

Obesity assessment - a realistic approach Sqn

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ABSTRACT

Obesity is a matter of great concern for individuals and organisations including the armed forces. Excess fat is detrimental to physical fitness and work performance. Although the height-weight tables adopted by the armed forces for obesity assessment are simple to use, yet they are not accurate enough, as a muscular individual may be labelled obese while a lean person with normal weight range may escape detection although he may have an abnormal fat content. There is a need for using a simple yet reasonably accurate method for body fat assessment, which can be used in the field units of Armed Forces. The author compared the skin-fold method of body fat assessment, circumference method of body fat assessment and the Body Mass Index (BMI). The circumference method is recommended to be used in the armed forces rather than the inaccurate height-weight measures.

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throughout most of human history, a wide girth has been viewed as a sign of health, and prosperity. Yet it is ironical that several million people are sent early to their graves by damaging effects of eating too much and moving too little. Clearly, overweight cannot be taken lightly. The problem of obesity is a matter of serious concern to the individual as well as the state. [1]. Obesity increases mortality and morbidity at all ages. [2]. It affects Military appearance, performance and general health and has traditionally been the cause for concern for Military leaders [3]. It is not surprising that the Armed Forces commanders consider obesity as a matter of great concern for the combatant. Excess fat is considered a detriment to physical fitness and work performance, which is also affected by a number of other variables such as age, sex, training, attitude, motivation, genetic and environmental factors [10].

Definition and measurement

Obesity is a condition in which there is an excessive accumulation of body fat [2]. The height-weight tables suggested by body composition working group have been extensively adopted as a first line screening technique for obesity [3] and the same has been adopted-by the

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Indian Armed Forces. Although of great importance to the Armed Forces, yet the assessment of obesity is based on the weight recording for height, age and sex [4]. Obesity is defined as, weight 20% greater than the desirable weight for that particular person [5].

This method is inaccurate as a muscular individual may be labelled obese while a lean person with normal weight range may escape detection although he may have an abnormal fat content. There is a need for the Armed Forces to use a more accurate method of body fat assessment.

Several methods have been used to assess body composition. Most methods of measuring the fat content in the living subject are, to a lesser or greater degree, indirect [2]. The three classical methods used in the lab are the measurements of whole body density, whole body water, and whole body potassium [6, 7]. Though more accurate these methods are time consuming and not feasible for routine body fat assessment.

Several workers have developed height-weight indices, also called indices of relative weight or 'indices of adiposity'. These are easily calculated requiring nothing more than the height (H), weight (W) and Age (A). A commonly used index is the **Body Mass Index (BMI)** / Quetlet's index which is = weight (kg) / height (m)². The acceptable (normal) range is 20 to 25; A BMI of greater than 27 is overweight while obesity is taken to start at a BMI of 30 [5], and a BMI of 40 and above indicates gross / morbid obesity [2]. The standards are the same for men and women [2].

However the H-W indices measure 'overweight' rather than obesity. Since the H-W indices cannot distinguish between excess fat, excess muscle mass (e.g. in weight lifters), fluid retention (oedema), large bones etc., these drawbacks lead to a high degree of inaccuracy.

Skin fold thickness method of body fat measurement

Since most adipose tissue is in the subcutaneous layer, the percent body fat has been traditionally estimated by measuring skin folds at midtriceps, biceps, subscapular and suprailiac regions, using a constant force callipers. The method was standardised by Durnin and Womersley [8]. Body fat is indirectly assessed from body density. The percent body fat is calculated by the equation : % BF = [(4.95 / body density) - 4.5] * 100. Though more accurate than the, H-W measures, the main drawback of the skin fold measurements is their poor repeatability [6] in the absence of a skilled observer. Moreover, measurements may be difficult or impossible in very obese people whose skin folds would not fit between the jaws of the measuring calliper [6, 7].

Circumference methods of body fat measurement.

In circumference methods, estimates of percent body fat are made with equations based on circumference measures typically involving areas prone to excess fat accumulation such as the upper and lower arm, waist, hip and thigh. The equations were first developed by Wright, Davis and Doston in 1981 [9] and include two body circumferences for males viz. **Neck circumference (NC)**, measured around the neck with the measuring tape passing just below the larynx; **Abdomen circumference (AC)**, measured around the abdomen at the level of the umbilicus. For females, 3

circumferences are included in addition viz., Bicep circumference (BC), measured at the largest circumference of the arm with the arm extended and palm facing up; Forearm circumference (FC), measured at the largest circumference of the forearm and; Thigh circumference (TC), measured on the left thigh just below the buttock. All circumferences are measured in centimeters.

