzędziem badawczym w dziedzinie zdrowia publicznego. Dokonuje się ich zazwyczaj prostymi w obsłudze, tanimi i mobilnymi metodami. Dotychczas najpowszechniej stosowanym wskaźnikiem antropometrycznym oceniającym masę ciała jest BMI (Body Mass Index), który jednak posiada swoje ograniczenia, co skłania ku poszukiwaniu alternatywnych miar nadwagi i otyłości. Najnowsze wskaźniki antropometryczne: ABSI (A Body Shape Index), BRI (Body Roundness Index), BAI (Body Adiposity Index), powstały w odpowiedzi na ograniczenia BMI, w celu lepszej oceny ryzyka zaburzeń zdrowia.

Dzięki BRI można przewidzieć zawartość tłuszczu w organizmie. BAI jest prosty do obliczenia, dlatego może być przydatny tam, gdzie dokładny pomiar masy ciała jest problematyczny. ABSI wydaje się być ważnym narzędziem do wykrywania zwiększonego ryzyka śmiertelności w zależności od kształtu ciała. Jest to również najbardziej obiecujący wskaźnik, który może zastąpić BMI w przyszłości.

Ten artykuł został poświęcony przeglądowi literatury na temat nowo powstałych wskaźników antropometrycznych.

Słowa kluczowe: *wskaźniki antropometryczne, otyłość, BMI, ABSI, BAI, WC, BRI*

Anthropometric measurements related to body weight and height are important tools of anthropometric evaluation of body composition in the field of public health, as they are generally simple to use, inexpensive and mobile methods. So far BMI (Body Mass Index) is the most widely used indicator, however with limitations which lead to the search for alternative measurements of overweight and obesity. Recent anthropometric indicators presented in this article: ABSI (A Body Shape Index), BRI (Body Roundness Index), BAI (Body Adiposity Index) have been created in response to the limitations of BMI, and in order to better assess the risk of health disorders.

BRI has the ability to predict the content of body fat comparable to traditional measurement accuracy. BAI is simple to calculate and can be useful in places where precise measurement of body weight is problematic. ABSI seems to be an important tool for the detection of an increased risk of mortality depending on body shape and it turns out to be the most promising indicator which may replace BMI in the future.

This article reviews the literature on new anthropometric indicators.

Key words: *anthropometric indicators, obesity, BMI, ABSI, BAI, WC, BRI*

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Introduction

For many years in almost all countries regardless of economic status, obesity has been a major public health problem. The report published by 'The Lancet' shows that the main cause of obesity is the 'modernization of the world', which makes people have increasingly abnormal eating habits from an early age and adverse lifestyle or less physical activity [1]. According to data published by organizations such as the WHO, the Institute for Health Metrics and Evaluation (IHME), the Trust for Americas Health (TFAH) and Robert Wood Johnson, overweight and obesity are the fifth most common cause of death in the world and is a growing global health problem. According to these organizations in the past 30 years the number of overweight and obese increased from 875 million to over 2.1 billion. In 2013 the number of obese people was estimated at over 670 million. More than half of them live in the USA, China, India, Russia, Brazil, Mexico, Egypt, Germany, Pakistan and Indonesia. In the US, obese people account for 13% of the total population and in China – up to 15%. In addition, obesity increases the risk of other related diseases, including cardiovascular disease, stroke, type 2 diabetes, pancreatic cancer and colorectal cancer, arthritis, high blood pressure and premature death. Currently, 210 billion dollars a year are being spent on treatment of diseases associated with excess weight in the US alone and the amount is still growing [2]. The world, including Europe and Poland cannot cope with the problem of obesity and overweight, which was confirmed by the results of an international survey conducted among children aged 11-12 years. On the average 28% of boys and 22% girls are already obese or overweight. Prevailing are the children and youth of Greece (excess weight was showed in 44% of boys and 38% girls). It is estimated that in 2015 and in subsequent years the number of obese and overweight will grow around the world (including Europe and Poland), and this is the reason for the declaration of a pandemic of obesity and diabetes epidemic, as one of the most serious health problems of the twenty-first century [1]. The epidemic of obesity brings about a huge problem, so the study of body composition is important and useful to both the cognitive and utilitarian point of view. Studies of body composition can be done in many ways. An important method is bioimpedance (bioelectric impedance – BIA), which is based on passing an electric current of appropriate intensity and frequency through the human body using surface electrodes. This method is easy to perform and inexpensive, and therefore is used not only in surgeries, but also in fitness clubs or in pharmacies. The BIA method provides information on the amount of muscle tissue (LBM), fat tissue (FBM), body water (TBW) and the body cell mass. Further methods of assessing body composition are imaging techniques of human body. Magnetic resonance imaging (MRI) allows for the assessment of the amount of body fat, to locate visceral tissue (VAT), subcutaneous tissue (SAT) and adipose tissue located between the ribbed muscles (IMAT). Dual-energy X-ray absorptiometry (DXA) can evaluate fat, lean body mass or lean soft tissue mass. DXA technique is not cumbersome and time of the test is not long. Computed tomography (CT) illustrates the distribution of muscle mass and fat and quantitative computed tomography (qCT) allows the determination of the distribution of minerals in particular fragments of bone. Anthropometric measurements and anthropometric indicators related to body weight and height are an important tool in clinical practice, because they are the easiest and the cheapest way to assess the composition of the human body [3].

