Statement on Ideal Body Weight
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The concept of Ideal Body Weight (IBW) has a history dating back over 150 years. It was first used by Broca, a French surgeon working in the military who used height and weight as a simple method of calculating normal or optimal body weight. The term IBW was originally proposed based on height and weight tables for men and women published in 1912. These tables used measurements collected from insurance policy holders between 1885 and 1908 (Chichester et al 2021). IBW was defined as the weight associated with the greatest life expectancy for a given height. In 1943 the Metropolitan Life Insurance Company introduced new height and weight tables which included frame size but excluded any reference to age (Pai and Paloucek 2000).

The 1959 Metropolitan Desirable Weight Table was developed based on the data from 26 different insurance companies. Body frame size was still included but was now more strictly defined and not left to subjective judgement (Pai and Paloucek 2000). Weight data, obtained from height and weight tables together with body frame size, was found to correlate with mortality. Consequently, weights associated with longevity and therefore lowest mortality, were termed "desirable" or "ideal" (Statistical Bulletin of the Metropolitan Insurance Company 1959). However, the Metropolitan Life study did not take into account any comorbidities, family history of disease or lifestyle factors such as tobacco use (Sandowski 2000).

The use of IBW formulae is a quick, non-invasive and relatively easy method used in a variety of clinical settings. For example, its use has been particularly important in pharmacotherapy. Some drugs, especially those with a narrow therapeutic range, when prescribed according to total body weight (TBW), could lead to overdose and toxicity in patient with obesity. This led to the development of an IBW formula by Devine in 1974 for gentamicin therapy (Devine *et al.* 1974). It is also of relevance in the dosing of anaesthetic agents (Ingrande and Lemmens 2010) where the administration of an anaesthetic agent based on TBW may result in overdose.

In weight management and bariatric surgery, IBW is used to calculate excess body weight (EBW) and % Excess Weight loss (%EWL). These are frequently used when describing the effectiveness of various treatment options offered to individuals living with obesity.

In nutritional support, the majority of predictive formulae for estimating energy requirements rely on body weight. These are unreliable when used for individuals living with obesity and can result in over estimating requirements. To avoid this, the use of IBW is frequently recommended.

There are numerous formulae for calculating IBW; the most commonly encountered are shown in **Table 1**.

Table 1. Formulae for estimating IBW.

Reference	Formulae	Comments
Hamwi *et al.* 1964	- Males: 106lb + 6lb per inch over 5' - Females: 100lb + 5lb per inch over 5' - Add 10% for a large frame (wrist size >7") - Subtract 10% for small frame (wrist size <7")	Uses height and body frame size. Tape measure needed to measure wrist circumference (to determine frame size). Commonly used in the USA
Devine *et al.* 1974	- Males: 50kg + 2.3kg per inch over 5' - Females: 45.5kg + 2.3kg per inch over 5'	Uses empiric data from an undescribed patient population. The IBW values for females are very low and unacceptably low for shorter females
Robinson *et al.* 1983	- Males: 52kg + 1.9kg per inch over 5' - Females: 49kg + 1.7kg per inch over 5'	Regression analysis of the 1959 MetLife tables. Thought to be a modification of the Devine Index. Unreliable for very short or tall individuals, the very old and the very young
Miller *et al.* 1983	- Males: 56.2kg + 1.41kg per inch over 5' - Females: 53.1kg +1.36kg per inch over 5'	Regression analysis of the 1983 MetLife tables. Thought to be a modification of the Devine Index
Hammond 2000	- Males: 48kg + 1.1kg per cm over 150cm - Females: 45kg + 0.9kg per cm over 150cm	Metric version of the Hamwi formula

