REPORT 07 OF THE COUNCIL ON SCIENCE AND PUBLIC HEALTH (A-23)
Support Removal of BMI as a Standard Measure in Medicine and Recognizing Culturally-Diverse and Varied Presentations of Eating Disorders and Indications for Metabolic and Bariatric Surgery
(Reference Committee D)

EXECUTIVE SUMMARY

INTRODUCTION. Resolution 407-A-22, referred by the House of Delegates, asked our American Medical Association to study the significant limitations and potential harms associated with the widespread use of body mass index (BMI) in clinical settings and study other validated, easily obtained alternatives to BMI for estimating risk of weight-related disease, and report its findings and report its findings to the AMA House of Delegates by the 2023 Annual Meeting. While this report was in development, the HOD also referred Resolution 937-I-22, “Indications for Metabolic and Bariatric Surgery” for consideration within this report. That resolution asked that our AMA acknowledge and accept the new American Society for Metabolic and Bariatric Surgery and International Federation for the Surgery of Obesity and Metabolic Disorders indications for metabolic and bariatric surgery.

METHODS. English language articles were selected from searches of PubMed and Google Scholar using the search terms “Body Mass Index (BMI),” “alternatives to BMI,” “BMI and Eating Disorders,” “Bariatric Surgery,” and “BMI AND culturally diverse.” Additional articles were identified by manual review of the reference lists of pertinent publications. Web sites managed by government agencies; applicable organizations were also reviewed for relevant information.

BACKGROUND. Body mass index (BMI) is easy to measure, is inexpensive, has standardized cutoff points for overweight and obesity, and is strongly correlated with body fat levels as measured by the most accurate methods. BMI is not a perfect measure, because it does not directly assess body fat. The current BMI classification system is also misleading regarding the effects of body fat mass on mortality rates. Numerous comorbidities, lifestyle issues, gender, ethnicities, medically significant familial-determined mortality effectors, duration of time one spends in certain BMI categories, and the expected accumulation of fat with aging are likely to significantly affect interpretation of BMI data, particularly in regard to morbidity and mortality rates. Other methods to measure body fat are not always readily available, and they are either expensive or need to be conducted by highly trained personnel. Furthermore, many of these methods can be difficult to standardize across observers or machines, complicating comparisons across studies and time periods. Further, the use of BMI is problematic when used to diagnose and treat individuals with eating disorders, because it does not capture the full range of abnormal eating disorders.

CONCLUSION. This report evaluates the problematic history of BMI and explores other alternatives to BMI. It outlines the harms and benefits to using BMI and points out that BMI is inaccurate in measuring body fat in multiple groups because it does not account for the heterogeneity across race/ethnic groups, sexes, and age-span. The recommendations recognize the issues with the use of BMI clinically, and highlights the need to use other methods. This report also acknowledges that AMA did not participate in the development of the “Indications for Metabolic and Bariatric Surgery” guidelines and therefore cannot endorse these guidelines.

REPORT OF THE COUNCIL ON SCIENCE AND PUBLIC HEALTH

CSAPH Report 07-A-23

Subject: Support Removal of BMI as a Standard Measure in Medicine and Recognizing Culturally-Diverse and Varied Presentations of Eating Disorders and Indications for Metabolic and Bariatric Surgery

Presented by: Noel Deep, MD, Chair

Referred to: Reference Committee D

Resolution 407-A-22, referred by the House of Delegates (HOD), asked that our American Medical Association (AMA):

> recognize the significant limitations and potential harms associated with the widespread use of body mass index (BMI) in clinical settings and supports its use only in a limited screening capacity when used in conjunction with other more valid measures of health and wellness; and
>
> support the use of validated, easily obtained alternatives to BMI (such as relative fat mass, body adiposity index, and the body volume index) for estimating risk of weight-related disease; and
>
> amend policy H-440.866, "The Clinical Utility of Measuring Body Mass Index and Waist Circumference in the Diagnosis and Management of Adult Overweight and Obesity," by addition and deletion to read as follows:
>
> The Clinical Utility of Measuring Body Mass Index Weight, Adiposity, and Waist Circumference in the Diagnosis and Management of Adult Overweight and Obesity, H-440.866
> Our AMA supports:
> (1) greater emphasis in physician educational programs on the risk differences ~~among ethnic and age~~ within and between demographic groups at varying weights and levels of adiposity ~~BMI~~ and the importance of monitoring waist circumference in all individuals ~~with BMIs below 35 kg/m2~~;
> (2) additional research on the efficacy of screening for overweight and obesity, using different indicators, in improving various clinical outcomes across populations, including morbidity, mortality, mental health, and prevention of further weight gain; and
> (3) more research on the efficacy of screening and interventions by physicians to promote healthy lifestyle behaviors, including healthy diets and regular physical activity, in all of their patients to improve health and minimize disease risks. (Modify Current HOD Policy); and
> amend policy H-150.965, by addition to read as follows in order to support increased recognition of disordered eating behaviors in minority populations and culturally appropriate interventions:
>
> H-150.965 – Eating Disorders
> The AMA (1) adopts the position that overemphasis of bodily thinness is as deleterious to one's physical and mental health as obesity; (2) asks its members to help their patients avoid

obsessions with dieting and to develop balanced, individualized approaches to finding the body weight that is best for each of them; (3) encourages training of all school-based physicians, counselors, coaches, trainers, teachers and nurses to recognize unhealthy eating, binge-eating, dieting, and weight restrictive behaviors in adolescents and to offer education and appropriate referral of adolescents and their families for culturally-informed interventional counseling; and (4) participates in this effort by consulting with appropriate and culturally informed educational and counseling materials pertaining to unhealthy eating, binge-eating, dieting, and weight restrictive behaviors. (Modify Current HOD Policy)

While this report was in development, the HOD also referred Resolution 937-I-22, "Indications for Metabolic and Bariatric Surgery" for consideration within this report. That resolution asked that our AMA:

acknowledge and accept the new American Society for Metabolic and Bariatric Surgery and International Federation for the Surgery of Obesity and Metabolic Disorders indications for metabolic and bariatric surgery; immediately call for full acceptance of these guidelines by insurance providers, hospital systems, policy makers, and government healthcare delivery entities; and work with all interested parties to lobby the legislative and executive branches of government to affect public health insurance coverage to ensure alignment with these new guidelines.

