Letter to the Editor

Comments on the article "Optimum waist circumference-height indices for evaluating adult adiposity: An analytic review": relationships to previous studies

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To the editor

The recent review of Hwaung et al. provides a detailed and valuable account of the history and rationale of the body mass index (BMI) and of indices relating waist circumference (WC) to body height that take the form WC/height$^{\alpha}$.[1] I show here how their evidence and analysis are usefully supplemented with those of earlier studies.

The ratio WC/height, with $\alpha = 1$, is widely used, but the authors have concluded that the optimum value of α is approximately 0.5, with this giving the strongest association with adiposity and the weakest correlation with height for men and women of four race/ethnic groups. Burton[2] also considered 0.5 to be an appropriate round-number value.

On dimensional grounds, one might choose a value of 1 for α, making the index dimensionless, but data scatter associated with variable body shape must lower values of α as estimated by regression analysis — just as it lowers the height exponent, *p*, of the Benn index, (body mass)/height^{p}.[2,3] (Here I am applying the symbol "α" just to WC and not also to body mass as in the review.) Both α and *p* necessarily correlate strongly with the respective correlation coefficients for WC and height and for body mass and height.[2-4] The negative value of α for Korean women (-0.43) — unadjusted for age — must be associated with a negative correlation between WC and height (though R^2 is positive). These negative values were also found by Han et al. for Europeans[4]. This, as well as Table 1[1], illustrates the importance of age in considering the height dependences of WC and body mass and therefore both α and *p*. In contrast, Table S9 in the supplementary material indicates that there is conveniently little

influence of age on correlations between WC and % fat and between body mass and % fat. With increasing age, body mass tends generally to increase and height tends to decrease.[4]

Figure 2 of Burton[2] shows a strong correlation between p and α (with α there denoted q) with most of the points being for data that were age-adjusted or grouped for age[4]. The tabulated results of Hwaung et al. show similar relationships, for values both un-adjusted and adjusted for age.[1] Moreover, their eight age-adjusted values, together with eight age-adjusted values of Han et al.[4], show a single clear straight-line relationship, with a correlation coefficient of 0.91. This suggests a link beyond the obvious between WC/height$^{\alpha}$ and (body mass)/height^{p} that has yet to be elucidated. The reduced major axis regression equation is:

$$\alpha = 0.69p - 0.78.$$

Hwaung et al. discussed the question of whether 1/BMI and 1/(WC/height$^{\alpha}$) are additive in multiple regression models for the prediction of % fat. Their Table S7 shows, for age-corrected values, that, for men, R^2 for % fat and 1/(WC/height$^{0.5}$) is higher than for % fat and 1/BMI, while the opposite is true for women. Multiple regression of % fat on both indices together did not increase R^2 above the highest of the two values by more than 0.01. So the two indices are not usefully additive. As a correlate or predictor of % fat, the better index evidently differs between men and women and WC/height$^{0.5}$ is only more appropriate than the BMI for men.

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