

Six reasons why the waist-to-height ratio is a rapid and effective global indicator for health risks of obesity and how its use could simplify the international public health message on obesity

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Abstract

We suggest that a simple, rapid screening tool—the waist-to-height ratio (WHTR)—could help to overcome debates about the use of different body mass index (BMI) boundary values for assessing health risks in different populations. There are six reasons for our proposal:

1. WHTR is more sensitive than BMI as an early warning of health risks.
2. WHTR is cheaper and easier to measure and calculate than BMI.
3. A boundary value of WHTR = 0.5 indicates increased risk for men and women.
4. A boundary value of WHTR = 0.5 indicates increased risk for people in different ethnic groups.
5. WHTR boundary values can be converted into a consumer-friendly chart.
6. WHTR may allow the same boundary values for children and adults.

Communicating messages about health risk could be much simpler if the same anthropometric index and the same public health message can be used throughout childhood, into adult life, and throughout the world. This simple message is: *Keep your waist circumference to less than half your height.*

Keywords: *Waist-to-height ratio, body mass index, global, obesity, metabolic syndrome, ethnicity, public health policy, children*

There is unanimous agreement that we are on the verge of a global pandemic of obesity and metabolic disturbances such as diabetes (World Health Organization 2002). Action is needed as soon as possible. But we seem to be locked into debate. The current debate about whether we need specific cutoffs for body mass index (BMI) to define obesity for Asian and Caucasian ethnic groups is a good example (Misra 2003; Stevens 2003). It is not as if just one set of BMI cutoffs has been proposed for Asians. The cutoff value for Asians, suggested by WHO experts, is BMI = 23 (Choo 2002), but a Chinese working group suggested BMI = 24 (Zhou 2002), and the

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Japanese have suggested 25 (Japan Society for the Study of Obesity 2000). The latest attempt to define appropriate BMI for Asians has all but admitted defeat (World Health Organization Expert Consultation 2004).

We believe that these debates about BMI are not necessary; they over-complicate the situation and do not help the promotion of a simple public health message. In fact, there is unanimous agreement that the health risks of obesity and metabolic syndrome are associated more with central obesity than with total obesity (Despres 2001). Many of the current guidelines, recognizing that waist circumference can be a good proxy for central obesity, include sex-specific cutoffs for waist circumference alongside the BMI cutoffs (World Health Organization 2000). But this has led to a more complex situation where we have different BMI *and* waist circumference cutoffs proposed for Caucasians and for Asians (World Health Organization 2002).

If we want to define obesity in children, the situation becomes even more complex. The often-used 85th and 95th percentile cut off points for BMI in children were arbitrarily determined and not directly based on evidence linking this level of fatness to adverse health outcomes. This system, which simply reflects current levels, masks any population trends. A sensible suggestion for a unified system to overcome these problems has recently been proposed (Cole et al. 2000). But this still requires measurement of weight and height with reference to new charts and will not allow the rapid screening of childhood obesity.

We wish to propose the adoption of a simple screening tool—the waist-to-height ratio (WHTR)—which should overcome all these problems. There are six reasons for our proposal:

1. *WHTR is more sensitive than BMI as an early warning of health risks.* It is significantly associated with all risk factors for obesity and metabolic syndrome and can predict morbidity and mortality in longitudinal studies, often better than BMI (Cox et al. 1996; Patel et al. 1999). Further, the use of WHTR can often identify people within the moderate range of BMI who have a higher metabolic risk, almost certainly because it is more closely associated with central obesity (Hsieh et al. 2000). WHTR can be even more sensitive than waist circumference in several different populations possibly because it encompasses the adjustment to different statures (Hsieh & Yoshinaga 1995; Lee et al. 1995; Patel et al. 1999; Lin et al. 2002; Hsieh et al. 2003; Sayeed et al. 2003) and because of the negative correlation of height to certain metabolic risk factors (Henriksson et al. 2001).
2. *WHTR is cheaper and easier to measure and calculate than BMI.* Its measurement simply requires knowledge of height (self-assessment is more stable and reliable than that of weight in the absence of standard measuring equipment) and of waist circumference requiring a tape measure rather than weighing scales.
3. *WHTR allows the same boundary values for men and women.* On average, men are taller than women and have larger waist circumferences. This means that average WHTR values are closer for men and women than average waist circumference values because of the adjustment for height, and the same boundary value can be used for both to indicate increased risk. We have proposed the simple boundary value of $WHTR = 0.5$ to indicate increased risk for adult men and women (Hsieh and Yoshinaga 1995; Ashwell 1998; Hsieh et al. 2003).
4. *WHTR allows the same boundary value for different ethnic groups.* Although the proposed WHO waist circumference values (World Health Organization 2000)