BACKGROUND

Body mass index (BMI) is the ratio of weight to height, calculated as weight (kg)/height (m2), or weight (lb)/height (in2) multiplied by 703.[1] BMI is easy to measure, is inexpensive, has standardized cutoff points for overweight and obesity, and is strongly correlated with body fat levels as measured by the most accurate methods. However, BMI is an indirect and imperfect measurement as it does not distinguish between body fat and lean body mass. It is not as accurate of a predictor of body fat in the elderly and at the same BMI women on average have more body fat than men and Asians have more body fat than whites.[1] Further, when combined with measuring waist circumference, patients may be screened for possible health risks that come with being overweight and having obesity. If most of the fat is around the waist rather than at the hips, an individual is at a higher risk for heart disease and type 2 diabetes.[1] This risk goes up with a waist size that is greater than 35 inches for women or greater than 40 inches for men.

BMI is used because it is an inexpensive and easy tool. Research has shown that BMI is strongly correlated with the gold-standard method for measuring body fat known as dual-energy x-ray absorptiometry (DXA), and it is an easy way for clinicians to screen who might be at greater risk of health problems due to their weight.[2] Other methods to measure body fat include skinfold thickness measurements (with calipers), underwater weighing, bioelectrical impedance, and isotope dilution.[2] However, these methods are not always readily available, and they are either expensive or need to be conducted by highly trained personnel. Furthermore, many of these methods can be difficult to standardize across observers or machines, complicating comparisons across studies and time periods.

BMI is just one of several considerations to help determine a more specific and individualized course of action for patients. Some researchers are advocating for a new kind of classification system based on the concept of Adiposity-Based Chronic Disease (ABCD) — focusing more on the health issues associated with obesity rather than body size alone.[3] The diagnostic term reflects both the pathophysiology and clinical impact of obesity as a chronic disease. The proposed coding system has four domains: pathophysiology, body mass index (BMI) classification, complications, and complication severity; and incorporates disease staging, specific complications that impact health, the basis for clinical intervention, individualized treatment goals and a personalized medicine approach.

METHODS

English language articles were selected from searches of PubMed and Google Scholar using the search terms "Body Mass Index (BMI)," "alternatives to BMI," "BMI and Eating Disorders," "Bariatric Surgery," and "BMI AND culturally diverse." Additional articles were identified by manual review of the reference lists of pertinent publications. Web sites managed by government agencies; applicable organizations were also reviewed for relevant information.

DISCUSSION

Prevalence of obesity in the U.S.

In 2021, the CDC Adult Obesity Prevalence Map shows that obesity remains high. Nineteen states and two territories currently have an obesity prevalence at or above 35 percent, more than doubling from 2018.[4] Adults with obesity are at increased risk for many other serious health conditions such as heart disease, stroke, type 2 diabetes, some cancers, and poorer mental health. Obesity also disproportionately impacts some racial and ethnic minority groups.[4] Non-Hispanic Black adults had the highest prevalence of self-reported obesity (41.7 percent), followed by non-Hispanic American Indian or Alaska Native adults (38.4 percent), Hispanic adults (36.1 percent), non-Hispanic White adults (31.0 percent), and non-Hispanic Asian adults (11.7 percent).[4]

Childhood obesity is a serious problem in the United States that puts children and adolescents at risk for poor health outcomes. From 2017-2020, the prevalence of obesity was 19.7 percent and affected about 14.7 million children and adolescents.[5] Obesity prevalence was 12.7 percent among 2- to 5-year-olds, 20.7 percent among 6- to 11-year-olds, and 22.2 percent among 12- to 19-year-olds. Obesity prevalence was 26.2 percent among Hispanic children, 24.8 percent among non-Hispanic Black children, 16.6 percent among non-Hispanic White children, and 9.0 percent among non-Hispanic Asian children.[5] Obesity-related conditions include high blood pressure, high cholesterol, type 2 diabetes, breathing problems such as asthma and sleep apnea, and joint problems.[5]

History of measures to calculate body weight (Body Build Index)

The concept of body fat as a major population-based medical issue gained popularity only shortly before 1900. Life insurance data accumulated at that time and subsequently indicated that body weight, adjusted for height (Wt/Ht), was an independent determinant of life expectancy, and in 1910, the effects of being overweight were noted to be greater for younger people than for the elderly.[6] The Metropolitan Life Insurance Company in 1959 published tables of average body weights for heights (Wt/Ht), also known as body build, by gender and at different ages.[7] This was based on data from 1935 to 1953 from more than 4 million adults, mostly men, insured by 26 different insurance companies. The risk for development of certain diseases as well as mortality data related to Wt/Ht differences also were analyzed and reported in the 1960 Statistical Bulletin of the Metropolitan Life Insurance Co.[8]

