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RESEARCH

Adult weight measurement: decoding the terminology used in literature

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Abstract:
There are various types of names given to describe the adult weight measurement. The most commonly used terms (actual body weight, estimated body weight, ideal body weight and adjusted body weight) have been defined and summarized to assist in their application in therapeutic nutrition.

Keywords: ABW, Adj-IBW, adjusted body weight, adjusted ideal body weight, adult weight measurement, actual body weight, ascities, BW-adj, BWef, chronic kidney disease, EBW, estimated body weight, dry body weight, IBW, ideal body weight, obesity, oedema, weight

Introduction

Anthropometry requires a fundamental grasp of methodology.[1,2] Weight and height are the most basic forms of anthropometry used in practice; however, clinicians may fail to fully understand the context of its application.[3] In the case of weight, there are several terminologies that have been documented to describe the nature of the adjustment made to the original measurement value. When these terms are not clearly defined by the author, it may lead to confusion and/or incorrect calculations. Therefore, the purpose of this review is to summarise the most frequently used weight anthropometric terminology and abbreviations that are mentioned in the literature to date.

Actual body weight

Actual body weight (ABW), *body weight* (BW), or simply standardised as *weight* in the literature, is defined as the measurement taken when the subject is able to stand unassisted using a calibrated scale.[4,5] The subject should wear minimal clothing, and should also remove shoes and socks.[4,5] Before starting, the scale should be zeroed and then the subject must stand in the centre of the scale, without support and with equal distribution of weight between both feet.[4,5] Measurements should be taken to the nearest 0.1 kilogram (kg). To account for diurnal variation, the most accurate measurement is taken in the morning after voiding.[4,5] When measured correctly, ABW can be used to compare with other anthropometric measurements, for example with height to calculate body mass index (BMI = weight/height^2).[4,5]

In cases where non-ambulatory patients are unable to stand, specialised scales can be used such as a sitting scale or bed scale. However, the downside of using these types of equipment includes that they require training in order to obtain an accurate measurement, they are expensive and are uncommonly available for everyday use. But it is possible to estimate weight using other body measurements. This is known as *estimated body weight* (EBW).[6]

Estimated body weight

When ABW is unable to be measured in non-ambulatory patients, EBW can be calculated using predictive equations.[6] The most commonly used equations that could be used to calculate body weight in an adult have been summarised in Table 1.[7–9] These equations have not been validated for use in a South African population.

Table 1 describes possible equations that could be used to calculate EBW. The calculations include the use of various body measurements and where appropriate are taken on the right side of the body.[7–9] The calf circumference is the largest circumference of the calf muscle.[7,8] Knee height is measured from the heel of the foot to head of the patella (kneecap), ensuring that the subject is in a supine position with the leg bent to form a 90 degree angle under the knee.[7–9] Arm circumference is measured at the midpoint between the acromion process of the scapula (bony protrusion on the shoulder) and the olecranon process (tip of the elbow).[7–9] The subscapular skinfold thickness is the site identified by allocating the undermost tip of the inferior angle of the scapula and is 2 cm along a line running laterally and downward.[7] The skinfold thickness is measured using calipers, and at a 45-degree angle to the scapula.[7] Abdominal circumference is measured as the largest circumference between the last palpable rib (10th rib) and the top of the iliac crest (hip bone), perpendicular to the long axis of the trunk.[8]

Ideal body weight

Ideal body weight (IBW) is defined as the goal weight at which nutritional requirements are met.[10] An IBW weight lies within the normal BMI range from 18.5 kg/m^2 to 24.9 kg/m^2.[10,11] Ideal body weight can be calculated by using body weight as a function of height and a target BMI value (IBW (kg) = (BMI x Ht^2)).[10,11] If the subject is underweight then the lower limit of the normal BMI range is used in the IBW equation. However, if the subject is overweight then the upper limit of the normal BMI range is used in the IBW equation.

Adjusted body weight

Adjusted body weight (BW-adj), refers to the calculation adjustments made to the body weight measurement and is applicable to subjects with amputations, oedema, ascites or chronic kidney disease, as well as in obesity.[12]

Adjustment for fluid: dry body weight

Dry body weight or *oedema-free body weight* (BWef), implies that the ABW has been adjusted to a figure that is minus the weight of excess bodily fluid.[13] This alteration for positive fluid balance is commonly associated with peripheral oedema, ascites and chronic kidney disease (CKD).[13]

