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THE REPEATABILITY OF ULTRASONIC FAT-DEPTH MEASUREMENTS MADE ON SHEEP UP TO 18 MONTHS OF AGE

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SUMMARY

Measurements of fat depth of *M. longissimus* at the 12th rib were made with an ultrasonic instrument on groups of live Southdown and Romney ewes and rams ranging from approximately 7 to 18 months of age. Weight-corrected fat measurements, calculated from double-log regression equations, were expressed as percentage deviation values.

In some groups a period of negative growth during late winter was followed by lower levels of fatness for the same weight. The repeatability of fat-depth deviations (in terms of intra-class correlations) ranged from 0.56 to 0.72 for the six groups. Corresponding measures for body-length deviations and withers-height deviations were in most cases less repeatable. Interrelationships between weight-corrected measures of fatness, length and height were inconsistent and generally not close.

INTRODUCTION

The usefulness of ultrasonic methods for measuring fatness of live sheep is dependent on their repeatability in several contexts. These include, firstly, the repeatability of measurements on the same sheep over time; secondly, the repeatability of measurements between different operators; thirdly, the relationship between live animal and carcass measurements; and finally, the repeatability over generations or heritability of the measurement. Available evidence indicates that the ultrasonic instrument described by Gooden *et al.* (1980) provides results which relate satisfactorily with comparable carcass measurements. The present paper outlines the extent to which ultrasonic measurements of fat depth were repeatable over periods of several months for groups of Southdown and Romney lambs and young sheep. Such information is required to ascertain whether measurements made at one age are likely to provide useful information on differences in fatness at a later age.

MATERIALS AND METHODS

The six groups of sheep described in Table 1 were run on pasture at the Massey University No. 1 sheep farm under commercial conditions.

TABLE 1: GENERAL DESCRIPTIONS OF THE SIX GROUPS OF SHEEP

| Group number | Breed | Sex | Year of birth | Number of animals | Number of measurements | Age range (months) |
|--------------|-----------|-----|---------------|-------------------|------------------------|--------------------|
| 1 | Romney | F | 1978 | 20 | 6 | 7-18 |
| 2 | Southdown | F | " | 20 | 6 | 7-18 |
| 3 | Romney | M | " | 30 | 4 | 8-15 |
| 4 | Romney | F | 1979 | 35 | 6 | 7-15 |
| 5 | Southdown | F | " | 43 | 6 | 7-15 |
| 6 | Southdown | M | " | 40 | 6 | 7-15 |

Ultrasonic measurements were made using an instrument similar to the AIDD (3) described by Gooden *et al.* (1980). The target site was between the last and second-to-last rib and at a distance off the midline which increased with liveweight in the following way: <35 kg-35 mm, 35 to 45 kg-40 mm, 45 to 55 kg - 45 mm, >55 kg - 50 mm.

Withers height was measured over the forelegs and body length was measured as the distance from the brisket (cranial end of the sternum) to the pin bones (*tuber ischii*).

Weight-corrected values of fat depth, withers height and body length were obtained from deviations of individual animals from log/log regression lines and were expressed as either positive or negative percentage deviations.

The log/log regression equations were calculated within breed and within time of measurements. Repeatability was assessed as intra-class correlations (Snedecor, 1956) and standard errors of intra-class correlations were calculated using the formula of Falconer (1960).

RESULTS AND DISCUSSION

Changes in measurements made on the sheep with increasing age are shown for the first four groups in Table 2 and for the other two groups in Figs. 1 and 2. The pattern of changes shown is similar for these latter groups with a period of negative liveweight growth in the late winter and spring period. The average weight losses were small when the effect of shearing was taken into account (average fleece weights were 2.1 and 1.8 kg respectively, for the Southdown rams and ewes) but were accompanied by big decreases in fat-depth. As expected, body length and withers height as measures of skeletal size, did not decrease in most instances. It is of interest that for both groups (Figs. 1 and 2) the fat depths, for example, at about

320 days post-weaning were considerably lower than those at about day 220 when the liveweights were slightly less. Similar patterns of fat depth and liveweight changes were shown in some other groups (Table 2), but a full discussion of the implications of these effects is outside the scope of this paper.