The Wt/Ht tables were used for many years as a reference for population-based studies. If a person's Wt/Ht was 20 percent above or below the mean for that height category, they were considered to be overweight or underweight, respectively.[14] The insurance data also indicated the ratios of weights for heights at which mortality was lowest in adults. The latter was referred to as the "ideal" or later the "desirable" weight. From 1959 to 1983, the weight/height representing the lowest mortality had increased.[9,10] However, a "desirable body" weight for height was invariably lower than the average weight for height in the insured population.[15,16]

Challenges with the wt/ht (body build) index

Early on it was recognized that taller people had a lower death rate than shorter people with the same Wt/Ht ratio.[11] It also was recognized that a person's height in general and leg length could affect the calculated body mass adjusted for height. A person's bone mass could also affect the interpretation of this ratio. In general, it reflected whether one was narrowly or broadly built. Thus, efforts were made to eliminate lower limb length and frame size as variables.[13] The strategy was to develop representations of body build, that is, charts of weight/height that were independent of these variables. The overall goal was to have the same distribution of Wt/Ht at each level of height.

Although not stated, the implicit goal in developing these tables was to define a person's fat mass as a proportion of their total mass, irrespective of their height or frame size.[12] Efforts were made to adjust for frame size (nonfat mass) by categorizing people as those with a small, medium, or large frame. Estimation of frame size was attempted using several measurements including shoulder width, elbow width, knee width, ankle width, and so on.[13] None of these were widely adopted. Further, frame size based on elbow width was included in the Metropolitan Life weight/height tables, even though it was never validated.[13]

Adoption of the BMI as an index of obesity

In 1972, the validity of Metropolitan Life Insurance published data was criticized.[14] Critics supported the use of the better documented weight for height data, which then popularized what is known as the Quetelet Index. The Quetelet Index was later known as an individual's body mass index (BMI). However, it was noted that even BMI rather poorly represents a person's percent of body fat.[20] Despite all the criticisms, the Metropolitan Life Tables criteria for defining obesity were widely used in the United States until the early 1990s.[15,16] At about that time, the World Health Organization (WHO) classification of body weight for height, based on the BMI, was published, and later it was widely adopted.[17,18] The distribution of BMIs in adult American men and women was determined in 1923 in 1026 individuals.[19] The median BMI was 24, but the mean BMI was 25. The distribution curve indicated a skewing toward an increase in BMI, and this trend has continued.[24]

WHO and the categorization of BMIs into quartiles

In 1993, the WHO assembled an Expert Consultation Group with a charge of developing uniform categories of the BMI. The results were published as a technical report in 1995.[20] Four categories were established: underweight, normal, overweight, and obese. An individual would be considered underweight if their BMI was in the range of 15 to 19.9, normal weight if the BMI was 20 to 24.9, overweight if the BMI was 25 to 29.9, and obese if it was 30 to 35 or greater.[26]

At the time that the WHO classification was published, the National Institutes of Health (NIH) in the United States classified people with a BMI of 27.8 (men) and 27.3 (women) or greater as being overweight. If they were below this BMI, they were considered to be "normal." This was based on an 85 percent cutoff point of people examined in the National Health and Nutrition Examination Study (NHANES) II.[21] Subsequently, in 1998, the cutoff point between normal and overweight was reduced to a BMI of 25 to bring it into line with the 4 categories in the WHO guidelines.[22] This then changed the categorization of millions of Americans from being "normal weight" to being "overweight."

In Western population-based studies, the mean or median BMI was about 24 to 27.[23,24] Therefore, the consequence of adopting the WHO classification resulted in approximately 50 percent or more of the general adult population being classified as overweight and obese. Indeed, the term "overweight" or particularly "preobesity" is prejudicial since people in this category were a major part of the expected normal distribution of BMI in the general population.

Advantages of BMI

A significant advantage of BMI is the availability of extensive national reference data and its established relationships with levels of body fatness, morbidity, and mortality in adults.[26] BMI is particularly useful in monitoring the treatment of obesity, with a weight change of about 3.5 kg needed to produce a unit change in BMI. In adults, BMI levels above 25 are associated with an increased risk of morbidity and mortality, with BMI levels of 30 and greater indicating obesity.[25] In children, BMI is not a straightforward index because of growth. However, high BMI percentile levels based on Centers for Disease Control and Prevention (CDC) BMI growth charts and changes in parameters of BMI curves in children are linked to significant levels of risk for adult obesity at corresponding high percentile levels.[26] Further, BMI is readily available, inexpensive, can be administered easily, and is understood easily by patients.[27] BMI can also be used as an initial screening tool to identify those at an elevated health risk because of excess body weight and poor distribution of fat mass.

Disadvantages of BMI

<u>BMI as a determinant of body fat mass</u>. BMI does not differentiate between body lean mass and body fat mass; a person can have a high BMI but still have a very low-fat mass and vice versa.[28,29] From an anatomical and metabolic perspective, it has been proposed that the term obesity should refer to an excessive accumulation of body fat (triacylglycerols). The accuracy of the BMI as a determinant of body fat mass has been repeatedly questioned because it has limitations in this regard.[30,31] Gender, age, ethnicity, and leg length are important variables not considered by BMI.[32,33] It should also be noted that in population-based studies women generally have a BMI that is lower than that in men, even though their fat mass relative to their body build or BMI is considerably greater.

The relatively poor correlation between percent of body fat mass and BMI has been shown more recently in the NHANES III database in which bioelectrical impedance was used to estimate the fat component of body composition.[39] In subjects with a BMI of 25 kg/m2, the percent of body fat in men varied between 14 percent and 35 percent, and in women it varied between 26 percent and 43 percent. Therefore, using the NIH criteria based on percent of body fat to define obesity, subjects with a BMI of 25, a group that would be considered "normal," were associated with a body fat mass that varied between "low normal" to "obese."