Table 1: Estimated body weight equations

	Estimated body weight (EBW) equations		Author
Female	Body weight (kg) = ((1.27 x right calf circumference (cm)) + (0.87 x right knee height (cm)) + (0.98 x right arm circumference (cm)) + (0.4 x right subscapular skinfold thickness (mm)) – 62.35)		Chumlea et al.[7]
Male	Body weight (kg) = ((0.98 x right calf circumference (cm)) + (1.16 x right knee height (cm)) + (1.73 x right arm circumference (cm)) + (0.37 x right subscapular skinfold thickness (mm)) – 81.69)		
Female	Body weight (kg) = ((0.5759 x right arm circumference (cm)) + (0.5263 x abdominal circumference (cm)) + (1.2452 x right calf circumference (cm)) – (4.8689 x 2) – 32.9241)		Rabito et al.[8]
Male	Body weight (kg) = ((0.5759 x right arm circumference (cm)) + (0.5263 x abdominal circumference (cm)) + (1.2452 x right calf circumference) – (4.8689 x 1) – 32.9241)		
White Female	19–59 yrs	Body weight (kg) = ((right knee height (cm) x 1.01) + (right arm circumference (cm) x 2.81) – 66.04)	Ross[9]
	60–80 yrs	Body weight (kg) = ((right knee height (cm) x 1.09) + (right arm circumference (cm) x 2.68) – 65.51)	
Black Female	19–59 yrs	Body weight (kg) = ((right knee height (cm) x 1.24) + (right arm circumference (cm) x 2.81) – 82.48)	
	60–80 yrs	Body weight (kg) = ((right knee height (cm) x 1.50) + (right arm circumference (cm) x 2.58) – 84.22)	
White male	19–59 yrs	Body weight (kg) = ((right knee height (cm) x 1.19) + (right arm circumference (cm) x 3.21) – 86.82)	
	60–80 yrs	Body weight (kg) = ((right knee height (cm) x 1.10) + (right arm circumference (cm) x 3.07) – 75.81)	
Black male	19–59 yrs	Body weight (kg) = ((right knee height (cm) x 1.09) + (right arm circumference m) x 3.14) – 83.72)	
	60–80 yrs	Body weight (kg) = ((right knee height (cm) x 0.44) + (right arm circumference (cm) x 2.86) – 39.21)	

Notes: cm = centimetres, mm = millimetres, kg = kilograms, EBW = estimated body weight.

Adjustment for fluid in peripheral oedema

Peripheral oedema is a clinical finding, defined as the abnormal excessive accumulation of fluid in the body tissues, i.e. the retention of water and sodium in the extracellular spaces.[8]

The possible causes of peripheral oedema include: (i) increased capillary hydrostatic pressure; (ii) regional venous hypertension, e.g. deep vein thrombosis; (iii) systemic venous hypertension, e.g. liver disease; (iv) increased plasma volume, e.g. congestive cardiac failure; (v) decreased plasma oncotic pressure; (vi) protein loss, e.g. malabsorption; (vii) reduced protein synthesis, e.g. malnutrition; (viii) increased capillary permeability, e.g. burns; and (ix) lymphatic obstruction or increased interstitial oncotic pressure, e.g. lymphoedema.[14]

There are two types of peripheral oedema, pitting (PO) and non-pitting (NPO).[15] Non-pitting oedema suggests that when pressure is applied to the affected area, no indentation is identified and therefore can be difficult to grade.[15] The causes of NPO are commonly associated with lymphoedema, lipoedema (abnormal fat deposition in extremities) and myxoedema (severe hypothyroidism).[15] Pitting oedema is measured by pressing one's thumb down onto the affected area, holding for three seconds, and if an indent is left then it is classified as PO.[15] The severity of PO can be classified according to either the site of oedema, measurement of the indent, or the time taken for the skin to rebound (summarised in Table 2).[15,16]

Table 2 describes the adjustment that can be made to ABW to calculate BWef, based on the grade of oedema identified.[17]

Table 2: Weight adjustment according to grading of peripheral oedema[15,16]

Grade	Symbol	Indent measurement	Rebound time	Site of oedema	Weight adjustment equation (BWef)
Mild	+	Barely detectable impression when finger is pressed into skin, ≤ 2 mm	Immediate rebound	Both ankles and/or feet	BWef (kg) = ABW – 1.0
Moderate	++	3–4 mm	Slight indentation, takes ≤ 15 seconds to rebound	Both feet, hands, lower arms and lower legs	BWef (kg) = ABW – 5.0
Severe	+++	> 4 mm	Deeper indentation, takes > 15 seconds to rebound	Generalized bilateral pitting oedema, which includes both legs, arms, feet and face	BWef (kg) = ABW – 10.0

Notes: ABW =actual body weight, BWef = dry body weight.

Table 3: Weight adjustment according to grading of ascites[18]

Grade	Symbol	Definition	Weight Adjustment equation (BWef)
Mild	+	Ascites is only detectable by ultrasound examination	BWef (kg) = ABW – 2.2
Moderate	++	Ascites causing moderate symmetrical distention of the abdomen	BWef (kg) = ABW – 6.0
Severe	+++	Ascites causing marked abdominal distention	BWef (kg) = ABW – 14.0

Notes: ABW = actual body weight, BWef = dry body weight.

