Correlations of skin thicknesses measured at monthly intervals from birth to eight months of age in New Zealand Romney sheep

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Summary

A recent study in New Zealand Romneys revealed a positive genetic association between skin thickness measured at eight months of age and lamb survival from birth to weaning, which had been postulated to be due to an effect of skin thickness at birth on thermoregulation of new-born lambs. The current experiment aimed to explore whether skin thickness was a repeatable trait when measured on 9 occasions between birth and eight months of age. Starting with 100 new-born Romney lambs, skin thickness was ultrasonically measured at monthly intervals until the lambs were eight months old. The results of analysis performed using PROC CORR procedure in SAS software, showed significant ($P<0.05$) correlations between skin thickness at birth and the measurements taken at 6, 7, and 8 months, with Pearson's correlation coefficient values of 0.29, 0.33, and 0.34, respectively. Therefore, skin thickness measured during 6-8 months could be considered as a low to moderate indicator of skin thickness at birth.

Keywords: skin thickness, thermoregulation, lamb survival, ultrasound, correlation

Introduction

Lamb survival as a trait of high economic importance, shows low response to genetic selection due to its low heritability (Lopez-Villalobos & Garrick, 1999). Therefore, indirect selection, based on selection for other easy-to-measure traits of higher heritability, that are genetically correlated with survival, can be considered as a supplement to direct selection for the trait itself. Due to its association with cold tolerance (Samson & Slee, 1981), as a component of lamb survival (Samson & Slee, 1981), skin thickness might be a potential alternative to direct selection for lamb survival. Skin thickness has a moderate to high heritability (Slee *et al*., 1991; Gregory, 1982) and could be easily measured in the field using objective techniques like ultrasonography (Brown *et al*., 2000), unlike cold resistance, whose assessment needs laboratory-based techniques that are not feasible for breeders.

In a recent study in New Zealand Romney sheep we found skin thickness measured ultrasonically at approximately eight months of age to be moderately heritable, and genetically, positively correlated with lamb survival from birth to weaning (Soltani-Ghombavani *et al*., 2017). The correlation was postulated to be due to the effect of skin thickness on improved thermoregulation through its effect on heat loss at birth. On the hand, to our knowledge, there is no published study reporting the association of skin thickness at birth with the measurements taken at 8 months of age and its changes during this period. Therefore, the main objective of the current study was to examine the correlations (as an

estimate of repeatability) among skin thickness measurements obtained at monthly intervals from birth to 8 month of age, in order to find out whether skin thickness at an older age is an appropriate indicator of the trait at birth.

Material and methods

Data collection

Initial skin thickness measurements were obtained by ultrasonography on 100 Romney-type lambs born during 9-24 September 2017 at Massey University farm, Palmerston North, New Zealand. The scanning was performed within 24 hours of birth by a commercial operator using an ultrasound scanning machine (Sonosite M Turbo) with a 38mm probe at 7.5 MHz set at a depth of 40 mm on the left dorsal loin region of the lambs around the 12th rib. All lambs were weighed and tagged within 12 hours of age and their sex, birth rank, and date of birth were recorded. The lambs were maintained on the farm under conventional New Zealand sheep farming conditions until eight months of age, and their skin thickness measured ultrasonically at monthly intervals by the same operator using the same scanning machine on the same region of body. Since some of the lambs died during the course of the study and a few were affected by dermatitis at the scanning region, the records for skin thickness at subsequent months after birth ended up with less than 100. Also, since triplet born lambs were used for a different experiment, only singles and twins were used in this study.

Statistical analysis

Univariate procedure in SAS software (SAS, 2015) was used to check for normality and edit the data (removing outlier observations). Cleaned data were analysed by PROC MIXED procedure of SAS software (SAS, 2015) to identify significant fixed and random effects influencing skin thickness. Birth weight was considered as a covariate for the analysis of skin thickness. Also, the CORR procedure of SAS software (SAS, 2015) was used to calculate Pearson correlation coefficients among skin thickness readings obtained at monthly intervals from birth to 8 months of age.

Results and discussion

Descriptive statistics for skin thicknesses measured at monthly intervals from birth to eight months of age are presented in Table 1. Ultrasound skin thickness in this study, recorded at birth, had a mean of 2.59 mm (Table 1), which is consistent with a report by Jopson *et al*. (2000) in new-born Coopworth lambs in New Zealand, though skin thickness was measured using skinfold callipers in their experiment. In the current study, neither sex nor birth rank had an effect on skin thicknesses measured at birth when adjustment was made for birth weight, both of which are in agreement with the study by Jopson *et al*. (2000). As presented in Table 1, from birth to three months of age, the mean skin thickness increased to 4.11 mm, followed by two consecutive decreases (3.99 mm and 3.47 mm at four and five months, respectively). Then, the mean skin thickness again showed an increase at six months of age (3.78 mm), followed by a decrease (3.57 mm), then another increase (3.83 mm) in the last two measurements. In a similar long-term study (Wodzicka, 1958a) that monitored skin thickness of 12 Romney wether lambs from 10 days of birth until five months of age at monthly intervals, skin thickness was found to increase by some 14% until the lambs were 5-

10 weeks of age. However, contrary to our results, by 13 weeks skin thickness decreased to the original thickness at birth and remained at this value until five months of age.