In addition, a recent study in individuals with or without diabetes in which the loss of lean body mass with aging was reported, the mean BMI in those without diabetes was 26.8. In those with diabetes, the BMI was 29.1. However, the percent of lean body mass was the same and therefore the increased BMI in those with diabetes was not due only to an excessive accumulation of fat.[34] Overall, although the correlation between the BMI and body fatness is strong, two people might have the same BMI, but the level of body fatness may differ.[35] Some examples of this include:

- Women tend to have more body fat than men,

- The amount of body fat may be higher or lower depending on the racial/ethnic group,[36]
- Older people, on average, tend to have more body fat than younger adults, and
- Athletes have less body fat than do non-athletes.

BMI does not account for body fat location. BMI does not capture body fat location information, which is an important variable in assessing the metabolic as well as mortality consequences of excessive fat accumulation. This was first recognized in France by Dr Jon Vague in the 1940-1950s.[37] He noted that accumulation of fat in the upper part of the body versus the lower part of the body was associated with an increased risk for coronary heart disease, diabetes, and also gallstones and gout. Men tend to accumulate fat in the abdominal (upper body) area, whereas women tend to accumulate it in the peripelvic (gluteal) area and the thighs. A substitute for this information has been to determine the abdominal circumference or an abdominal/hip circumference ratio. Subsequent data indicate that the risk for development of diabetes as well as coronary heart disease, is more strongly related to the accumulation of upper body fat than lower body fat in both sexes.[38]

More specifically, both visceral fat accumulation and an expanded girth have been associated with development of insulin resistance, diabetes, and risk for coronary heart disease and hypertension.[39] Accumulation of fat in the abdominal area appears to correlate best with triacylglycerols accumulating in the liver and skeletal muscle. Further, the relatively small accumulation of fat in these organs would not be detectible by BMI determinations, and they do not correlate with total body fat mass.[40]

BMI does not account for the life cycle and location of accumulated fat caused by hormones. Girls tend to accumulate relatively large amounts of fat during and after puberty, particularly in the peripelvic and thigh region; boys do not. During and after puberty, boys accumulate a relatively large amount of lean mass (bone and muscle) but not fat mass. In both sexes, these changes are reflected in an increased BMI. With aging, both sexes tend to develop fat in the upper part of the body.[41] The reason for these changes in amount and distribution is not completely understood. Generally, it is considered to be caused by hormonal changes. Further, a study noted BMI cutoffs fail to capture most postmenopausal women whose actual body fat percentage would classify them as obese.[42] As women age, they tend to lose bone and muscle mass, which are heavier than fat. So even if a 65-year-old woman weighs the same as she did at 25 years of age, fat accounts for a larger share of her weight. The study suggested that to improve the sensitivity of BMI in identifying postmenopausal women at risk of obesity-related diseases, the obesity cutoff might need to be set to 24.9, which is currently the top of the normal BMI range for the general adult population.[42]

BMI as a predictor of morbidity and mortality. The BMI classification system currently is being widely used in population-based studies to assess the risk for mortality in the different categories of BMI. Even when some comorbidities are considered, the correlation of mortality rates with BMI often does not take into consideration such factors as family history of diabetes, hypertension, coronary heart disease, metabolic syndrome, dyslipidemias, familial longevity or the family prevalence of carcinomas, and other genetic factors. For example, it has been reported that more than 50 percent of susceptibility to coronary artery disease is accounted for by genetic variants.[43]

Frequently, when correlations are made, they also do not take into consideration a past as well as a current history of smoking, excessive alcohol use, serious and persistent mental illness or the duration of obesity, when in the life cycle it appeared, and whether the body weight is relatively stable or rapidly progressive. In most population-based studies, only the initial weight and/or BMI are given, even though weight as well as fat stores are known to increase and height to decrease with aging. In addition, the rate of weight gain varies among individuals, as does the loss of muscle mass.[44] Muscle mass has been correlated negatively with insulin resistance and prediabetes.[45] Lastly, population-based studies do not take into consideration the present and past history of a person's occupation, medication-induced obesity, and how comorbidities are being treated.

BMI does not appropriately represent racial and ethnic minorities. The rise in obesity prevalence rates has disproportionately affected U.S. minority populations. For example, one longitudinal study of healthy women found that at the same BMI, Asians had more than double the risk of developing type 2 diabetes than whites; Hispanics and blacks also had higher risks of diabetes than whites, but to a lesser degree.[46] Increases in weight over time were more harmful in Asians than in the other ethnic groups: For every 11 pounds Asians gained during adulthood, they had an 84 percent increase in their risk of type 2 diabetes; Hispanics, blacks, and whites who gained weight also had higher diabetes risks, but again, to a much lesser degree than Asians.[46] Several other studies have found that at the same BMI, Asians have higher risks of hypertension and cardiovascular disease than their white European counterparts, and a higher risk of dying early from cardiovascular disease or any cause.[47,48]