Aim

Since anthropometric methods are generally the most common method of measuring human body, this article reviews the literature on anthropometric indicators and their usefulness in the assessment of nutritional status, and thus the health of an individual population.

BMI and WC

So far, the largest use in clinical practice has BMI (Body Mass Index) which is determined as the body mass divided by the square of the body height. However, this indicator does not have the ability to distinguish between body fat (FM) and lean body mass (LBM). There is an increasing evidence that excess body fat in the abdomen (central obesity) increases the risk of chronic metabolic disorders such as cardiovascular disease, stroke, or kidney problems, and by using BMI it is not possible to determine the distribution of fat in the body [4]. A group of Korean researchers in 2013 presented one of the studies on the association between central obesity with a more rapid decline in renal function. On the basis of a prospective study of the Korean population (Hallym Aging Study – HAS) consisting of 453 participants it has been demonstrated that waist circumference (waist circumference – WC) is a good marker of abdominal obesity that leads to a faster decline in renal function, defined as a decline in the value of glomerular filtration (eGFR factor). It has been shown that WC (waist circumference) is a good predictor of abdominal fat and an important addition to BMI, but it was not clear to what extent the scope of WC depends on the size of the body. This has led to attempts to design a better indicator of overweight and obesity, taking into account the shape of the body by combining together the traditional measures (such as height, weight, BMI, WC) [5].

ABSI

In 2012 in order to better assess the risk associated with abdominal obesity Nir Krakauer and Jesse C. Krakauer [6] proposed 'A Body Shape Index' (ABSI) based on a WC adjusted for height and weight, expressed by the formula:

$$ABSI=WC/(BMI^{2/3}\times h^{1/2})$$

where: WC – waist circumference [m], h – height [m], BMI [kg/m^2].

Moreover, Krakauer and Krakauer made attempts to link ABSI, BMI and WC with mortality risk by taking into account the population of the United States between 1999-2004 NHANES (National Health and Nutrition Examination Survey).The results of the Cox proportional hazard modeling for risk of mortality were as follows:
- ABSI had a marked effect on mortality as compared with BMI and WC
- mortality has increased approximately exponentially above the average output of ABSI
- 22% of mortality risk in populations was due to the high ABSI, as compared to 15% of BMI and 15% for WC

– logarithm of the mortality risk increased steadily with ABSI, but decreased with an increasing BMI and WC to the average values for the population
– ABSI relationship with mortality occurred even after taking into account other risk factors (smoking, diabetes, blood pressure, cholesterol levels) [6].

Based on these results Nir and Jesse Krakauer came to the conclusion that ABSI had the ability to express an increased risk due to the high WC in a convenient form complementing BMI and other known risk factors [6].

Since the NHANES study had some limitations, Nir and Jesse Krakauer re-assessed the predictive power of ABSI for mortality using Health and Lifestyle Surveys (HALS1 and HALS2), the UK studies. NHS (National Health Service records) were used to identify the number of deaths and cancer among the participants. Total follow-up was 24 years. In order to correlate the total mortality from the HALS study with ABSI and other variables such as BMI, WC, WHR and WHtR, the Cox proportional hazard models with age in the time scale were used. To link this study with the NHANES data, normal population values for ABSI and other measures (height, weight, WC, BMI) between these studies were compared. It turned out that ABSI was a strong indicator of risk of mortality in this population. Using normal values of the NHANES study to calculate standardized variables of ABSI, similar results to those received on a sample of HALS were obtained. ABSI proved to be a better indicator of risk of mortality than other measures of obesity, such as waist circumference (WC), waist-to-height ratio (WHtR) and waist-to-hip ratio (WHR). Moreover ABSI was found to be a consistent indicator of risk of mortality up to 20 years after baseline measurements. Changes in ABSI between the two HALS surveys (with a 7-year break between them) also showed an increased risk of mortality: people with the initial lower-ABSI, whose ABSI grew were at greater risk of mortality than those with falling ABSI [7].