are valuable for predicting risk in fairly homogenous Caucasian populations where the influence of height is less important, there is great global variation in average height of both men and women. Asian populations tend to be shorter than their Caucasian counterparts. Further, the health risks for Asians begin to increase for smaller amounts of central fat and smaller waist circumferences than their Caucasian counterparts (World Health Organization 2002; World Health Organization Expert Consultation 2004). Division of waist circumference by height has the effect of counteracting these differences such that the same values are appropriate in both ethnic groups. In fact, the use of WHTR was proposed at the same time by groups studying Asian and British populations (Hsieh and Yoshinaga 1995; Ashwell et al. 1996). A boundary value at $WHTR = 0.5$ was originally proposed by these groups to indicate where health risk started to increase. Further research to determine optimal cutoff values for WHTR in other populations has indicated that $WHTR = 0.5$ is the simplest value that corresponds to more precise cutoff values in both sexes (Lin et al. 2002; Sargeant et al. 2002; Bertias et al. 2003; Ho et al. 2003).

5. *WHTR boundary values can be converted into a consumer-friendly chart.* A prototype of a chart with waist circumference on the x -axis and height on the y -axis, including the proposed boundary value ($WHTR = 0.5$) between the 'OK' and 'Take care' regions and a second provisional boundary value ($WHTR = 0.6$) between the 'Take care' and 'Action' regions, has been available since the mid-1990s (Ashwell 1998). This has proved very popular with health professionals (see Figure 1).
6. *WHTR may allow the same boundary value for children and adults.* There is now growing evidence that WHTR can be used to predict risk in children (Savva et al.

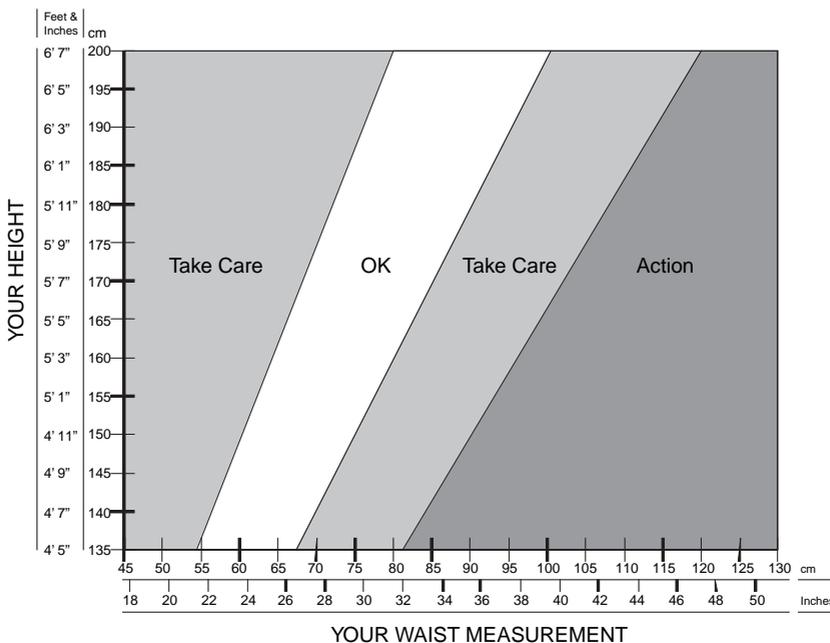


Figure 1. Waist circumference against height showing proposed boundary values of WHTR.

2000; Hara et al. 2002; Kahn et al. 2005). Since the height and waist circumference of children increases continually as they age, the same boundary value (WHTR = 0.5) could be used across all age groups (McCarthy & Ashwell 2003).

Communicating messages about health risk will be much simpler if the same anthropometric index and the same simple public health message: '*Keep your waist circumference to less than half your height*' may be used throughout childhood, into adult life, and throughout the world. We are aware that most researchers will have data on waist circumference and on height in their study populations but might not yet have calculated WHTR and its relation to morbidity and mortality. In view of the six key points outlined here, we welcome views from others who have data to support or refute our proposal. Comments on our proposed boundary values are also welcome.