Researchers are still assessing why Asians have higher weight-related disease risks at lower BMIs. One possible explanation is body fat. When compared to white Europeans of the same BMI, Asians have 3 to 5 percent higher total body fat.[49] South Asians, in particular, have especially high levels of body fat and are more prone to developing abdominal obesity, which may account for their very high risk of type 2 diabetes and cardiovascular disease.[50] In contrast, some studies have found that blacks have lower body fat and higher lean muscle mass than whites at the same BMI, and therefore, at the same BMI, may be at lower risk of obesity-related diseases.[51] While genetic differences may be at the root of these different body fat patterns in Asians and other ethnic groups, environmental factors seem to be a much stronger force. For example, research suggests that under-nutrition during fetal life, such as during the Chinese famine of 1954 to 1964, raises the risk of diabetes in adulthood, especially when individuals live in nutritionally rich environments later in life.[52]

BMI AND EATING DISORDERS

Eating disorders are behavioral conditions characterized by severe and persistent disturbance in eating behaviors and associated distressing thoughts and emotion. Types of eating disorders include anorexia nervosa, bulimia nervosa, binge eating disorder, avoidant restrictive food intake disorder, other specified feeding and eating disorders, pica and rumination disorder. Eating disorders affect up to 5 percent of the population, and most often develop in adolescence and young adulthood.[53] Evidence suggests that genes and heritability also play a part in why some people are at higher risk for an eating disorder.[53]

Anorexia nervosa is an eating disorder characterized by self-starvation and weight loss resulting in low weight for height and age.[53] BMI is used to diagnose an individual with anorexia nervosa and is determined by an individual having a BMI of 18.5 or less.[53] Although BMI is used to diagnose anorexia nervosa, BMI does not accurately capture individuals with bulimia nervosa. Individuals with bulimia nervosa can be slightly underweight, normal weight, overweight or even obese.[53] Further, BMI is inaccurate in capturing individuals with other specified feeding and eating disorders. These include eating disorders or disturbances of eating behavior that cause distress and impair family, social or work function but do not fit the other categories. In some cases, this is because the frequency of the behavior does not meet the diagnostic threshold (i.e., the frequency of binges in bulimia or binge eating disorder) or the weight criteria for the diagnosis of anorexia nervosa are not met.[53] An example of another specified feeding and eating disorder is "atypical anorexia nervosa". This category includes individuals who may have lost a lot of weight and whose behaviors and preoccupation with weight or shape concerns and fear of fatness is consistent with anorexia nervosa, but who are not yet considered underweight based on their BMI because their baseline weight was above average.[53] Therefore, utilizing BMI can lead to substandard treatment, typically due to the use of BMI by insurance companies to cover inpatient treatment.[54] Further, as mentioned above, BMI is an inaccurate measure of obesity especially in children and adolescents and can therefore hinder access to eating disorder treatments.[41]

OTHER DIAGNOSTIC MEASURES FOR DIAGNOSING OBESITY

Abdominal Circumference

Obesity is commonly associated with increased amounts of intra-abdominal fat. A centralized fat pattern is associated with the deposition of both intra-abdominal and subcutaneous abdominal adipose tissue.[55] It should be noted that abdominal circumference is an imperfect indicator of intra-abdominal adipose tissue, as it also includes subcutaneous fat deposition, as well as visceral adipose tissue. This does not preclude its usefulness, as it is associated with specific health risks.[56] Persons in the upper percentiles for abdominal circumference are considered to have obesity and at increased risk for morbidity, specifically type 2 diabetes and the metabolic syndrome, and mortality.[57] The ratio of abdominal circumference (often referred to incorrectly as “waist” circumference) to hip circumference is a rudimentary index for describing adipose tissue distribution or fat patterning.[58] Abdomen-to-hip ratios greater than 0.85 represent a centralized distribution of fat. Most men with a ratio greater than 1.0 and women with a ratio greater than 0.85 are at increased risk for cardiovascular disease, diabetes, and cancers.[59]

Skinfold Measurement

Skinfold measurements are used to characterize subcutaneous fat thickness at various regions of the body, but it should be noted that they have limited utility in people who are considered overweight or have obesity. The primary limitation is that most skinfold calipers have an upper measurement limit of 45 to 55 mm, which restricts their use to subjects who are moderately overweight or thinner.[2] A few skinfold calipers take large measurements, but this is not a significant improvement because of the difficulty of grasping and holding a large skinfold while reading the caliper dial. The majority of national reference data available are for skinfolds at the triceps and subscapular locations. The triceps skinfold varies considerably by sex and can reflect changes in the underlying triceps muscle rather than an actual change in body fatness. The statistical relationships between skinfolds and percent or total body fat in children and adults are often not as strong as that of BMI.[60] Further, the upper distribution of subcutaneous fat measurements remains unknown because most children and adults who have obesity have not had their skinfolds measured.

Waist-to-hip Ratio

The waist-to-hip ratio is often considered a better measurement than waist circumference alone in predicting disease risk. To calculate the waist-to-hip ratio, a measuring tape is used to measure waist circumference and hip circumference at its widest part. Observational studies have demonstrated that people with “apple-shaped” bodies, (who carry more weight around the waist) have greater risks for chronic disease than those with “pear-shaped” bodies, (who carry more weight around the hips). A study with more than twenty-seven thousand participants from fifty-two countries concluded that the waist-to-hip ratio is highly correlated with heart attack risk worldwide and is a better predictor of heart attacks than BMI.[61] Abdominal obesity is defined by the World Health Organization (WHO) as having a waist-to-hip ratio above 0.90 for males and above 0.85 for females.