Based on the above results, ABSI proved to be a useful indicator of mortality risk in both the US population (NHANES) and the UK population (HALS).

In 2013, the Nir and Jesse Krakauer published a study on the relationship between ABSI and mortality in hemodialysis patients (HD). The rate of death among patients was determined on the basis of observations between 2005 and 2010. ABSI, BMI, WC, WHR were calculated using standard formulas. For the whole group the Pearson correlation analysis showed that ABSI correlated with BMI, WC, HC, WHR, calcium and high-sensitive C-reactive protein (hs-CRP). Since the normal value was not determined for ABSI, patients were divided into two groups based on the median ABSI. This study was the first that examined the specific relationship between ABSI and mortality in HD patients. However, in contrast to the general population, no relationship was found between ABSI and mortality. This indicates that ABSI, the new anthropometric index is not associated with mortality in HD patients. Further studies are needed to determine whether the results of this study can be generalized to other hemodialysis patients [8].

The studies presented above were conducted to link ABSI with mortality, while in 2014 Gianni Bio et al. published a study on the effectiveness of ABSI to predict the variability of the FFM index (fat-free mass index – FFMI) among women and men characterized by BMI over 25 kg/m^2.The study was designed to examine whether ABSI can lead to define the risk of sarcopenia in overweight or obese patients. Data was collected on overweight/obese subjects consisting of 111 women and 89 men with no comorbidities. Standard anthropometric indicators, including ABSI and body composition data (FM and FFM measured through BIA) were calculated. The study revealed a negative correlation between ABSI and FFMI, among both men and women. In addition, the subjects were divided into groups based on the median values of ABSI. A groups of lower-ABSI showed a significantly higher rate of FFMI than those with higher-ABSI, for comparable BMI values. According to the authors these results confirm the assumptions that the deposition of fat in the abdomen may lead to the loss of skeletal muscle mass. Furthermore, G. Biolo et al. showed that ABSI cannot be only an indicator of visceral obesity, but also a marker of reduced muscle mass. Therefore, it was suggested that ABSI may be useful in the first level diagnosis of the sarcopenic obesity [9].

In 2015, Malara et al. presented the first study to assess the relationship between ABSI and metabolic risk factors (in comparison to BMI).The study involved 114 healthy male university students. Basic anthropometric indicators were calculated. Blood samples, levels of triacylglycerols, total cholesterol and plasma LDL/HDL-cholesterol levels, as well as circulating insulin were determined. The results showed that BMI was only correlated with tricylglycerols, while ABSI was correlated with plasma levels of insulin, total cholesterol, LDL-cholesterol and non-HDL cholesterol. Additionally, the survey outcomes led the authors to conclude that ABSI could be useful in predicting type 2 diabetes or/and atherogenesis. Additionally, the differences between lower and upper quartiles of BMI were higher than differences among lower and upper quartiles of ABSI, therefore it can be postulated that even slight changes in ABSI present information about variability in metabolic risk. In accordance with the authors, ABSI appears to be a better indicator of evaluating the variation in circulating insulin and lipoproteins than BMI, at least in young men who do not have health problems [10].

In 2014, Cheung YB [11] attempted to investigate whether ABSI scaling exponents for standardizing waist circumference for BMI and height were useful in the population of Indonesia, as the relationship between the health effects and anthropometry in Asian populations differ from other populations (which is due to significant disparity in lifestyle and nutrition etc.). Moreover Indonesia is characterized by a relatively slim body size, which further raises doubts as to the usefulness of ABSI among this population. For the purpose of the study The Indonesian Family Life Survey (IFLS), which involved 8255 people aged from 40 to 85 years in 2000 (IFLS3) and 2007/2008 (IFLS4) was conducted. The survey included anthropometric measurements as WC, HC, weight, height and more. In order to match the ABSI scaling exponents for the Indonesian population, Cheung YB adapted similar principles which Krakauer used to create ABSI. The values for men were the same as obtained by the previous US study i.e. 2/3 for BMI and 1/2 for height. The values for women were different i.e. 5/3 for BMI and 1/5 for height. The ABSI formula with the scaling exponents for the Indonesian female population therefore appears as follows:

$$ABSI=WC/(BMI^{3/5}\times h^{1/5})$$

where: WC – waist circumference [m], h – height [m], BMI [kg/m^2].