TABLE 2: CHANGES IN LIVELWEIGHT, FAT DEPTH, LENGTH AND HEIGHT FOR FOUR OF THE GROUPS OF SHEEP DESCRIBED IN TABLE 1 AS THEY INCREASED IN AGE (MEANS AND S.E.)

| Group number | Age (days from weaning) | Liveweight (kg) | | Fat depth (mm) | | Body length (cm) | | Withers height (cm) | |
|--------------|-------------------------|-----------------|------|----------------|------|------------------|------|---------------------|------|
| | | \bar{x} | S.E. | \bar{x} | S.E. | \bar{x} | S.E. | \bar{x} | S.E. |
| 1 | 119 | 28.9 | 0.8 | 1.70 | 0.19 | 62.6 | 0.6 | 53.4 | 0.5 |
| | 158 | 35.2 | 0.8 | 2.46 | 0.25 | 62.9 | 0.5 | 52.9 | 0.7 |
| | 257 | 42.4 | 0.8 | 3.03 | 0.26 | 67.4 | 0.6 | 55.1 | 0.7 |
| | 340 | 43.4 | 0.9 | 2.87 | 0.29 | 68.7 | 0.6 | 55.5 | 0.9 |
| | 390 | 44.7 | 0.9 | 3.46 | 0.44 | 69.8 | 0.6 | 55.9 | 0.7 |
| | 446 | 45.4 | 1.0 | 4.85 | 0.55 | 70.1 | 0.6 | 55.6 | 0.8 |
| 2 | 119 | 29.5 | 0.7 | 2.55 | 0.28 | 62.9 | 0.6 | 48.8 | 0.4 |
| | 158 | 33.5 | 0.8 | 2.98 | 0.30 | 63.1 | 0.6 | 49.6 | 0.4 |
| | 257 | 39.1 | 0.7 | 4.65 | 0.28 | 67.6 | 0.6 | 51.0 | 0.5 |
| | 340 | 43.6 | 0.7 | 4.14 | 0.23 | 68.8 | 0.6 | 51.3 | 0.4 |
| | 390 | 44.1 | 0.8 | 4.63 | 0.35 | 69.2 | 0.6 | 51.9 | 0.5 |
| | 446 | 46.2 | 0.7 | 5.93 | 0.40 | 69.5 | 0.5 | 52.4 | 0.6 |
| 3 | 158 | 39.9 | 0.7 | 2.05 | 0.16 | 66.6 | 0.4 | 56.1 | 0.5 |
| | 257 | 55.5 | 0.7 | 2.87 | 0.18 | 74.4 | 0.5 | 58.9 | 0.5 |
| | 340 | 59.2 | 1.0 | 2.82 | 0.15 | 76.1 | 0.4 | 61.6 | 0.4 |
| | 390 | 63.4 | 0.9 | 5.10 | 0.35 | — | — | — | — |
| 4 | 141 | 36.9 | 0.5 | 3.19 | 0.16 | 65.1 | 0.4 | 52.5 | 0.4 |
| | 189 | 41.2 | 0.6 | 3.73 | 0.23 | 66.0 | 0.4 | 53.9 | 0.3 |
| | 223 | 46.1 | 0.5 | 5.12 | 0.25 | 67.9 | 0.4 | 54.2 | 0.4 |
| | 258 | 42.5 | 0.5 | 4.34 | 0.25 | 67.3 | 0.4 | 54.7 | 0.3 |
| | 303 | 39.7 | 0.6 | 2.49 | 0.16 | 67.3 | 0.4 | 56.0 | 0.4 |
| | 369 | 51.4 | 0.7 | 3.97 | 0.23 | 73.7 | 0.4 | 57.7 | 0.4 |

Repeatability values for weight-corrected values of fat depth, body length and withers height ranged from 0.32 to 0.72 for the six groups (Table 3). All weight-corrected values were expressed as

