Letter to the Editor

The body adiposity index is not the best hip–height index of adiposity

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The 'body adiposity index' (BAI) proposed by Bergman *et al.*[1] estimates percentage body fat from hip circumference (HC) and body height as $((HC (cm))/(height (m))^{1.5} - 18)$. A recent study published in *The British Journal of Nutrition* by Freedman *et al.*[2] found the BAI to be less strongly associated with skinfold thicknesses and cardiovascular risk factors than were either waist circumference or BMI. In other studies, the BAI has been found to correlate with percentage fat about as well as does the BMI, but more often less well[3–7]. In these studies, men and women were treated separately. The original finding was that percentage fat correlated much more strongly with BAI than with BMI[1], but that was for a mixed sample of men and women, and the sexes differ markedly in the relationship between adiposity and BMI[1,4].

Fundamental to the derivation of the BAI is the negative correlation between percentage fat and height when both sexes are considered together, but this is due only to the tendencies for men to be taller and to contain relatively less fat[2,5]. Bergman *et al.*[1] acknowledged that the relationship between BAI and percentage fat is not exactly linear and their Fig. 3 also shows that there is a different curvilinear relationship for each sex. Indeed, for values of BAI near 40–50, percentage fat is predominantly higher in women than in men. It is therefore certain that HC and height can be combined in a better index of adiposity, if only by treating the sexes separately and by allowing for the curvilinear relationships between adiposity and the ratio $HC/(height)^{1.5}$. But is 1·5 the optimum height exponent? That it could be nearer to zero is suggested by findings that HC correlates about as well with percentage fat as does the BAI, or slightly more strongly[5,7]. One approach to estimate the best height exponent is to find, for a given population, the value of x that optimises the index $HC/height^x$ as a predictor of percentage fat. Another approach, not needing data on adiposity, is to determine the value of x that minimises the correlation between $HC/height^x$ and height, thus producing an index that is independent of height. That index could prove to be equally valid for adiposity and for some cardiovascular risk factors. In regard to the second approach, regression of log(HC) on log(height) has given estimates of x to be 0·72 (r 0·33) for men and 0·39 (r 0·14) for women[8]. Future estimates will probably differ slightly amongst datasets, and may then be expected to correlate positively with the corresponding values of r[9]. Nevertheless, a round-number value of 0·5 (i.e. between 0·72 and 0·39) could well prove to be appropriate – as seems to be true for the equivalent index based on height and waist circumference[9]. The relationships between the index and percentage fat would need to be defined for men and women separately. Many researchers already have the data to explore this and, if a useful index is then identified, it can be tested as a predictor of cardiovascular risk factors.

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References

1. Bergman RN, Stefanovsky D, Buchanan TA, *et al.* (2011) A better index of body adiposity. *Obesity (Silver Spring)* **19**, 1083–1089.
2. Freedman DS, Blanck HM, Dietz WH, *et al.* (2012) Is the body adiposity index (hip circumference/height$^{1.5}$) more strongly related to skinfold thicknesses and risk factor levels than is BMI? The Bogalusa Heart Study. *Br J Nutr* (Epublication ahead of print version 13 April 2012).
3. Marques-Vidal P, Waeber G & Vollenweider P (2012) Another (better) index of adiposity. *Obesity (Silver Spring)* **20**, 1137–1138.
4. Barreira TV, Harrington DM, Staiano AE, *et al.* (2011) Body adiposity index, body mass index, and body fat in white and black adults. *JAMA* **306**, 828–830.
5. Schultze MB, Thorand B, Fritsche A, *et al.* (2012) Body adiposity index, body fat content and incidence of type 2 diabetes. *Diabetologia* **55**, 1660–1667.
6. Miazgowski T, Safranow K, Major-Gołuch A, *et al.* (2012) Validation of a new index of body adiposity (BAI) to assess body fat in normal weight premenopausal Caucasian women. *e-SPEN J* **7**, e115–e118.

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7. López AA, Cespedes ML, Vicente T, et al. (2012) Body adiposity index utilization in a Spanish Mediterranean population: comparison with the body mass index. PLoS One 7, e35281.

8. Heymsfield SB, Heo M & Pietrobelli A (2011) Are adult body circumferences associated with height? Relevance to normative ranges and circumferential indices. Am J Clin Nutr 93, 302–307.

9. Burton RF (2010) Waist circumference as an indicator of adiposity and the relevance of body height. Med Hypotheses 75, 115–119.