In addition, Cheung YB compared the relationship between hypertension and ABSI and other anthropometric indicators. The analysis of developing hypertension among study IFLS3 and IFLS4 (the interval between examinations is 7.5 years) with respect to ABSI showed a stronger relationship with the Indonesian scaling exponents. However, both versions of ABSI were less associated with the occurrence of hypertension than WC and BMI. As the researchers have noticed, abdominal obesity in Indonesia is not yet as widespread and does not constitute such a serious health threat as in America where ABSI was created. It may contribute to the limited usefulness of this indicator in Indonesia. At this point BMI is likely to remain an useful indicator of public health in Indonesian population [11].

BRI

Another innovation is an indicator developed in 2013 by Diana M. Thomas et al. [12], the new geometric index BRI (Body Roundness Index). It was created in response to the limitations of BMI as an attempt to find a tool by which it would be possible to predict both the percentage of total body fat and percentage of abdominal fat (VAT) based on anthropometric measurements of the body. To do this the researchers mapped the shape of the human body as an ellipse, which is recognized by circumference of the body in relation to the height (body roundness). On the basis of data on race, height, weight, gender, WC, % of body fat and % of abdominal fat (VAT) measured through dual-energy X-ray absorptiometry (DEXA) or through MRI derived from three different databases, two elliptical models of the human body were developed. Body Roundness was calculated based on a formula using the degree of circularity of an ellipse, which has a value of abstract numbers defined as eccentricity. The values of eccentricity are included between 0 and 1, where 0 has a perfect circle and one vertical line:

$$\varepsilon=(1-(WC/\pi h)^2)^{1/2}$$

where: ε – eccentricity, WC – waist circumference [m], h – height [m].

Due to the difficulties in contrast the differences between the values that are so small in size, the authors mapped eccentricity in the range of 1-20 by transformation:

$$BRI=364.2-365.5\times(1-(WC/\pi h)^2)^{1/2} \quad [12].$$

The maximum observed value of BRI was 16, while the lowest value was 1. Regression models were developed on the basis of eccentricity and other variables to predict the percentage of total body fat and percentage of abdominal fat. The results showed that BRI slightly improved these predictions when compared to traditional indicators: BMI, WC, and HC. WC turned out to be the most accurate indicator of predictive %VAT. An important advantage of BRI is not only the ability to predict the content of fat in the body comparable to traditional measurement accuracy, but also the possibility of a visual comparison of body types. There is also no doubt that BMI is so far the most readily available indicator of obesity due to its simplicity (the use of two easily obtain measurements: height and weight). The authors of BRI emphasize the need for further research to demonstrate how Body Roundness Index refers to mortality and other health determinants (such as cardiovascular disease and type 2 diabetes) and whether any predictive advantage of BRI over BMI exceeds the complexity of the model [12].

Ability of ABSI and BRI to detect cardiovascular diseases (CVD) and diabetes mellitus (DM)

In 2014 a group of Dutch researchers attempted to assess the ability of ABSI and BRI for the identification of cardiovascular diseases and risk factors for these diseases (as the effects of overweight or obesity) among the Dutch population. Nijmegen Exercise Study, conducted by Radboud University Medical Center (The Netherlands) in June 2011 was used. Based on the collected anthropometric data WC, BMI, ABSI, and BRI were calculated using standard formulas. The participants also answered questions about the health status of the cardiovascular system. Quintiles of ABSI, BRI, BMI and WC were used in regard to the incidence of CVD. 27.7% of the participants reported the presence of CVD or CVD risk factors and these individuals were older as compared with the control group. Moreover, the group of CVD risk factors and CVD was characterized by higher body weight and frequency of cigarette smoking [4].

This study also showed that both ABSI and BRI were not more effective for determining the presence of CVD or CVD risk factors than BMI or WC. However, BRI has similar capabilities as the generally known BMI and WC, and ABSI was not useful for the identification of risk factors and the presence of cardiovascular diseases. This study was the first which rated BRI in terms of its relationship with cardiovascular disease [4].

