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Invited commentary

Universal cut-off BMI points for obesity are not appropriate

The World Health Organization (1998) defines obesity as a condition with excess body fat to the extent that health and well-being are adversely affected. The BMI (weight/height^2, kg/m^2) is normally used for classification. The use of BMI as a surrogate measure for body fat percentage (BF%) is justified on the observation that BMI correlates well with BF% and is hardly dependent on height. The suggested cut-off points for overweight (BMI $\geq$ 25 kg/m^2) and obesity (BMI $\geq$ 30 kg/m^2) are based on observational studies in Europe and USA on the relationship between morbidity and mortality with BMI. In Caucasians, a BMI 30 kg/m^2 corresponds to a BF% about 25 % in young adult males and about 35 % in young adult females (World Health Organization, 1995).

The paper of Ko *et al.* (2001) addresses an important issue: the validity of the currently used cut-off points for overweight and obesity based on the BMI for various ethnic groups. There are a number of recent studies showing that the relationship between BMI and BF% is not only age and sex dependent, but also differs among ethnic groups. Wang *et al.* (1994) showed that 'Asians' living in New York, NY, USA, have lower BMI but higher BF% than age- and sex-matched Caucasians. Differences in the BMI:BF% relationship compared with Caucasians were also found in Polynesians (Swinburn *et al.* 1996), in Indonesians (Gurrici *et al.* 1999), in Japanese (Gallagher *et al.* 2000) and recently also in Singaporean Chinese, Malays and Indians (Deurenberg-Yap *et al.* 2000). There are also differences among different groups from African origin (Luke *et al.* 1997). In several studies differences in BMI:BF% relationship could be ascribed to differences in body build and/or frame size (Gurrici et al. 1999; Deurenberg-Yap *et al.* 2000). It is well known that ethnic groups differ in frame size as well as in relative leg length (relative sitting height) and that this has an impact on the BMI (Norgan, 1994). There are also studies that do not find differences among ethnic groups as for example Beijing Chinese compared with Dutch Caucasians (Deurenberg *et al.* 1997) and American Blacks compared with Caucasians (Gallagher *et al.* 1996). Those data are not necessarily conflicting. It could be, however, that the methods and/or formulas used to determine BF% are not appropriate. Many methods used for the assessment of BF% rely on assumptions that are not validated in the population under study. It is obvious that this can falsely lead to either acceptance or rejection of the hypothesis.

Recent studies also show that in some 'Asian' populations morbidity and mortality of obesity-related diseases are high already at a low level of BMI. This affirms the World Health Organization (1998) definition of obesity, namely that not only BF% should be increased, but that in addition also health and well being should be affected.

The consequence of these observations, if true, is obvious: an universal BMI cut-off point for obesity is not appropriate.

Changing the level of BMI cut-off points has consequences for the prevalence of obesity. For example, according to BF% and health risks in Singapore, lowering the cut-off point for obesity from 30 kg/m^2 to 27 kg/m^2 would increase the prevalence of obesity from about 6 % to 16 % (Deurenberg-Yap *et al.* 2000). Such an 'increase' has of course an enormous impact on the public health policies of a country. However, in the long term, the economic burden of a hidden high obesity prevalence might be much higher. On the other hand, it is interesting to note that the cut-off point for underweight might also be different among ethnic groups. For example in the recent *National Health Survey* (Ministry of Health, 1999) in Singapore, as much as 11 % females and 7 % males had a BMI $<$ 18·5 kg/m^2. The proportion of Singaporeans with a BMI $<$ 20 kg/m^2 were 25 and 15 % for females and males respectively. There is no reason at all to assume that undernutrition is epidemic among Singaporeans.

Redefining (different) cut-off points for different ethnic groups should be based on proper evidence. Such evidence should not only be based on the relationship between BMI and BF%, but also on morbidity and mortality risks in relation to BMI. For the body composition component, this calls for international multi-centre studies in which the method for measuring BF% is highly standardised and free of assumptions. Small systematic differences in estimated BF% have already a big impact on the BMI:BF% relationship as 1 % point body fat is equivalent to about one BMI unit. Chemical more compartment models (comprising of water, mineral, protein and fat) (Deurenberg-Yap *et al.* 2000; Gallagher *et al.* 2000) would be ideal, but may be practically impossible in many countries. ^2H_2O dilution might be the most feasible alternative, as the method is easy to standardise, application is relatively easy even in field situations and samples can be sent for analyses to a specialised laboratory. Those studies should ideally include as much as possible ethnic (population) groups including Caucasians, as there are indications that the BMI:BF% relationship also differs among Caucasian groups (Deurenberg *et al.* 1998).

The argument that different cut-off points in different populations are confusing for the population concerned as well as for international comparisons is only partly true. People are well aware of differences between ethnic groups. As for comparison of prevalence data between

countries: no scientist wants to compare apples with pears and that is precisely what is happening when using a universal cut-off point.

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