A Trial of the Ponderax Skinfold Caliper*

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SUMMARY

Skinfold measurements on young men and on young women, with a simple caliper (Ponderax Mark II), available free to medical practitioners, and with a widely used research caliper (Harpenden), showed good agreement, but at skinfold measurements above 20 mm, it was found desirable to add 5% to the Ponderax reading. When total body fat was predicted from two selected skinfold measurements in young men and from two others in young women, the Ponderax caliper gave lower figures than the Harpenden, but the difference, even in the moderately obese, was considerably less than the error inherent in the prediction. The Ponderax caliper is recommended for clinical use.

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Skinfold measurements are related to total body fat and are a useful indication of degrees of obesity. Research quality calipers for measurement of skinfold thickness have been available for some years, and, more recently, a simple caliper has been produced by the manufacturers of fenfluramine (Ponderax) for free distribution to medical practitioners. The present investigation reports a comparison of skinfold measurements and of predictions of total body fat, with a research quality instrument and with the new caliper.

SUBJECTS AND METHODS

The calipers compared in this investigation are the Harpenden (Fig. 1), described by Tanner and Whitehouse,[1]

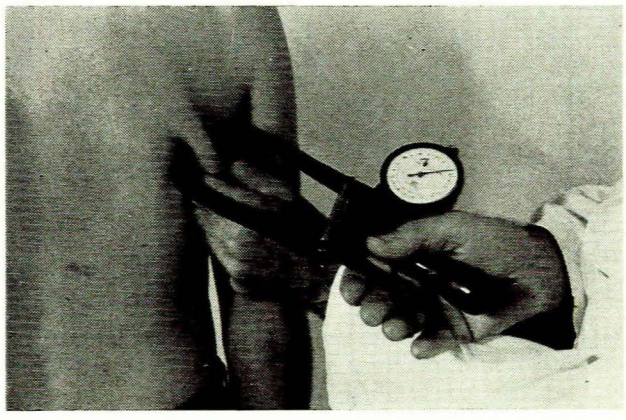

Fig. 1. Harpenden skinfold caliper.

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and since used by many research workers, and the Ponderax Mark II (Fig. 2). Both calipers are spring-loaded

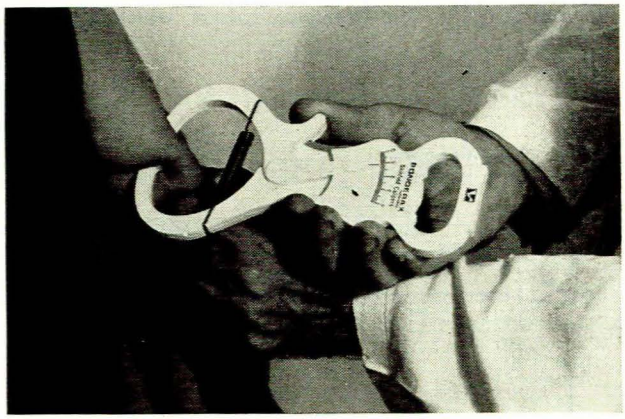

Fig. 2. Ponderax Mark II skinfold caliper.

and designed to exert a nominal pressure of 10 g/mm² at any degree of separation of the jaws. The actual closing pressures within the range 0 - 35 mm were measured on a Harpenden caliper, on a Ponderax caliper which had been in use for some time, and on two new Ponderax calipers.

The triceps skinfold was measured on 73 young men and on 31 young women aged 18 - 25 years, with the Harpenden and with a much-used Ponderax caliper. This is a vertical skinfold in the midline of the back of the arm, halfway between acromion and olecranon processes, with the arm hanging freely. Skin and subcutaneous tissue are picked up betwen finger and thumb and the caliper is applied 1 cm away from the finger and thumb, beyond the convexity of the skinfold. Sixteen further pairs of readings were taken in the subscapular and supra-iliac regions of 8 female subjects, to obtain additional comparisons of the two calipers in the higher range of measurements (above 20 mm), making a total of 120 comparisons in all.

Since nomograms are available for prediction of total body fat from skinfold measurements at two selected sites in young men and in young women,[2] a further series of 50 young men and 50 young women was investigated, to compare the predicted body fat from measurements with the two types of caliper. In young men the sites of choice for the skinfold measurements are thigh and scapula, the thigh skinfold being vertical in the midline of the thigh, halfway between inguinal ligament and top of patella with the leg extended, and the scapular being in a line running downwards and

laterally, at an angle of about 30° to vertical from the inferior angle of the scapula.[3] In young women the sites of choice are triceps and supra-iliac, the latter being a vertical fold in the midaxillary line just above the iliac crest.[4] By convention all the measurements are made on the right side of the body.

