

Neonatal skinfold thickness

Measurement and interpretation at or near term

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SUMMARY Skinfold thickness was measured at five sites in 750 infants. The study population was unselected except that twin pregnancies and the infants of diabetic mothers were excluded, and very preterm infants were under represented. A pilot study had indicated that skinfold measurement was most reproducible at the thigh site. Thigh skinfold correlated better with the sum of other skinfolds than did skinfold measurement at any other site and closely resembled the summed skinfold in correlations with a number of maternal and fetal variables. Median skinfold increased with birthweight and was greater in girls than in boys. 'Corrected skinfold', a mathematical approach to comparing skinfolds in infants of differing sex and birthweight, is suggested as an alternative to absolute skinfold measurement.

Skinfold thickness measurements are widely used in the assessment of nutritional status. In the neonate they reflect obesity in the infant of the diabetic mother.¹

Methods

Two studies are reported here, the first a pilot study to assess the repeatability of skinfold measurements at various sites and the second a more extensive study of 750 infants of mothers whose glucose tolerance had been assessed during pregnancy in the course of another investigation (to be reported elsewhere). In both studies, skinfolds on the left side of the body were measured by the author using the Holtain skinfold calliper (Holtain UK). The fully stabilised reading² was taken at the sites listed in Table 1.

In the first study, repeat skinfolds were made at each of the five sites, only one pair of measurements at one site being made on any infant. The study population comprised infants in the special care baby unit; none was acutely ill, and they varied in

sex, gestational age, postnatal age, and build. Paired measurements were made several hours apart to ensure that the first measurement had been forgotten and could not influence the second recording.

The second study involved 750 infants, unselected except that twins and the infants of diabetic mothers were excluded. Birthweight was measured unclad within the first two hours of life. The five skinfolds described above were measured between 12 and 48 hours of age. Gestation was calculated from the date of the mother's last menstrual period, supplemented by ultrasound data where appropriate. Due to the design of the original study, few of the infants were of less than 34 weeks' gestation and none was less than 30 weeks. Birthweight was standardised for maternal height and midpregnancy weight,³ and was corrected for sex, gestation, and parity using the equations of Altman and Coles.⁴ The resulting index ('corrected birthweight') is expressed in standard deviations from the mean. Maternal midpregnancy weight was extrapolated from antenatal clinic records.

The second study was analysed by computer

Table 1 *Sites of skinfold measurements*

<i>Thigh</i>	Midway between the upper pole of patella and the anterior superior iliac spine, in the long axis of the femur; hip and knee flexed at right angles.
<i>Triceps</i>	Midway between the olecranon process and the acromion process, in the long axis of the humerus; elbow slightly flexed.
<i>Biceps</i>	Midpoint of the humerus anteriorly, in the long axis of the arm; elbow slightly flexed.
<i>Suprailiac</i>	Immediately above the iliac crest, along the axis of the anterior axillary line.
<i>Subscapular</i>	At the lower angle of the scapula, in the axis of the skin crease.

package.^{5 6} Correlations are quoted as Pearson coefficients throughout, and for the purposes of these correlations, sex was coded as boy=1 and girl=2.

Results

The results of the first study are summarised in Table 2. No significant trend was found between initial and repeat readings at any site. When coefficients of variation were examined, the difference between repeat readings was lowest for thigh skinfold.

In the second study, skinfolds measured at different sites were correlated. The resulting coefficients varied between 0.821 (thigh with triceps) and 0.615 (suprailiac with biceps). Limb skinfolds as a group did not seem to vary independently of trunk skinfolds. In Table 3, the skinfold at each site is correlated with the sum of values at all other sites. Thigh skinfold correlated more strongly than any other with sex ($r=0.132$; $P<0.001$), gestation ($r=0.269$; $P<0.001$), birthweight ($r=0.644$; $P<0.001$), and maternal midpregnancy weight ($r=0.216$; $P<0.001$). All skinfolds correlated significantly with parity ($r=0.085$ to 0.118). None correlated significantly with social class, and measurements at biceps and triceps sites did not correlate significantly with sex. When the sum of all skinfolds was correlated with the same variables, the coefficients closely resembled those obtained using thigh skinfold.

