The benefits and limitations of anthropometric measures (weight and shape) to assess the health risks of obesity are discussed. They include the body mass index, the waist-to-hip ratio, the waist circumference (WC), and the waist-to-height ratio (WHtR).

The use of WHtR, a proxy for central obesity and shape, could be an important new public health screening tool that can be used for all adults and children older than 5 years, in all ethnic groups. Use of a boundary value of WHtR 0.5 to denote increased risk converts into a simple message: “Keep your waist circumference to less than half your height.” Nutr Today. 2011;46(2):85–89

Weight for Height and Body Mass Index

The health risks of excess body fat for adults were known for many years to be associated with inappropriate weights for height. Tables of such weights for different frame sizes were originally derived from insurance data. Various indices based on weight and height were then suggested as correlates of total body fat. The body mass index (BMI)—weight in kilograms divided by the square of the height in meters—became the most widely accepted.

Since the early 1980s, the classic BMI chart has been used extensively to assess the health risks of obesity. Healthy weight for height is usually defined as a BMI between 18.5 and 25 kg/m$^2$, overweight as equal to or more than 25 kg/m$^2$ and less than 30 kg/m$^2$, and obesity as a BMI of equal to or more than 30 kg/m$^2$. Body mass index has served us well as a proxy for obesity for many years, but it has always been recognized that it does not differentiate between the overweight and the overweight except at very high BMIs. There is another problem with BMI—even in the overweight—it is only a proxy for total fat in the body, and it does not distinguish between individuals with different types of fat distribution.

Body mass index does not differentiate between the overmuscled and the overweight unless BMI is very high. Furthermore, it is only a proxy for total fat in the body, and it does not distinguish between individuals with different types of fat distribution.

Apples and Pears

Jean Vague first pointed out in the 1940s and 1950s that people with a “central” type of fat distribution (android shape) were at greater health risk than those whose fat was deposited “peripherally” (gynoid shape). However, it has only been in the last 3 decades that there has been general agreement that health risks (predominantly cardiovascular disease [CVD] and diabetes) can be determined more by the relative distribution of the excess fat than by its total amount. The use of imaging techniques such as computed tomography and magnetic resonance imaging has subsequently indicated that the “unhealthy apple shape” (Vague’s android shape) is characterized by a preferential deposition of fat in the internal, visceral fat depots rather than in the external, subcutaneous fat depots, which lead to the “healthy pear shape” (Vague’s gynoid shape).
Waist-to-Hip Ratio

Relative fat distribution can be measured by the waist circumference (WC)–to–hip circumference ratio (WHpR). This was shown to be a good predictor of health risk and was popular for many years. However, although it was useful for risk assessment, WHpR is not helpful in practical risk management because both waist and hip can decrease with weight reduction, and so the ratio of WHpR changes very little as weight is lost. So attention then shifted to the use of WC by itself as a possible replacement for BMI.

Waist Circumference

Jean-Pierre Desprès and his colleagues produced exciting results from the Quebec Cardiovascular Study, which showed that WC alone is much better than BMI for predicting not only the traditional metabolic complications of excess fat (eg, hypertension, CVD and type 2 diabetes) but also the newer very important risk factors or “markers” for these complications (high insulin, high apoprotein B, increased concentration of small dense lipoprotein particles; glucose intolerance, high triglycerides, low high-density lipoprotein cholesterol, high ratio of cholesterol to high-density lipoprotein, insulin resistance, and altered haemostatic variables such as fibrinogen). Using his analogy of an iceberg, Desprès pointed out that measuring BMI allows you to see only the tip of the iceberg when it is too late, but measuring WC can tell you much more and allow you to take preventive measures before it is too late.

Consequently, the simple measurement of WC has been suggested as a good proxy measure for body fat distribution and subsequent health risk. Unfortunately, several cutoff or boundary values for WC have been proposed, and these have had different values for men and women and also, sometimes, for different age and ethnic groups. Further, a report from Japan showed that metabolic risks differed between people of similar WC with different heights. Another problem is that WC cutoff values for children would have to be sex and age specific. So how can the simple measure of WC be used satisfactorily in a public health context? The solution is to think about WC in relation to height.