RESULTS

The pressure exerted by the Harpenden caliper was within the range 9 - 11 g/mm² for widths of separation from zero to 35 mm (Fig. 3). The Ponderax caliper which had been

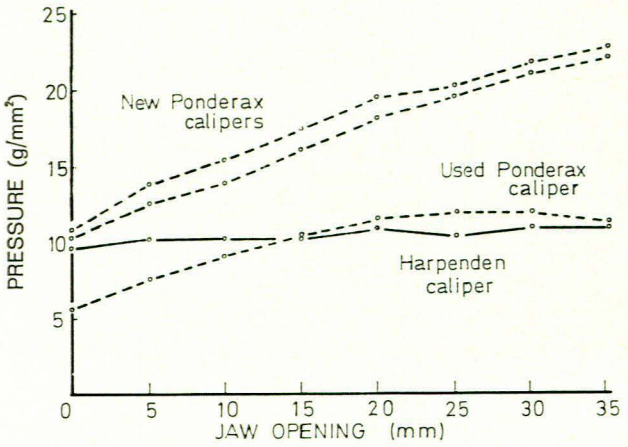

Fig. 3. Pressures exerted by Harpenden and by Ponderax calipers.

in use for some time showed reasonable agreement with the Harpenden at jaw openings of 10 mm and above, but the pressure dropped steeply at smaller openings. Two new Ponderax calipers had higher pressures throughout the range of opening than either the Harpenden or the 'used' Ponderax caliper.

Fig. 4 shows the correlation between 120 pairs of skinfold measurements of young healthy adults, one of the pair being made with the Harpenden caliper and the other, at the same site, with the Ponderax. In the range 5 - 19 mm the correlation coefficient (r) was 0,95 and the mean reading by the Ponderax caliper was 3,6% lower than by the Harpenden. However, since the standard error of the estimation was 7,8%, within the limits of accuracy of the method, it is reasonable to assume a 1 : 1 relationship between the two calipers in this range. Above a skinfold measurement of 20 mm, the slope of the regression line is defined by the function:

$$H_R = (P_R \times 1{,}168) - 2{,}533$$

where H_R is the reading on the Harpenden caliper, and P_R is the reading on the Ponderax. The correlation coefficient is lower than for smaller skinfolds (r = 0,89) but, for practical purposes the Ponderax reading + 5% gives a sufficiently close approximation to this line and then falls well within the standard error of estimation in this range.

When the total body fat is calculated from the appropriate pair of skinfold measurements for men and for

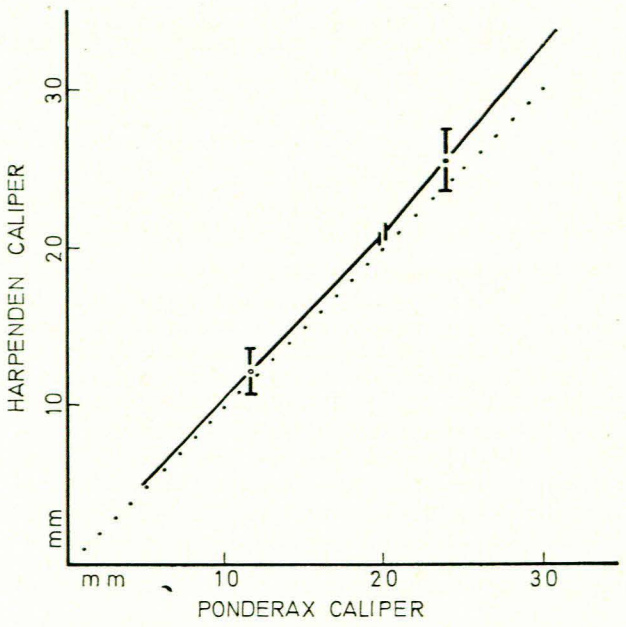

Fig. 4. Comparison of 120 skinfold measurements by Ponderax and by Harpenden calipers. Mean ± SE is indicated in each range. Dotted line represents 1 : 1 relationship.

women, the two instruments gave closely corresponding results in the middle of the range about the mean for each sex (Fig. 5), but the slopes of the regression lines