Visceral Adiposity Index (VAI)

The Visceral Adiposity Index (VAI) is an empirical-mathematical model, gender-specific, based on simple anthropometric (BMI and WC) and functional parameters (triglycerides (TG) and HDL cholesterol (HDL)), and indicative of fat distribution and function.[62] It is an empirical-mathematical model that does not originate from theoretical assumptions, but from observation in a healthy normal/overweight population of a linear relationship between BMI and CV, from which a linear equation has been extrapolated. The main strength to consider is that the VAI is an indicator of early cardiometabolic risk in all borderline conditions in which overt metabolic syndrome is not present. This is explained by the fact that three of the variables making up the VAI (WC, TG, and HDL) are all expressed in the criteria for metabolic syndrome. An important limitation to consider is the application of the VAI in non-Caucasian populations and in patients aged less than 16 years.[58] This is because the mathematical modelling process was done on healthy Caucasian men and women, aged between 19 and 83 years.[58] A study which evaluated the VAI in children, found that the VAI should be extrapolated with caution in this age range.[63] Therefore, VAI is a useful measurement in the following populations: healthy or apparently healthy population with BMI < 40 kg/m2, patients with one or two of the 5 components of the metabolic syndrome, women with PCOS, and patients with endocrine disorders (i.e., acromegaly, adult GH deficiency, hypogonadism, hyperprolactinemia, or abnormal thyroid function).[58]

Relative Fat Mass (RFM)

Relative fat mass (RFM) is a simple linear equation based on height-to-waist ratio, and has promise as a potential alternative tool to estimate whole-body fat percentage in women and men 20 years of age and older. One study performed using nationally representative samples of the US adult population which allowed evaluation of the performance of RFM among Mexican Americans, European Americans, and African Americans.[64] The performance of RFM to estimate body fat percentage was overall more consistent than that of BMI among women and men, across ethnic groups, young, middle-age and older adults, and across quintiles of body fat percentage, although the accuracy of RFM was lower among individuals with lower body fatness.[60]

Hydrostatic weighing (densitometry)

Hydrostatic weighing (underwater weighing), or densitometry, is the difference of the body weight in air and water is used to compute the body's density.[65] Assuming a two-component model with different densities for fat mass and fat-free mass and correcting for the air volume in the lungs, the total body fat percentage can be estimated. This technique, however, cannot give any measurements of the distribution of adipose tissue or lean tissue (LT).

Air displacement plethysmography (ADP)

ADP, also known under its commercial brand name as BOD POD, measures the overall body density, total body fat and lean tissue but not their distributions.[66] By putting the body in an enclosed chamber and changing the chamber's volume, the volume of the displaced air (i.e., the volume of the body) can be determined from the changes in air pressure.[60] Since ADP is based on the same two-component model as hydrostatic weighing, it is also affected by the same confounders, mainly variations in bone mineral content and hydration. Therefore, ADP, as well as hydrostatic weighing, is limited to gross body composition analysis, and not estimates of regional fat or muscles.

Bioelectrical impedance analysis (BIA)

BIA uses the electrical properties of the body to estimate the total body weight and from that the body fat mass.[67] The body is modeled as five cylindrical lean tissue compartments; the trunk and the four limbs, while fat is considered to be an insulator. The impedance is assumed to be proportional to the height and inversely proportional to the cross-sectional area of each compartment. BIA requires different model parameters to be used depending on age, gender, level of physical activity, amount of body fat, and ethnicity in order to be reliable.[68]

Dual-energy X-ray absorptiometry (DXA)

DXA is a two-dimensional imaging technique that uses X-rays with two different energies. By using two different energy levels, the images can be separated into two components (i.e., bone and soft tissue). DXA is mainly used for bone mineral density measurements, where it is considered as the gold standard, but it can also be used to estimate total and regional body fat and lean tissue mass.[69] DXA has been found to be more accurate than density- based methods for estimating total body fat.[70] Due to its ability to estimate regional fat and measure lean tissue, in combination with relatively high availability, DXA has been used for body composition analysis in a wide range of clinical applications and is considered the gold standard for measuring body fat.[71]

Computed Tomography (CT) Scan

CT gives a three-dimensional high-resolution image volume of the complete or selected parts of the body, computed from a large number of X-ray projections of the body from different angles. As opposed to the previously described techniques, CT can accurately determine fat in skeletal muscle tissue and in the liver.[72] In practice, however, CT-based body composition analysis is in most cases limited to two-dimensional analysis of one or a limited number of axial slices of the body. This approach, however, limits its precision since the exact locations of slices, in relation to internal organs, cannot be determined and will vary between scans. Regardless, CT, together with MRI, is today considered the gold standard for body composition analysis, which assessed the proportion of fat to fat-free mass in your body.

Magnetic resonance imaging (MRI)

MRI uses the different magnetic properties of the nuclei of certain chemical elements (normally hydrogen in water and fat) in the cells to produce images of soft tissue in the body. Several MRI-based methods for quantification of adipose tissue and muscles have been developed and implemented.[73] MRI is used to obtain precise measurements of regional adipose tissue and lean tissue, as well as diffuse fat infiltration in other organs. However, due to several undeterminable factors affecting the MR signal, an MR image is not calibrated on an absolute scale and therefore cannot be quantitative. But by using different postprocessing techniques, the image can be calibrated to quantitatively measure fat or adipose tissue.[69]

CALCULATING OBESITY IN CHILDREN AND ADOLESCENTS

In the United States, obesity and severe obesity in children and adolescents are defined using threshold values from the 2000 CDC sex-specific body mass index-for-age growth charts.[74] In addition to defining obesity, BMI z-scores and percentiles are used to monitor children’s weight status over time and to evaluate obesity treatments in research settings. Percentiles near the upper limit of 100 percent become less useful for detecting meaningful differences, and therefore percentiles can be converted to z-scores that indicate the number of standard deviations of a value from the mean. However, BMI z-scores (BMIz) and percentiles based on the 2000 BMI-for-age

CDC growth charts (BMIz and BMI percentiles) were never meant to be used to monitor children with extremely high BMI values, and significant limitations exist when they are used to monitor children with severe obesity.[75] Specifically, BMIz values corresponding to extremely high BMI values are compressed into a very narrow range. Studies on obesity prevalence, its impact, and the availability of effective treatment have highlighted the need for meaningful standardized measures to track extremely high values of BMI in clinical and research settings.

