



National
Obesity
Observatory



Body Mass Index as a measure of obesity

June 2009

Executive summary

Body Mass Index (BMI) is a person's weight in kilograms divided by the square of their height in metres. It is one of the most commonly used ways of estimating whether a person is overweight and hence more likely to experience health problems than someone with a healthy weight. It is also used to measure population prevalence of overweight and obesity. It is used because, for most people, it correlates reasonably well with their level of body fat. It is also a relatively easy, cheap and non-invasive method for establishing weight status. However, BMI is only a proxy for body fatness. Other factors such as fitness, ethnic origin and puberty can alter the relation between BMI and body fatness and must be taken into consideration. Other measurements such as waist circumference and skin thickness can be collected to indicate a person's weight status or body fatness. None of these is as widely used as BMI.

What is BMI?

BMI is a summary measure of an individual's height and weight, calculated by dividing a person's weight in kilograms by the square of their height in metres. Using a measure such as BMI allows for a person's weight to be standardised for their height, thus enabling individuals of different heights to be compared.

BMI is the most commonly used measure for monitoring the prevalence of overweight and obesity at population level. It is also the most commonly used way of estimating whether an individual person is overweight or obese.

Although BMI is used to classify individuals as obese or overweight, it is only a proxy measure of the underlying problem of excess body fat. As a person's body fat increases, both their BMI and their future risk of obesity-related illness also rise,¹ although there is still some uncertainty about the exact nature of this relationship, especially in children.

Why use BMI?

Excess body fat is known to be linked to both current and future morbidity. BMI is an attractive measure because it is an easy, cheap and non-invasive means of assessing excess body fat. True measures of body fat are impractical or expensive to use at population level (e.g. bioelectrical impedance analysis or hydro densitometry), and other proxy measures of body fat are difficult to measure accurately and consistently across large populations (e.g. skin fold thickness or waist circumference).

BMI is widely used around the world and has been measured for some time, enabling comparisons between areas, across population sub-groups and over time. Another advantage of BMI as a practical measure of obesity is the availability of published thresholds and growth references to which children's BMI can be compared. BMI in children varies with age and sex, which prevents the use of fixed thresholds as in adults. Equivalent growth references do not exist for other measures such as waist circumference.

What are the problems with its use?

BMI does, however, have some drawbacks. It is only a proxy indicator of body fatness; factors such as fitness (muscle mass), ethnic origin and puberty can alter the relationship between BMI and body fatness. Therefore, BMI may not be an accurate tool for assessing weight status at an individual level, and other ways of measuring body composition may be more useful and accurate.

BMI does not provide any indication of the distribution of body fat and does not fully adjust for the effects of height or body shape, which may be particularly important when comparing figures across ethnic groups.

These drawbacks are not necessarily very important at population level as these problems even out when used across large numbers of people; in any case, many of these issues also apply to the other anthropometric measures that might be used in place of BMI.

The widespread use of BMI and the resulting supporting literature mean that very convincing arguments would be needed to move to routine use of any other index of fatness.

How should we interpret different BMI levels?

BMI provides an indication of health status: a number of research studies have demonstrated a relationship between raised BMI and increased risk of illness or death.

For Caucasian adults, aged 18 years and over, a person's weight status is categorised according to the level of their BMI as shown in the table below. The thresholds do not change with age and are the same for both men and women.

BMI (kg/m ²)	Weight Status
Below 18.5	Underweight
18.5 to 24.9	Healthy weight
25.0 and above	Overweight
30.0 and above	Obese

Research has shown that individuals whose BMI falls into the overweight or obese categories are more likely to experience health problems associated with excess weight. Although there is still some debate as to whether the same thresholds should be employed for all individuals or whether, for example, different thresholds should be used with some ethnic groups, these BMI thresholds are used worldwide.

Is BMI interpreted the same way for children as it is for adults?

For children the picture is more complicated than it is for adults. The relationship between fatness and BMI varies with age and sex, so definitions of obesity and overweight need to take these two variables into account. Children's BMI measures are therefore usually compared

to a growth reference in order to determine a child's weight status. Factors such as timing of puberty or ethnicity can cause additional difficulty when classifying children's BMI.

Internationally, a number of different child growth references and associated thresholds are currently in use. In the UK, the UK90 Growth Reference is the most commonly used adjustment tool; new UK growth charts using the WHO standard have recently been introduced for children from birth to four years.²

The evidence linking specific BMI thresholds to future morbidity and mortality is weaker for children than for adults. There is however a body of evidence showing that children with a high BMI are also more likely to have a high BMI when they become adults, and thus a raised risk of future health problems.

How should measurements of height and weight be made?

Standardised, easily reproducible protocols should be used for measuring height and weight, so that inaccuracies and inconsistencies are minimised. Ethical considerations should also be taken into account, particularly when weighing and measuring children.

*The National Child Measurement Programme (NCMP) and the Health Survey for England (HSE) have established basic standards for these procedures, including using standardised weighing and measuring equipment and ensuring consistent posture and head positioning of participants when measuring height. More detailed guidance is available on the Department of Health website in the National Child Measurement Programme guidance for PCTs: 2008/09 school year.*³

What other measures of fatness are available?

Some research suggests that other measures may provide a better indication of 'fatness' than BMI. Among these alternative measures are waist or hip circumference, body fat ratio and skin fold thickness.

Although these measures may provide a better indication of an individual's propensity to future ill health, they are more difficult or expensive to collect in large numbers. To measure body fat, body density or skin fold thickness requires special equipment and measures such as hip or waist circumference are harder to record accurately and consistently, especially when conducted on a large scale.

By contrast, as BMI relies solely on height and weight, most individuals will either know or have access to the equipment to take these measurements. BMI can therefore be measured and calculated with reasonable accuracy by the public in their own home.

Furthermore, the precise thresholds used to classify individuals as obese, overweight or underweight using other measures are not as well established as those for BMI, although standard thresholds for waist circumference do exist. This means that, even if these measures were routinely collected, it would not be easy to produce population prevalence figures. There

would also be a lack of published data with which to compare the resulting statistics. Increased BMI is correlated with increased values of other measures such as waist circumference, body fat ratio and skin fold thickness. BMI provides a reasonable measure of 'fatness', although other measures might provide a more accurate indication of any individual's weight status.

So what should we conclude?

BMI is an adequate proxy measure for monitoring the underlying increase in health risk due to excess weight at a population level. Although BMI is not a 'gold standard' measure of overweight or obesity, its advantages in terms of ease of measurement, established cut offs, and existing published statistics make it the only currently viable option for producing high level summary figures at population level.

References

1. National Heart Foundation in association with the Faculty of Public Health and Department of Health, 2007. *Lightening the load: tackling overweight and obesity: a toolkit for developing local strategies to tackle overweight and obesity in children and adults*. [Online] London: Department of Health. Available at: http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_073936 [Accessed May 2009].
2. Royal College of Paediatrics and Child Health, World Health Organisation, Department of Health, 2009. *UK-WHO Growth Charts: Early Years*. [Online] London: Department of Health. Available at: <http://www.rcpch.ac.uk/Research/UK-WHO-Growth-Charts> [Accessed June 2009].
3. Department of Health, 2009. *The National Child Measurement Programme Guidance for PCTs: 2008/09 school year*. [Online] London: COI for the Department of Health. Available at: http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/DH_086724 [Accessed May 2009].