The Waist-to-Height Ratio

The waist-to-height ratio (WHtR) was originally proposed more or less simultaneously in Japan and the United Kingdom as a way of assessing shape and monitoring risk reduction. Both proposals suggested that WHtR values greater than 0.5 should indicate increased health risk. We also made a proposal, based on pragmatism, that values greater than 0.6 should indicate substantially increased risk in the prototype shape chart we published in the mid-1990s.

We recently conducted a systematic review of studies that have measured WHtR and BMI or WC and their relationship with metabolic risk factors, diabetes, or CVD in adults or children. Inclusion criteria were human subjects; male, female, or mixed; any age, adults or children; any ethnic group; novel studies, either prospective or cross-sectional design; WHtR; and either BMI or WC measured at least once; studies also had to have a mortality and a cardiometabolic disease end point or cardiometabolic risk outcome measure and present the relationship between obesity and the disease end point or risk outcome.

Prospective and cross-sectional studies (78 in all) showed odds ratios or correlations that were similar for all anthropometric indices, but tended to be higher for WHtR and WC than BMI. Furthermore, WHtR and WC tended to be significant predictors more often than BMI in all prospective analyses, which included 9 studies with diabetes outcomes and 14 studies with CVD outcomes. Thirteen cross-sectional analyses in children supported these predictions.

Analyses to determine the performance of each anthropometric index as a screening tool in adults (ie, assessing and comparing the diagnostic accuracy of different indices for a particular outcome) showed that WHtR was invariably a better tool than WC or BMI. A, yet to be published, meta-analysis has added further support. These specificity and sensitivity analyses were performed in more than 26 studies covering men and women in many ethnic groups including white, Asian, Afro Caribbean, and Hispanic.

These data also confirmed that the cutoff (or boundary) value of WHtR 0.5 for increased risk is appropriate across age, sex, and ethnic populations in adults.

The greater propensity for Asians to develop diabetes at lower BMI than whites has been recognized for some time, leading to different BMI ranges being
The use of WHtR circumvents such problems because the adjustment of WC for height means the same boundary value is suitable for both ethnic groups (Figure 1).

In the 1990s, we developed a chart based on WHtR (The Ashwell Shape Chart) that allows health professionals and/or their patients to match their WC against their height—in inches or in centimeters—and to see into which category they fall. These are the 4 regions and what they mean to the patient:

- If your shape is in the “chilli” region (WHtR < 0.4), you should “take care.”
- If your shape falls in the “pear” region (WHtR between 0.4 and 0.5), you have a “healthy OK” shape.
- If your shape falls in the “pear-apple” region (WHtR between 0.5 and 0.6), you should “consider action.”
- If your shape falls in the “apple” region (WHtR > 0.6), your health is probably at risk. Why not talk with your health care provider, dietitian, or practice nurse and “take action?”

The data in the chart have recently been converted to plastic disc format—the Ashwell Shape Calculator (Figure 2). This makes it easy for the patients to line up their height (say, 165 cm) with their WC (say, 105 cm) to see that they are recommended to “take action.”

The scientific evidence therefore supports the concept that patients should be advised to “keep their waist circumference to less than half their height.”

### Practical Example of WHtR as a Better Screening Tool Than BMI

We recently had the opportunity to test WHtR against BMI in British survey data on nearly 2000 men and women.

Data from the nationally representative National Diet and Nutrition Survey, collected in 2000/2001, allowed us to investigate how the BMI and WHtR are associated with CVD risk factors.

Screening CVD health risk by BMI alone would “miss” 35% of men and 14% of women who are within...
The data in the Ashwell Shape Chart have recently been converted to plastic disc format—the Ashwell Shape Calculator. The calculators above have been produced for the Royal College of Nursing in United Kingdom to distribute in their journals.

Further validation of the boundary values supports the applicability for all adults and, maybe, even for children. It is particularly important that this standardization includes population groups such as the elderly and very obese.

Conclusion

The use of WHtR, a proxy for central obesity, could be an important new public health tool that has global applicability for all adults and, maybe, even for children. Further validation of the boundary values for higher risk in adults and for children is now required. A new comprehensive systematic review supports the use of WHtR of 0.5 as a simple screening tool, as used in the Ashwell Shape Chart, and provides a simple message: “Keep your waist circumference to less than half your height.”

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