As a result of needing more standardized measures the CDC studied alternative BMI metrics which include:

- BMI (untransformed),
- BMI z-scores and percentiles (modified),
- BMI z-scores and percentiles (extended),
- Percent of 95th percentile BMI units or percent from median, and
- Adjusted BMI units or percent from median.[76]

None of these metrics had the problem of compression at extremely high BMI values, but all had limitations, especially when applied across the weight status spectrum and a wide range of ages. The report however concluded that the extended method for calculating z-scores and percentiles stands out among the alternatives.[72] First, the extended method improves the characterization of BMI distributions at very high values using nationally representative data, but all other BMI metrics that refer to a reference population (all alternative metrics except untransformed BMI) rely on extrapolating beyond this reference population.[72] Second, below the 95th percentile, extended BMI z-scores and percentiles preserve CDC 2000 z-scores and percentiles that are currently in use, which allows seamless transitions from the current CDC z-scores and percentiles below the 95th percentile to extended z-scores and percentiles above the 95th percentile.[72] Alternative BMI metrics other than extended BMIz and percentiles may be appropriate for use in certain scenarios, such as during adolescence when differences among the metrics are less pronounced, when transitions to or from obesity are minimal, or for monitoring BMI changes over short periods when adjusting for expected growth and development is less critical.

INDICATIONS FOR METABOLIC AND BARIATRIC SURGERY

During the HOD Interim meeting in 2022, Resolution 937 “Indications for Metabolic and Bariatric Surgery,” was introduced by the American Society for Metabolic and Bariatric Surgery, Society of American Gastrointestinal and Endoscopic Surgeons . This resolution called for adoption of the new American Society for Metabolic and Bariatric Surgery and International Federation for the Surgery of Obesity and Metabolic Disorders indications for metabolic and bariatric surgery. Given that these guidelines depend on BMI, they were referred for consideration in this report.

The American Society for Metabolic and Bariatric Surgery (ASMBS) and the International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) have convened to produce a joint statement on the current available scientific information on metabolic and bariatric surgery and its indications recommending the following updates:

- Metabolic and bariatric surgery (MBS) is recommended for individuals with a body mass index (BMI) ≥35 kg/m2, regardless of presence, absence, or severity of co-morbidities.
- MBS should be considered for individuals with metabolic disease and BMI of 30-34.9 kg/m2.
- BMI thresholds should be adjusted in the Asian population such that a BMI ≥25 kg/m2 suggests clinical obesity, and individuals with BMI ≥27.5 kg/m2 should be offered MBS.

- Long-term results of MBS consistently demonstrate safety and efficacy.
- Appropriately selected children and adolescents should be considered for MBS. [77]

It should be noted that the AMA did not participate in the development of these guidelines and therefore cannot endorse these guidelines. AMA policies are also adopted for a period of 10 years with the option of renewal through the Sunset process, therefore it is important to not reference specific guidelines in policy which may change over time.

EXISTING AMA POLICY

Under existing AMA Policy H-440.866, "The Clinical Utility of Measuring Body Mass Index and Waist Circumference in the Diagnosis and Management of Adult Overweight and Obesity" the AMA supports: (1) greater emphasis in physician educational programs on the risk differences among ethnic and age groups at varying levels of BMI and the importance of monitoring waist circumference in individuals with BMIs below 35 kg/m2; (2) additional research on the efficacy of screening for overweight and obesity, using different indicators, in improving various clinical outcomes across populations, including morbidity, mortality, mental health, and prevention of further weight gain; and (3) more research on the efficacy of screening and interventions by physicians to promote healthy lifestyle behaviors, including healthy diets and regular physical activity, in all of their patients to improve health and minimize disease risks.

Policy H-150.928, "Eating Disorders and Promotion of Healthy Body Image," supports increased funding for research on the epidemiology, etiology, diagnosis, prevention, and treatment of eating disorders, including research on the effectiveness of school-based primary prevention programs for pre-adolescent children and their parents, in order to prevent the onset of eating disorders and other behaviors associated with a negative body image.

Policy H-150.965, "Eating Disorders" notes that the AMA (1) adopts the position that overemphasis of bodily thinness is as deleterious to one's physical and mental health as is obesity; (2) asks its members to help their patients avoid obsessions with dieting and to develop balanced, individualized approaches to finding the body weight that is best for each of them; (3) encourages training of all school-based physicians, counselors, coaches, trainers, teachers and nurses to recognize unhealthy eating, dieting, and weight restrictive behaviors in adolescents and to offer education and appropriate referral of adolescents and their families for interventional counseling; and (4) participates in this effort by consulting with appropriate specialty societies and by assisting in the dissemination of appropriate educational and counseling materials pertaining to unhealthy eating, dieting, and weight restrictive behaviors.