In 1984, Hodgdon and Beckett derived equations for estimation of percent body fat in the males, using the same circumference measures and height (in cms) of the individual [9]. The equations are :

Percent body fat (men) =

$$(0.740 * AC) - (1.249 * NC) + 0.528$$

Percent body fat (females) =

$$(1.051 * BC) - (1.522 * FC) - (0.89 * NC) +$$

$$(0.326 * AC) + (0.597 * TC) + 0.707$$

The circumference measures and height is used to estimate body density by the following equation :
Body density (men) =

$$(- 0.1.9077 * \log_{10} (AC-NC) +$$

$$(0.15456 * \log_{10} [Ht]) + 1.0324$$

Percent body fat is then estimated from the body density by the same equation as used in the skin fold method of body fat measurement.

The estimate used by Hodgdon and Beckett is currently used by U.S. Navy, since October 1986 [9] for the initial screening for obesity during the initial medical examination of its personnel. Conway et al (1989), found that the estimates of percent body fat were more strongly related with physical fitness than were the H-W indices [9], and thus concluded that circumference methods of body fat estimation

assess actual body fat more reliably than the H-W indices.

Material and Methods

Height and weight of subjects were taken using standard scales. Body mass index (BMI) was computed using Quetlet's index. Percent body fat was assessed by two different methods (Photographs attached as appendices I and II). In skin fold method as standardised by Durnin and Womersley [8], the biceps, triceps, subscapular and supriliac skin folds were measured in mm by a skin fold callipers, (0-50 mm, 0.1 mm accuracy; supplied by Caliber Technology, Bangalore) all readings taken on the left side. The site for the first two skin folds were mid-biceps and mid-triceps and the readings were taken longitudinal to the arm, whereas the other two folds were measured obliquely along the crease lines, as suggested by Brozek in 1956. The soft tissue and skin was pinched firmly and lifted between index finger and thumb of the left hand and both the digits were made to slide over each other till the muscle slipped out and only skin and subcutaneous tissue remained in the 'pinch'. Then the callipers was applied 1 cm away from the digits. Three readings were taken at each site, and the mean reading for each site was used in regression equation of Durnin and Womersley for calculation of body density and from it the fat percentage.

In the circumference method [9], the neck circumference (measured just below the larynx) and the abdomen circumference (measured at the level of umbilicus) were measured in cm using a simple measuring tape. The body density was calculated with the help of the equation used by Hodgdon

and Beckett [9] which in turn was used to compute percent body fat.

Results

Body fat estimated by BMI, Skin fold, Circumference method showed a highly significant correlation with each other.

Table 1 : Correlation coefficients amongst measures of body composition (n = 56)

	% BF (SF)	% BF (Circ.)
BMI (kg/m ²)	0.784***	0.785***
% BF (SF)	—	0.090***

Correlation coefficient = 0.909***

Discussion

In this study, body fat was estimated by the skin fold method as well as circumference method. The mean percent body fat estimated by the skin fold method was 13.8%. Though percent body fat has been traditionally estimated by a standardised skin fold method [9], circumference method was used in this study in order to standardise this simple technique and compare it with the skin fold method in an attempt to develop it as a suitable field test for percent body fat assessment as the only equipment needed is a simple measuring tape. Percent body fat estimated by this method showed a significantly, high correlation of 0.909 with that estimated by skin fold method. The mean and SD of the percent body fat assessed by the skin fold method was 13.8 ± 4.45 while that circumference method was 13 ± 4.33 among the 56 males used

in this study as is depicted in table 3). Skin fold method of body fat estimation may not be feasible in large scale field studies [3] whereas on account of its simplicity and accuracy, the circumference method can serve as a useful tool in assessing percent body fat content in the field and peripheral

hospitals and is recommended to be used for first line screening of obesity in recruitment and medical evaluation of the Armed Forces Personnel in case height-weight measures suggest any abnormal weight. This method has been successfully employed by the U.S. Navy since 1986 for recruitment of personnel [9].

Conclusion and Recommendation

The skin fold method is time consuming and is not feasible for large scale field studies [3] whereas the circumference method, and BMI as used in this study, could serve as convenient alternatives as both appear to be accurate and simple methods of body fat assessment. However body fat measurement by circumference method is not only simple and needs no equipment other than a measuring tape, but would also appear more objective and convincing to the patient as well. It is therefore suggested that the circumference method of body fat assessment may be adopted in the Armed Forces instead of the relatively inaccurate H-W measures used presently. The author is carrying out body fat assessment on female patients too and the results would be published as and when these are ready.

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