In 2015, Chang et al. published a study which evaluated two new body indicators (ABSI and BRI) for their ability to identify diabetes mellitus (DM) among the rural population of northeast China. The study participants were 5253 men and 6092 women, of whom 10.4% had DM and those people had all five anthropometric indices higher (ABSI, BRI, WC, BMI, WHtR) than non-diabetics. The results of this study showed that WHtR was the best predictor of DM in the studied population, while ABSI had the worst predictive power. BRI proved the potential usefulness, however it was no better than traditional measurements including BMI, WC and WHtR. According to the authors, this low usability of ABSI for the detection of DM in this population may be due to the ethnic differences and the subjects' characteristics [13].

BAI

Another alternative BMI measure of obesity was proposed by R.N Bergman and his team, Body Adiposity index, BAI [14]. To define it study 'BetaGene' involving 1.733 Mexican Americans was used. Data were collected on age, gender, height, weight, BMI, waist circumference (WC), hip circumference (HC), and percent body fat measured by the DEXA method. The main aim of research was to find a specific feature or combinations of features that were most strongly correlated with obesity as measured by DEXA. Finally, BAI was defined as:

$$BAI=HC\times h^{-1/5}-18$$

where: HC – hip circumference [cm], h – height [m].

The BAI usability was confirmed by the TARA study (triglyceride and Cardiovascular Risk in African-Americans), based on the population of African Americans. Body Adiposity Index showed a similar ability to predict % of body fat in both ethnic groups. According to the authors of the newly formed anthropometric indicator, it can be useful in places where precise measurement of body weight is problematic because it is based solely on data which are height and hips circumference [14].

In 2014, Shilpi Gupta and Satwanti Kapoor examined gender-specific relationship between BAI, BMI and percentage of body fat in inbred inhabitants of Delhi, India. The researchers used a cross-sectional study conducted among Aggarwal Baniyas castes in 2008-2009. On the basis of data on weight, height, skinfold thickness, HC and WC, anthropometric indexes as BMI, BAI and PBF (percentage body fat) using the Durnin and Womersley equation were calculated. The accuracy of BMI, BAI, WC, WHR and WHtR in the detection of hypertension based on measurements of systolic and diastolic blood pressure were examined by calculating the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV). The results of this study showed that in the analyzed population adipose tissue was more associated with BMI than with BAI. Although the correlation between PBF and BMI was higher than between BAI, the sensitivity and specificity of BAI in predicting hypertension was better than BMI and other anthropometric measures. In addition, the researchers noted that despite the ease of hip circumference measurement even in difficult terrain, calculation of BAI could be cumbersome in such places. Therefore, BAI turns out to be useful as an additional marker in screening, but as the authors emphasize its usefulness must be checked among other populations and ethnic groups [15].

In 2015 Audrey Djeneba Djibo et al. published a study which is the first to assess the usefulness of BAI and its association with metabolic syndrome (MetS) among older women (50-70 years) across three different ethnic groups. The study consisted of 369 Caucasian, 336 African American and 275 Filipina women. Anthropometric measurements, blood glucose levels, history of illnesses and dual energy X-ray absorptiometry were estimated. The results showed that the Filipina women had higher MetS compared to African-American and Caucasian women (according to the National Cholesterol Education Program and International Diabetes Federation definition). The Caucasian women with MetS had a significantly higher BAI, as well as BMI and % of BF than those who did not have metabolic syndrome, while among the Filipina and African American women with MetS only BMI was statistically higher as compared to those without MetS. In contrast to BMI, BAI simulated specific ethnic differences found when using expensive DXA %BF in conjunction with the metabolic syndrome. This suggests that BAI appears as a fast, economical way to estimate the fat in certain ethnic groups including Asian women who experience adverse metabolic effects even if they have normal or low body size. This study further emphasizes that an ethnic and age group specific threshold should be developed for BAI to enhance its clinical utility [16].

Anthropometric indicators in predicting fat mass among athletes

A study conducted by Diana A. Santos et al. in which the effectiveness of novel indicators in predicting fat mass was tested, showed that none of them were superior to commonly used field methods as BIA or skinfold prediction models. The survey was conducted among athletes (159 men and 50 women). Body composition was examined by the BIA method and skinfold prediction models, anthropometric indicators such as BMI, BAI, ABSI, BRI an WC were calculated. Among novel indices, statistically significant correlation was found only between ABSI and adiposity in men. BMI classified athletes as having normal weight, even if they had low fat mass. The most significant correlation showed WC and a sum of skinfolds. Therefore, according to the authors the new anthropometric indicators are limited in predicting fat mass in athletes [17].