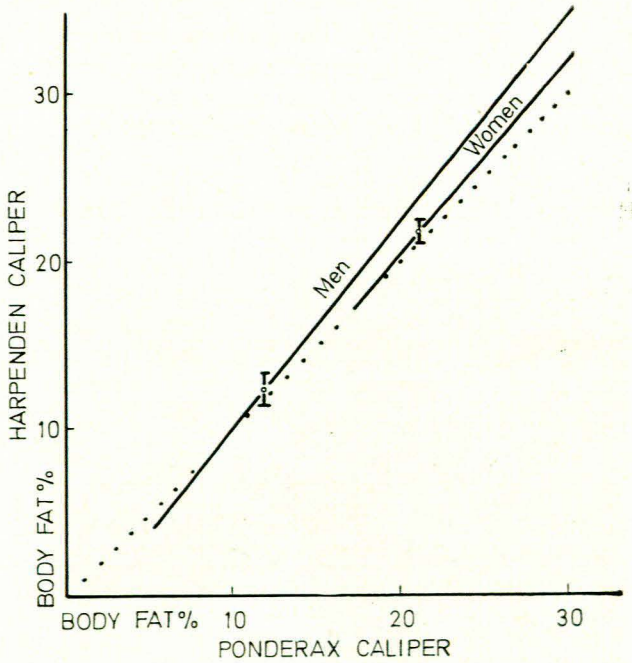

Fig. 5. Comparison of predicted total body fat (expressed as per cent of body weight) by Ponderax and by Harpenden calipers. Mean ± SE is indicated for each sex. Dotted line represents 1 : 1 relationship.

are such that large differences can be expected in obese subjects (about 17% of the Ponderax reading for men, and about 10% for women at a total body fat of 30%).

DISCUSSION

Since obesity is a very common and very dangerous condition[5,6] it is important to be able to measure it. Body weight is not a reliable index of obesity (bone and muscle are heavier than fat), although changes in body weight over a period of weeks or months are usually due to gain or loss of fat.[7] The most accurate method at present available for determination of total fat in the living human body is the measurement of body density, from which the percentage by weight of fat in the body may be calculated.[8] Body density is determined by weighing the subject in air and completely submerged in water at known temperature, allowing for the residual air in the lungs and air passages during the underwater weighing;[9] since this requires laboratory facilities and is not suitable for every patient, simpler methods, including measurements of skinfold thickness, have been developed. Human skin is of fairly uniform thickness except on the face, palms of hands, soles of feet and at the extremes of age, so the different thicknesses of skinfold at different sites and in different inviduals are due to differences in thickness of the layer of subcutaneous adipose tissue, which are related to differences in total body fat.[10,11]

Ideally the caliper used for the measurements should be spring-loaded and exert a constant pressure, whatever the thickness of the skinfold. Keys and Brozek[12] found that differences in pressure within the range 10 - 90 g/mm^2 have only a small effect on skinfold measurements and Sloan and Shapiro[13] found a negligible difference in the range 10 - 28,5 g/mm^2. Consequently the observed pressure difference between the calipers compared in this investigation should have no significant effect on the readings.

The degree of obesity of an individual may be expressed in terms of the thickness of a single skinfold, which has a high correlation with body density, such as that over the triceps.[14,15] Seltzer and Mayer[16] took as their criterion of obesity a triceps skinfold in excess of one standard deviation above the mean for the age and sex. In the present investigation, there was reasonable agreement between the triceps measurements with the two calipers, up to a skinfold measurement of about 20 mm, but above this the Ponderax caliper gave lower readings; for practical purposes the addition of 5% to the Ponderax reading in this range gives good agreement with the Harpenden.

The total of several skinfold measurements at selected sites is a more accurate index of obesity than a single measurement.[17,18] Alternatively, total body fat may be predicted by formulae based on the correlation of selected skinfolds with body density,[19,20] or from nomograms based on such formulae.[2] Predictions of total body fat from measurements of the two selected skinfolds in young men[3] and in young women[4] showed fair agreement between the two calipers. Even for the wider skinfolds, where the Ponderax caliper gave lower readings, the difference was considerably less than the error of the prediction, which is ± 4% body weight.[21]

The Ponderax caliper can be recommended for the clinical estimation of obesity. It can assist the medical practitioner in the diagnosis of this prevalent and dangerous condition and in following his patient's response to treatment.

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