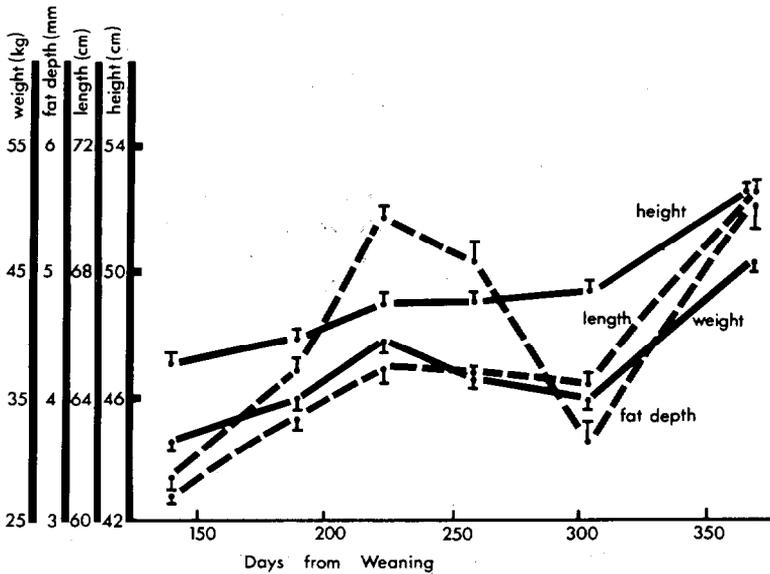


FIG 1: Changes in liveweight, fat depth, body length and withers height with increasing time after weaning for Group 6. (40 Southdown Rams); means with S.E. bars.

percentage deviations and for all but one group the best repeatability was for fat-depth percentage deviation. Withers-height percentage deviation was more repeatable than the comparable length measurement in all but one group. Standard errors of the intra-class correlations in Table 3 ranged from 0.06 to 0.12.

Correlations between adjacent fat-depth deviations in a series varied considerably (Fig. 3), but were generally higher than the intra-class correlations (Table 3), and also higher than correlations between the first and last values (Fig. 3). For some groups, correlations between adjacent measures at the end of a series were higher (Fig. 3), but this was not a consistent pattern.

From these results it appears that weight-corrected measures of fat depth in terms of percentage deviation values are moderately repeatable, so that sheep which are fat for their weight at 7 to 8 months of age are likely to retain this characteristic up to at least 15 to 18 months. This is less likely to be the case for withers height or body length, probably because these characteristics vary less within groups of sheep (Figs. 1 and 2).

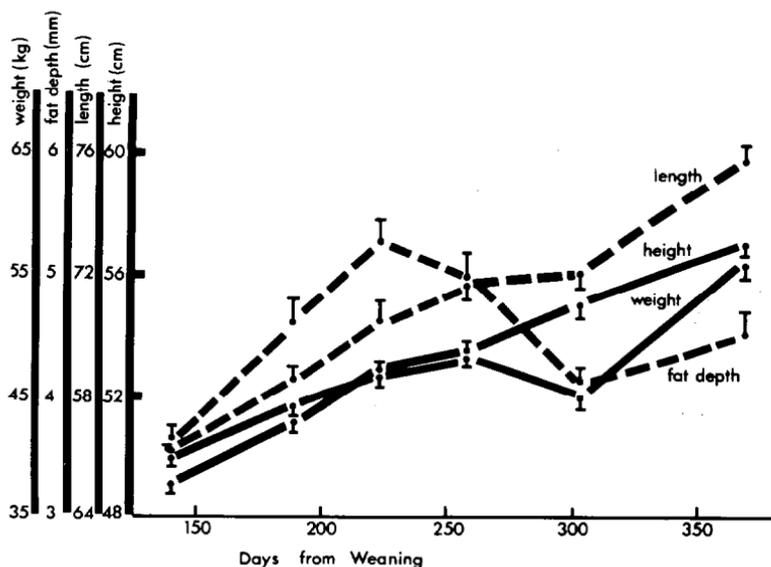


FIG 2: As for Fig. 1, but for Group 5. (43 Southdown ewes).