CONCLUSIONS

The most basic definition of obesity is having too much body fat, so much so that it presents a risk to health.[78] A reliable way to determine whether a person has too much body fat is to calculate the ratio of their weight to their height squared. This ratio, called the body mass index (BMI), accounts for the fact that taller people have more tissue than shorter people, and so they tend to weigh more. BMI is not a perfect measure, because it does not directly assess body fat. Muscle and bone are denser than fat, so an athlete or muscular person may have a high BMI, yet not have too much fat. Risk of developing health problems, including several chronic diseases such as heart disease and diabetes, rises progressively for BMIs above 21. There's also evidence that at a given BMI, the risk of disease is higher in some ethnic groups than others.

Critics of BMI note that body fat location is also important and could be a better indicator of disease risk than the amount body fat.[79] Fat that accumulates around the waist and chest (what is called abdominal adiposity) may be more dangerous for long-term health than fat that accumulates around the hips and thighs. Some researchers have further argued that BMI should be discarded in favor of measures such as waist circumference.[75] However, this is unlikely to happen given that BMI is easier to measure and has a long history of use. In adults, measuring both BMI and waist circumference may be a better way to predict someone's weight-related risk. In children, however, there is no good reference data for waist circumference, so BMI-for-age is currently the gold standard. Overall, BMI does not describe body fat distribution, so additional anthropometric parameters should be used to assess enhanced accumulation of visceral adipose tissue.

Further, the current BMI classification system is misleading regarding the effects of body fat mass on mortality rates. The role of fat distribution in the prediction of medically significant morbidities as well as for mortality risk is not captured by use of the BMI. Also, numerous comorbidities, lifestyle issues, gender, ethnicities, medically significant familial-determined mortality effectors, duration of time one spends in certain BMI categories, and the expected accumulation of fat with aging are likely to significantly affect interpretation of BMI data, particularly in regard to morbidity and mortality rates. Such confounders as well as the known clustering of obesity in families, the strong role of genetic factors in the development of obesity, the location in which excessive fat accumulates, its role in the development of type 2 diabetes and hypertension, and so on, need to be considered before promulgation of public health policies that are designed to apply to the general population and are based on BMI data alone. Further, the use of BMI is problematic when used to diagnose and treat individuals with eating disorders, because it does not capture the full range of abnormal eating disorders. It should also be noted that the recent increase in fat transfer procedures may complicate BMI measurements and should be further studied.

RECOMMENDATIONS

The Council on Science and Public Health recommends that the following be adopted, and the remainder of the report be filed.

1. Our AMA recognizes:
    1. the issues with using body mass index (BMI) as a measurement because: (a) of the eugenics behind the history of BMI, (b) of the use of BMI for racist exclusion, and (c) BMI cutoffs are based on the imagined ideal Caucasian and does not consider a person's gender or ethnicity.
    2. the significant limitations associated with the widespread use of BMI in clinical settings and suggests its use be in a conjunction with other valid measures of risk such as, but not limited to, measurements of: (a) visceral fat, (b) body adiposity index, (c) body composition, (d) relative fat mass, (e) waist circumference and (f) genetic/metabolic factors.
    3. that BMI is significantly correlated with the amount of fat mass in the general population but loses predictability when applied on the individual level.
    4. that relative body shape and composition heterogeneity across race/ethnic groups, sexes, and age-span is essential to consider when applying BMI as a measure of adiposity.
    5. that in some diagnostic circumstances, the use of BMI should not be used as a sole criterion for appropriate insurance reimbursement. (New HOD Policy)

2. Our AMA supports further research on the application of the extended BMI percentiles and z-scores and its association with other anthropometric measurements, risk factors, and health outcomes. (New HOD Policy)

3. Our AMA supports efforts to educate physicians on the issues with BMI and alternative measures for diagnosing obesity. (New HOD Policy)

4. That our AMA amend policy H-440.866, "The Clinical Utility of Measuring Body Mass Index and Waist Circumference in the Diagnosis and Management of Adult Overweight and Obesity," to read as follows:
   The Clinical Utility of Measuring Body Mass Index, Body Composition, Adiposity, and Waist Circumference in the Diagnosis and Management of Adult Overweight and Obesity, H-440.866
   Our AMA supports:(1) greater emphasis in physician educational programs on the risk differences ~~among ethnic and age~~ within and between demographic groups at varying levels of adiposity, BMI, body composition, and waist circumference and the importance of monitoring these ~~waist circumference~~ in all individuals ~~with BMIs below 35 kg/m2~~; (2) additional research on the efficacy of screening for overweight and obesity, using different indicators, in improving various clinical outcomes across populations, including morbidity, mortality, mental health, and prevention of further weight gain; and (3) more research on the efficacy of screening and interventions by physicians to promote healthy lifestyle behaviors, including healthy diets and regular physical activity, in all of their patients to improve health and minimize disease risks. (Modify Current HOD Policy).

5. That our AMA amend policy H-150.965, "Eating Disorders" to read as follows: The AMA (1) adopts the position that overemphasis of bodily thinness is as deleterious to one's physical and mental health as obesity; (2) asks its members to help their patients avoid obsessions with dieting and to develop balanced, individualized approaches to finding the body weight that is best for each of them; (3) encourages training of all school-based physicians, counselors, coaches, trainers, teachers and nurses to recognize ~~unhealthy~~ abnormal eating behaviors, dieting, and weight restrictive behaviors in adolescents and to offer education and appropriate referral of adolescents and their families for evidence-based and culturally-informed interventional counseling; and (4) participates in this effort by consulting with appropriate, culturally-informed educational and counseling materials pertaining to ~~unhealthy~~ abnormal eating behaviors, dieting, and weight restrictive behaviors. (Modify Current HOD Policy)

6. That our AMA not adopt Resolution 937-I-22, "Indications for Metabolic and Bariatric Surgery."

Fiscal Note: less than $1,000

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