Anthropometric indicators in Chinese population

Shihui Fu, Leiming Luo and others in 2014 published a study comparing the latest anthropometric parameters in terms of power for detecting cardio-metabolic disorders among the Chinese population. The study revealed a serious public health problem in the Peoples Republic of China, which like other developed countries is characterized by an alarming increase in obesity. Among the study population roughly two-thirds of adults were overweight based on the BMI standards. The prevalence of overall obesity was 22.2% in men and 28.1% in women, including abdominal obesity was 65.99% in men and 65.97% in women. Anthropometric parameters were significantly higher in men who smoked as compared with men who did not smoke (except BMI and BAI). Women who smoked had only WHR and ABSI higher than non-smokers. All anthropometric indicators for men and women who had higher levels of triglycerides, low HDL-C and elevated LDL-C were significantly higher than for the participants who did not show these irregularities. For Chinese adults anthropometric indicators have uneven power in the assessment of risk associated with different disorders. It was observed that WHR was better than other anthropometric indicators in assessing the risk of elevated levels of LDL-cholesterol and hypertension in both genders, and WC better highlights the high levels of triglycerides and decreased HDL levels [18].

Limitations of ABSI

In 2014 Krakauers published an article on the limitations of existing publications which used ABSI in their studies. As noted, not all researchers adjusted ABSI for standardized variables for age and gender, which was recommended by the authors. Moreover, one study showed a higher ABSI value for women, contrary to expectations of higher waist measurement in men. According to the authors of the index, adjusting for age is particularly important because the average ABSI increases from the youngest to the oldest adult about two standard deviations of young adults ABSI (increases with age more than BMI or WC). The authors of ABSI showed that despite some minor differences between the odds ratios, ABSI significantly better reflected total mortality than BMI, WC, WHtR and WHR. Taking into account the proposed methodical guidelines, ABSI can be a useful tool for assessing the risk among populations or individuals. If ABSI confirms its value in future studies, it can appear in the medical literature over several years to a decade, with a frequency similar to bibliometric trends observed for WHR and WC [19].

Summary

In summary, BMI has many limitations and most problematic is that this index does not have the capacity to differentiate the weight associated with fat, muscle mass and water, so at the same time does not include the distribution of adipose tissue in the human body. Therefore, it does not fulfill its role in people both with significantly expanded muscle tissue (because BMI of such persons may be high despite a relatively small amount of adipose tissue) as well as in people with high body fat but relatively normal weight (a passive person, thoughtless about diet, with a reduction of muscle tissue to fat tissue, which may ultimately lead to health disorders, despite normal BMI). It was also noted that abdominal obesity was a good identifier of health disorders. Nevertheless, the Waist Circumference (WC) has been criticized for not taking into account differences in height and hip circumference (HC), and therefore WHR (waist-to-hip ratio) and WHtR (waist to height ratio) appeared, as new parameters of body fat. Recent anthropometric indicators presented in this article: ABSI (A Body Shape Index), BRI (Body Roundness Index), BAI

(Body Adiposity Index), were also created in response to the limitations of BMI, and in order to better assess the risk of health disorders. ABSI turned out to be the most promising indicator and may replace BMI in the future as it proved to be a useful indicator of mortality risk and a better indicator of evaluating the variation in circulating insulin and lipoproteins than other measurements. ABSI also has some limitations as high sensitivity to age and gender of the studied population. Regarding BRI, its advantage is not only the ability to predict the body fat content comparable to traditional measurement accuracy, but also the possibility of a visual comparison of body types. However BRI is more difficult in calculations when compared to readily available indicators. In contrast, BAI appears as a fast, economical way to estimate the fat in certain ethnic groups and it can be useful in places where precise measurement of body weight is problematic because it is based solely on the height and hips circumference. In the Chinese population WHR was the most adequate anthropometric indicator in assessing the risk of elevated levels of LDL-cholesterol and hypertension in both genders, and WC better highlighted high levels of triglycerides and decreased HDL levels.

Conclusions

The emergence of a new, easily computable anthropometric index, which would prove useful in the diagnosis of obesity would be a breakthrough for public health. Body Roundness Index (BRI) has the ability to predict the content of body fat comparable to traditional measurement accuracy. Body Adiposity Index (BAI) is simple to calculate and can be useful in places where precise measurement of body weight is problematic. Body Shape Index (ABSI) seems to be an important tool for the detection of an increased risk of mortality depending on body shape. According to the authors ABSI expresses the increased risk caused by high waist circumference in an accessible form of complementary commonly known BMI. ABSI can succeed in the future, but researchers must adapt standardized variables for ABSI for age and gender. Further research of actual utility of new anthropometric indices is necessary.

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