LETTERS TO THE EDITOR

Ultrasonographic assessment of adipose tissue volume

EDITOR,—The validity of an ultrasound method for measurement of lean and adipose tissue volumes in the upper and lower limbs as a potential method of predicting body composition was described in 1994 by Eston *et al.*¹ In trying to replicate this study we reached the opinion that their method was flawed. It was based upon ultrasound measurements of segmental radii acquired using real-time ultrasound scanning. Proportionate volumes of adipose tissue were then calculated by the application of the geometry of a cone.² This method describes the calculation of proximal and distal cross sectional areas of the inner and outer cones, which requires a measurement of the radius of the bones (humerus and femur). The image presented in the paper by Eston *et al* showed measurements of the femoral bone cortex to skin surface and bone cortex to muscle boundary and failed to take into account the measurement of the bone radii. As the bone radii were omitted from the method we feel that it was not appropriate to use the measurements they obtained to calculate cross sectional area. If this were the case, it has to be assumed that no bone volumes were included in the calculation of segmental volumes and, therefore, all subsequent calculations of segmental and adipose tissue volume are incorrect. The consideration of the nature by which ultrasound is attenuated at a muscle-bone boundary throws further doubt on the method described. At such a boundary there is a large difference in the acoustic impedance between muscle and bone, consequently there is a strong reflection, which renders imaging deep to the bone surface impossible.³ A single frame real-time ultrasound image will therefore only show the anterior bone surface and does not permit the estimation of the bone radius as required for the calculation described.

VICKI J MOSCRIP
JULIE M WALTON

Lecturers
Department of Medical Imaging

- 1 Eston RG, Evans R, Fu F. Estimation of body composition in Chinese and British men by ultrasonographic assessment of segmental adipose tissue volume. *Br J Sports Med* 1994;28:9-13.
- 2 Jones PRM, Pearson J. Anthropometric determination of leg fat and muscle plus bone volumes in young male and female adults. *J Physiol* 1969;204:63-6.
- 3 McDicken WN. Controls of equipment in pulsed echo imaging. *Diagnostic ultrasonics, principles and use of instruments*. Edinburgh: Churchill Livingstone, 1991.

Authors' reply

Thank you for allowing us the opportunity to reply to the letter from Moscrip and Walton, regarding the paper by Eston, Evans, and Fu on "Estimation of body composition in Chinese and British men by ultrasonographic assessment of segmental adipose tissue vol-

Figure 1 A transverse ultrasound image of the thigh showing the rectus femoris (REC F) and the vastus intermedius (VAS I) muscles. Caliper measurement of the diameter of the distal femur (femoral cortex shows up as a white line) is shown (diameter 3.5 cm).

Figure 2 Method of calculating the cross sectional area of the adipose tissue.

ume".¹ Although we welcome their criticism, their assertion that our method is flawed is misguided.

As part of the study we set out to evaluate the validity of applying the geometry of a cone to both the upper and the lower limbs in order to estimate the lean and fat proportions as a method for predicting body composition. Figures 1 and 2 demonstrate this method.

Ultrasound allows the above measurements to be taken at two representative cross sectional areas. In our study we used two arbitrary points which were 20 cm apart at the thigh and 10 cm apart in the upper arm. We regarded the distal femur and humerus as circular in shape, which is clearly not the case anatomically. We also made the assumption that the segments could be represented mathematically as cones with even surfaces, as suggested by Jones and Pearson.² The methods used allowed us to calculate the respective cross sectional areas and hence the segmental adipose tissue and volumes and proportions of adipose tissue.

While we accept that Moscrip and Walton are correct in their statement that true bone

radii cannot be measured with ultrasound, a bone diameter can be easily measured. Hence a representative bone radius is easily calculated. Unfortunately, our method for estimating the radius of bone was not fully explained in our paper. Clearly this has caused confusion. As can be seen from fig 1, which is an ultrasound image on one of the subjects from the study (the same subject as shown in fig 3 in our original paper), calipers can be used to measure the bone diameter. Half of the diameter was taken as the radius, as shown in fig 2. In retrospect, perhaps we should have used an additional image in our original paper to show how we calculated bone radii.

It is clear from published reports to date, that the methods we used were innovative and offered a different approach to the estimation of percentage fat by ultrasound technology. However, in recognition of the possible limitations of the methodology, we also presented results from an alternative method that required direct measurement of the circumference at each segmental site by surface anthropometry. The adipose tissue thickness, as measured by the ultrasound, was then sub-