The correlations of thigh skinfold with sex, gestation, and birthweight are shown graphically in Figs. 1 and 2. The partial correlation between thigh skinfold and gestation correcting for sex and birthweight was negative ($r=-0.129$; $P<0.001$), indicating that skinfold thickness falls slightly but significantly in relation to birthweight with advancing gestation.

The relation between thigh skinfold and birthweight is virtually linear, with median skinfold being almost exactly 0.5 mm greater in girls than boys in all but the lowest birthweight groups (Fig. 2). Thigh skinfold can therefore be standardised for sex and birthweight by subtracting 0.5 mm from the measurement in girls, then dividing by birthweight. The resulting index, 'corrected skinfold', correlates

Table 3 Skinfolds at various sites correlated with the sum of the other skinfolds

Site	Thigh	Triceps	Biceps	Suprailiac	Subscapular
Sum of other skinfolds	0.851	0.845	0.701	0.799	0.812

(All correlations significant $P<0.001$).

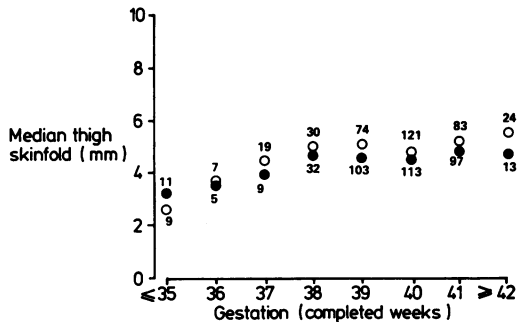


Fig. 1 Relation between median thigh skinfold thickness and gestation in boys (●) and girls (○).

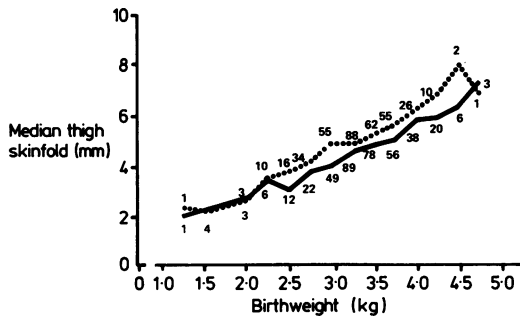


Fig. 2 Relation between median thigh skinfold thickness and birthweight in boys (—) and girls (.....).

slightly with birthweight ($r=0.12$; $P<0.01$) but does not correlate significantly with either sex or gestation. A similar index may be constructed from the triceps fold except that no adjustment for sex is required.

Table 2 Repeatability of skinfold measurements (mm) at various sites

Site	No of cases	First reading (mean)	Second reading (mean)	Mean difference	Standard deviation of difference	Coefficient of variation
Thigh	4	4.30	4.34	0.04	0.37	0.086
Triceps	5	3.72	3.74	0.02	0.67	0.179
Biceps	7	3.63	3.57	-0.06	0.54	0.148
Suprailiac	5	3.24	3.54	0.30	0.31	0.091
Subscapular	5	5.26	4.48	-0.78	0.85	0.174

Discussion

This study confirms previous reports that thigh skinfold is the most repeatable^{7 8} and the most representative⁹ of the skinfolds. Because babies are as upset by the application of the calliper as by heelprick blood sampling, it seems preferable for most purposes to measure only the thigh skinfold.

The correlations of skinfold with sex, gestation, birthweight, and maternal weight are well documented elsewhere.^{2 10} Parity seems to influence neonatal skinfold towards term in the same manner as it does birthweight.³

Oakley, Parsons, and Whitelaw² have produced standards for triceps and subscapular skinfold in term infants; their 'centile' charts are symmetrical and seem to have been mathematically derived rather than observed. Because skinfold measurements are poorly reproducible without considerable practice, and because there is considerable variation between observers, these charts cannot replace appropriately constituted and personally studied control groups. The 'corrected skinfold' described here offers an alternative approach to comparing skinfolds in term infants of differing sex and birthweight, and allows amalgamation for statistical purposes of small groups of term infants differing in these respects. The clinical usefulness of the index remains to be evaluated.

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