TABLE 3: INTRA-CLASS CORRELATIONS AS MEASURES OF THE REPEATABILITY OF WEIGHT-CORRECTED VALUES OF FATNESS, LENGTH AND HEIGHT FOR THE SIX GROUPS OF SHEEP DESCRIBED IN TABLE 1

| Group number | Intra-class correlation for weight-corrected: | | |
|--------------|---|-------------|----------------|
| | Fat depth | Body length | Withers height |
| 1 | 0.72 | 0.53 | 0.66 |
| 2 | 0.58 | 0.32 | 0.47 |
| 3 | 0.56 | 0.35 | 0.66 |
| 4 | 0.70 | 0.45 | 0.63 |
| 5 | 0.64 | 0.54 | 0.46 |
| 6 | 0.58 | 0.39 | 0.45 |

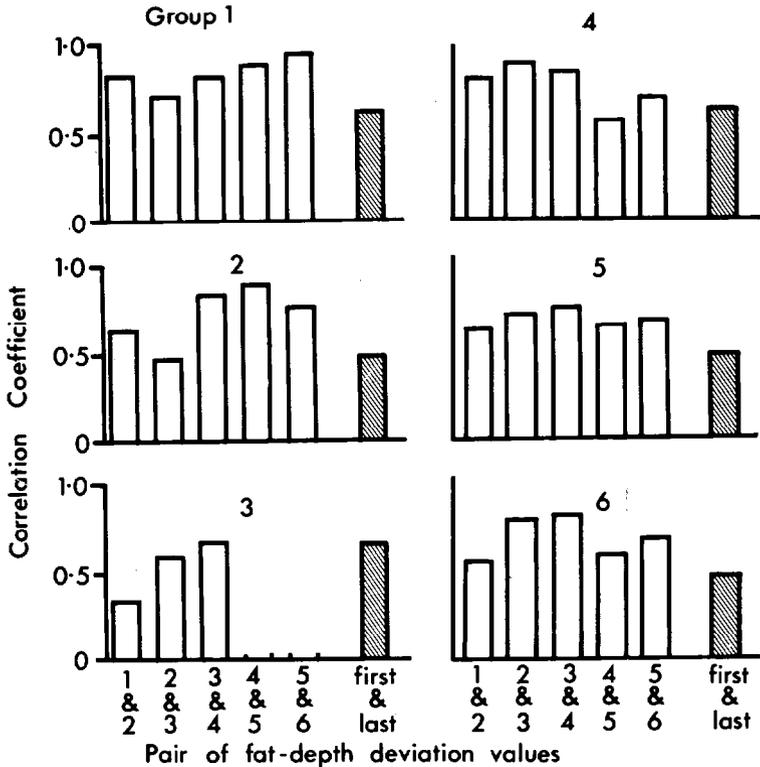


FIG 3: Correlation coefficients between measures of fat depths taken at adjacent ages within each group of sheep (see Table 1), and between the first and last measurement for each group.

Interrelations between fatness, length and height after the effect of liveweight on each of these characteristics had been removed, were not close (Table 4). In most groups there was a tendency for animals which were fat for their weight to also be short and low for their weight, and for those which were short to also be low for their weight. However, the correlations in Table 4 are too small and inconsistent to suggest that useful assessments of fatness can be obtained from measures of length and height.

TABLE 4: INTER-RELATIONSHIPS BETWEEN WEIGHT-CORRECTED VALUES OF FAT DEPTH, BODY LENGTH AND WITHERS HEIGHT FOR THE SIX GROUPS DESCRIBED IN TABLE 1 (VALUES FROM THE LAST MEASUREMENT OF EACH GROUP)

| Group number | Correlation coefficients for relationships between weight-corrected values of: | | |
|--------------|--|----------------------|-------------------|
| | Fat depth and length | Fat depth and height | Length and height |
| 1 | -0.43 | -0.49 | 0.68 |
| 2 | -0.55 | -0.39 | 0.28 |
| 3 | 0.21 | -0.16 | 0.29 |
| 4 | -0.02 | 0.14 | 0.42 |
| 5 | -0.30 | -0.03 | 0.08 |
| 6 | -0.36 | -0.18 | 0.36 |

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