References

- Ashwell M. 1998. The Ashwell Shape Chart—a public health approach to the metabolic risks of obesity. *Int J Obes Relat Metab Disord* 22(Suppl 3):S213.
- Ashwell M, LeJeune SRE, McPherson K. 1996. Ratio of waist circumference to height may be better indicator of need for weight management. *Br Med J* 312:377.
- Bertsias G, Mammias I, Linardakis M, Kafatos A. 2003. Overweight and obesity in relation to cardiovascular disease risk factors among medical students in Crete, Greece. *BMC Public Health* 3(1):3.
- Choo V. 2002. WHO reassesses appropriate body-mass index for Asian populations. *Lancet* 360(9328):235.
- Cole T, Bellizzi M, Flegal K, Dietz W. 2000. Establishing a standard definition for child overweight and obesity worldwide: international survey. *Br Med J* 320:1240–1243.
- Cox BD, Whiclow MJ, Ashwell MA, Prevost AT. 1996. Comparison of anthropometric indices as predictors of mortality in British adults. *Int J Obes Relat Metab Disord* 20(Suppl 4):141.
- Despres JP. 2001. Health consequences of visceral obesity. *Ann Med* 33(8):534–541.
- Hara M, Saitou E, Iwata F, Okada T, Harada K. 2002. Waist-to-height ratio is the best predictor of cardiovascular disease risk factors in Japanese schoolchildren. *J Atheroscler Thromb* 9(3):127–132.
- Henriksson KM, Lindblad U, Agren B, Nilsson-Ehle P, Rastam L. 2001. Associations between body height, body composition and cholesterol levels in middle-aged men. The coronary risk factor study in southern Sweden. *CRISS. Eur J Epidemiol* 17(6):521–526.
- Ho SY, Lam TH, Janus ED. 2003. Waist to stature ratio is more strongly associated with cardiovascular risk factors than other simple anthropometric indices. *Ann Epidemiol* 13(10):683–691.
- Hsieh SD, Yoshinaga H. 1995. Abdominal fat distribution and coronary heart disease risk factors in men—waist/height ratio as a simple and useful predictor. *Int J Obes Relat Metab Disord* 19:585–589.
- Hsieh SD, Yoshinaga H, Muto T. 2003. Waist-to-height ratio, a simple and practical index for assessing central fat distribution and metabolic risk in Japanese men and women. *Int J Obes Relat Metab Disord* 27(5):610–616.
- Hsieh SD, Yoshinaga H, Muto T, Sakurai Y, Kosaka K. 2000. Health risks among Japanese men with moderate body mass index. *Int J Obes Relat Metab Disord* 24(3):358–362.
- Japan Society for the Study of Obesity. 2000. New criteria for the diagnosis of obesity. *Himankenkyu* 6: 18–28.
- Kahn HS, Imperatore G, Cheng JY. 2005. A population based comparison of BMI percentiles and waist-to-height ratio for identifying cardiovascular risk in youth. *J Pediatr* 146(4):482–488.
- Lee JS, Aoki K, Kawakubo K, Gunji A. 1995. A study on indices of body fat distribution for screening for obesity. *J Occup Health* 37:9–18.
- Lin WY, Lee LT, Chen CY, Lo H, Hsia HH, Liu IL, Lin RS, Shau WY, Huang KC. 2002. Optimal cut-off values for obesity: using simple anthropometric indices to predict cardiovascular risk factors in Taiwan. *Int J Obes Relat Metab Disord* 26(9):1232–1238.
- McCarthy H, Ashwell M. 2003. Trends in waist:height ratios in British children aged 11–16 over a two-decade period. *Proc Nutr Soc* 62:46A.
- Misra A. 2003. Revisions of cutoffs of body mass index to define overweight and obesity are needed for the Asian-ethnic groups. *Int J Obes Relat Metab Disord* 27(11):1294–1296.

- Patel S, Unwin N, Bhopal R, White M, Harland J, Ayis SA, Watson W, Alberti KG. 1999. A comparison of proxy measures of abdominal obesity in Chinese, European and South Asian adults. *Diabet Med* 16(10):853–860.
- Sargeant LA, Bennett FI, Forrester TE, Cooper RS, Wilks RJ. 2002. Predicting incident diabetes in Jamaica: the role of anthropometry. *Obes Res* 10(8):792–798.
- Savva SC, Tornaritis M, Savva ME, Kourides Y, Panagi A, Silikiotou N, Georgiou C, Kafatos A. 2000. Waist circumference and waist-to-height ratio are better predictors of cardiovascular disease risk factors in children than body mass index. *Int J Obes Relat Metab Disord* 24(11):1453–1458.
- Sayeed MA, Mahtab H, Latif ZA, Khanam PA, Ahsan KA, Banu A, Azad Khan AK. 2003. Waist-to-height ratio is a better obesity index than body mass index and waist-to-hip ratio for predicting diabetes, hypertension and lipidemia. *Bangladesh Med Res Counc Bull* 29(1):1–10.
- Stevens J. 2003. Ethnic-specific revisions of body mass index cutoffs to define overweight and obesity in Asians are not warranted. *Int J Obes Relat Metab Disord* 27(11):1297–1299.
- World Health Organization. 2000. Obesity. Preventing and managing the global epidemic. Report of a WHO Consultation on obesity, 3–5 June 1997, Geneva. Geneva: World Health Organization.
- World Health Organization. 2002. Report of a WHO Consultation on appropriate BMI for Asian populations and its implications for policy and intervention strategies. Geneva: World Health Organization.
- World Health Organization Expert Consultation. 2004. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet* 363(9403):157–163.
- Zhou BF. 2002. Effect of body mass index on all-cause mortality and incidence of cardiovascular diseases—report for meta-analysis of prospective studies open optimal cut-off points of body mass index in Chinese adults. *Biomed Environ Sci* 15(3):245–252.