Lemmens *et al.* 2005	IBW = 22 x h^2, where h is equal to patient height in metres	Attempted to address the flaws of previous formulae. Estimates IBW based on BMI. The same formula is used for men and females. This formula gives weight values midway within the range of weights obtained using published IBW formulae
Deitel and Greenstein 2003	• Males: 135lb for the first 63" (5'3") plus 3lb per inch over 63" • Females:119lb for the first 60" (5') plus 3lb per inch over 60"	This formula corresponds to the mid point of the medium frame of the Metropolitan Life tables with a reported accuracy of 1% To convert to IBW for small or large frame, decrease or increase the result by 10%. 1 foot = 30.4cm 1 inch = 2.54cm Divide by 2.2 to change to kg

Similarities exist between all IBW formulae because they all use actuarial data from height-weight tables (see **Table 2**). The exception to this is the Devine Index which uses empirical data. Lemmens uses a single formula for both females and males whereas the others use separate formulae for females and males (Lemmens *et al.* 2005). The Lemmens formula is also the only one which depends on the square of the individual's height and hence is more consistent with body mass index (BMI), whereas all the other formulae use a linear relationship. The majority of these formulae are only applicable if the individual's height is greater than 5' (152cm). The exception is the formula of Deitel and Greenstein.

Table 2 Calculated IBW (kg) using different formulae based on a male of 1.78m (5'10") and female of 1.65m (5'5")

Formula	Males (IBW kg)	Females (IBW kg)
Hamwi Formula	75.3	56.7
Devine Index	73	57
Robinson Formula	71	57.5
Miller Formula	70.3	59.9
Hammond formula	78.8	58.5
Lemmens Formula	69.7	59.9
Deitel and Greenstein	70.9	60.9

Each formula was devised under different circumstances and intended for a variety of purposes (Kammerer et al 2015).

For example, The American Association for Parenteral and Enteral Nutrition calculated IBW using the Hamwi formula because the existing evidence, although limited, is based on that formula (McClave *et al.* 2016). One author felt that a system based on weight at a BMI of 25kg/m^2 would be more appropriate, but she was unable to convince the remaining co-authors because of the current lack of supporting evidence (personal communication with Charlene Compher PhD RD).

On the other hand, Obesity Surgery, the official journal of the International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) suggested the use of the formula attributed to Deitel and Greenstein, for calculating IBW (Deitel and Greenstein 2003). The formula is in feet and lbs but does provide information for conversion to metric.

IBW does have limitations and its use continues to be controversial. Criticism has been directed at the inconsistencies used in the original data sets. Approximately 20% of the height and weight measurements for the 1959 tables were self-reported by the life insurance policy holders (Shah et al 2006). Arbitrary adjustments were made to take into account the presence of clothing and footwear when recording weight and height. Assessment of body frame size was only defined in later Metropolitan Life Tables; prior to that, assigning body frame size was at the discretion of the examiner (Chichester et al 2021). It is also worth remembering that the data was collected from a much smaller population; the incidence of overweight and obesity was approximately 6% and 7% respectively at that time.

Debate also continues as to whether mortality alone should be considered as the only factor when calculating IBW or whether morbidity should also be included (Sandowski 2000). Many comorbidities have a considerable impact on health, quality of life and psychosocial functioning. If morbidity is included, then the question arises as to how it should be defined and what degree of morbidity should be considered significant (Sandowski 2000).

A further criticism is that all IBW formulae predict a single-target body weight as a linear (or – in the case of Lemmens – quadratic) function of height. However, the relationship between weight and height is more complex, and weight is known to be affected by several factors including body volume and muscle mass. There is no single body weight that applies across all demographics such as gender, ethnicity and age, nor is there a single body weight that applies to all comorbidities and causes of mortality (Peterson et al 2016). It has been suggested that a range of target body weights that fall between a body mass index (BMI) of 18.5-24.9kg/m^2 should be used.

Whichever formula is used for calculating IBW, clinicians must be aware of the limitations appertaining to these methods. In clinical practice most dietitians would probably aim for a weight equivalent to a BMI of 25kg/m^2, but there is no

evidence to support this. Sound clinical judgement should be used when assessing individual patients.

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