Adjustment for fluid in ascites

Ascites is defined as the accumulation of fluid in the peritoneal cavity, causing abdominal swelling.[18] Potential causes of ascites include: (i) liver disease; (ii) cirrhosis; (iii) cardiac failure; (iv) nephrotic syndrome; (v) malignancy; (vi) pancreatitis; and (vii) infection such as tuberculosis.[18] The grade of uncomplicated ascites can be categorised according to clinical findings, which are summarised in Table 3.[18]

Table 3 describes the adjustment that can be made to ABW to calculate BWef, based on the grade of ascites identified.[18]

Adjustment for fluid in chronic kidney disease

Dry body weight for CKD patients receiving haemodialysis (HD) or continuous ambulatory peritoneal dialysis (CAPD) is defined as the ABW in the absence of oedema, which is measured post-dialysis or post-drainage.[19] In CKD patients, it is recommended that this BWef measurement be compared with *standard body weight* (SBW).[19–21] Standard body weight is defined as the median body weight categorised according to age, gender, frame size and height.[21] If the CKD patient's percentage SBW (%SBW = ((BWef/SBW) x100)) falls outside the range of 95% to 115%, then this weight measurement should not be used.[20] Rather, the *adjusted dry body weight* (aBWef) must be calculated (aBWef = BWef +((SBW − BWef) x 0.25)) and this measurement can be effectively used in nutritional assessment and prescription.[19–21]

Adjustment for amputation

In subjects with amputations, it is important to account for the percentage of the total body weight that was contributed by the individual body parts that were removed.[12] The percentage weight of these body parts has been summarised in Table 4.

Table 4: Weight of individual body parts[11,12]

Body part	% Contribution of total body weight	Weight of body part (WtBP)
Hand	0.7	WtBP (kg) = ((0.7 /100) x ABW)
Lower arm and hand	2.3	WtBP (kg) = ((2.3 /100) x ABW)
Entire arm	5.0	WtBP (kg) = ((5.0 /100) x ABW)
Foot	1.5	WtBP (kg) = ((1.5 /100) x ABW)
Lower leg and foot	5.9	WtBP (kg) = ((5.9 /100) x ABW)
Entire leg	16	WtBP (kg) = ((16 /100) x ABW)

Notes: ABW = actual body weight, WtBP = weight of body part.

Table 5: Correction factors for obesity[22–25]

Application	Equations for the adjustment for obesity (Adj-IBW)
If ABW is ≥ 25% of IBW *or*, if(ABW ≥ (IBW x 1.25))	BW-adj[1] = ((ABW − IBW) x 0.25) + IBW
If ABW is ≥ 30% of IBW *or*, if(ABW ≥ (IBW x 1.30))	BW-adj[2] = ((ABW − IBW) x 0.50) + IBW

Notes: ABW = actual body weight, IBW = ideal body weight, Adj-IBWj = adjusted ideal body weight, BW-adj[1] = adjusted body weight type 1, BW-adj[2] = adjusted body weight type 2.

Table 4 describes how to calculate the weight of individual body parts (WtBP).[12] The WtBP can be added to ABW to obtain BW-adj, and then BW-adj can be used to work out the BMI of the subject.[11,12]

Adjustment for obesity

It has been recommended that BW-adj be used in the calculation of nutritional requirements in obese patients.[22–25] Adjusted body weight in the context of obesity is defined as the weight that represents the metabolically active lean body tissue and therefore prevents over- or underestimation of nutritional requirements in the obese subject.[22–25] In obese subjects BW-adj, sometimes known as *adjusted ideal body weight* (Adj-IBW),[25] is determined by applying a correction factor to the ABW (see Table 5).[22–25]

Table 5 explains how to calculate BW-adj in overweight/obesity and when its application is relevant for use in clinical practice.[22–25] If a subject's ABW falls below (IBWx1.25), then ABW can be used in the calculation of nutritional requirements.[25] However, if the ABW falls between (and including) 25% and 29% more than the IBW, then BW-adj type 1 (BW-adj[1]) can be calculated.[25] Furthermore, if the ABW is calculated to be ≥ 30% more than the IBW, then BW-adj type 2 (BW-adj[2]) can be calculated.[25] The equations are recommended to prevent overfeeding in the obese critically ill patient and can be used when permissive hypo-caloric feeding is warranted.[22–25] The BW-adj can be used with the Harris–Benedict equation or simplistic caloric equations, e.g. kcal/kg.[22–25]

Conclusion

The anthropometric terminology and abbreviations used in the literature can leave the reader confused, unless they have been fully explained. In the context of adult weight measurement, the most common terms that are used have been defined and decoded to aid in its application in therapeutic nutrition.

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