Table 1. Descriptive statistics and number of records for the skin thicknesses from birth to 8 months of age measured at monthly intervals

Measurement time (month)	No. of records	Mean (mm)	SD	Min.	Max.	CV (%)
Birth	100	2.59	0.52	1.66	4.31	20.08
1	92	3.36	0.38	2.46	4.39	11.43
2	91	3.61	0.44	2.39	4.78	12.08
3	91	4.11	0.50	2.85	5.48	12.21
4	86	3.99	0.41	3.16	5.16	10.29
5	75	3.47	0.44	2.46	4.58	12.64
6	77	3.78	0.45	2.54	4.70	11.90
7	76	3.57	0.42	2.54	4.62	11.70
8	76	3.83	0.43	2.39	5.08	11.08

As shown in table 2, there was no significant correlation ($P>0.05$) between skin thickness at birth and any of the measurements taken between one and five months, while there were significant ($P<0.05$) correlations between skin thickness at birth and the measurements at six ($r = 0.29$), seven ($r = 0.33$), and eight ($r = 0.34$) months. In line with this, when the lambs were categorized into three groups of significantly different skin thickness at birth (thin, medium, and thick-skinned), their mean skin thickness differed only during 6-8 months, but not during first five months.

Table 2: Pearson's correlation coefficients (below diagonal) among skin thicknesses measured at monthly intervals from birth to 8 months of age, and the number of records used for each pair (above diagonal)

Month	Birth	1	2	3	4	5	6	7	8
Birth		92	91	91	86	75	77	76	76
1	0.04		90	90	85	74	76	75	76
2	0.09	0.18		91	86	75	77	76	76
3	-0.13	0.02	0.29**		86	75	77	76	76
4	0.02	0.24*	0.35***	0.36***		71	74	73	73
5	0.20	0.06	0.20	0.26*	0.33**		71	69	69
6	0.29*	0.17	0.12	0.10	0.51***	0.40***		75	75
7	0.33*	0.05	0.14	0.22	0.48***	0.46***	0.61***		75
8	0.34*	0.08	0.23	0.18	0.40***	0.48***	0.50***	0.51***	

Significance: *P ≤ 0.05; **P ≤ 0.01; ***P ≤ 0.001.

The real reason behind the trend observed in skin thickening is not clear, however, it might be due to different adaptation responses lambs of different skin thickness showed to survive cold environment and/or rain they faced, based on their themoregulatory capabilities during the early stages of life. Since thin-skinned lambs would generally lose more heat from skin surface, they need to shrink (thicken) their skin more than thick-skinned ones. However, as body size and wool grow, skin might need to play a lesser role in thermoregulation, which could be the reason for the significant correlations appearing from the sixth month onwards. Similarly, in a study by Wodzicka-Tomaszewska (1960), skin thickness was shown to increase

in sheep after a period of cold stress. Furthermore, Wodzicka (1958b) observed thickening of the skin, following shearing and this was attributed to cold stress. Also, a high within-day repeatability of 0.88 obtained in our study (the intra-class correlation of skin thickness measurements taken twice on 75 lambs on the same day at the sixth month) demonstrates the reliability of the measurements taken by the operator.

In conclusion, skin thickness measured at eight months of age could be a reliable indicator of skin thickness at birth. Further, the study findings support the idea that the positive genetic correlation of skin thickness at eight months of age with lamb survival, found in our previous study (Soltani-Ghombavani *et al*., 2017), might be due to improved thermoregulation through less heat loss from skin surface in new born lambs. The correlation found is of high importance from both practical and economic points of view, since measuring skin thickness at eight months of age is much easier than at birth. Furthermore, ultrasound measurement of skin thickness at eight months of age, instead of at birth, facilitates simultaneous recording of other traits of importance like fat depth and eye muscle depth, which are normally taken at this age, consequently saving money and time. Finally, from a biological perspective, it would be interesting to investigate further to find out if at all and when the shin thickness in growing lambs would approach back to birth-level.

List of References

Brown, D.J. M.L. Wolcott, B.J. Crook, 2000. The measurement of skin thickness in Merino sheep using real time ultrasound. Wool Tech Sheep Bree. 48: 269-276.

Gregory, I.P., 1982. Genetic Studies of South Australian Merino Sheep III Heritabilities of various wool and body traits. Aust. J. Agric. Res. 33: 355-362.

Jopson, N.B. G.J. Greer, W.E. Bain, J.A. Findlay, J.C. McEwan, 2000. Lamb survival traits in Coopworth sheep selected for high or low backfat depth. Proc. NZ Soc. Anim. Prod. 60: 61-64.

Lopez-Villalobos, N. D.J. Garrick, 1999. Genetic parameter estimates for lamb survival in Romney sheep. Proc. NZ Soc. Anim. Prod. 59: 121-124.

Samson, D.E. J. Slee, 1981. Factors affecting resistance to induced body cooling in newborn lambs of 10 breeds. Anim. Prod. 33: 59-65.

SAS, 2015. Statistical Analysis System. SAS Institute, version 9.4, Cary, NC, USA.

Slee, J. G. Alexander, L.R. Bradley, N. Jackson, D. Stevens, 1991. Genetic aspects of cold resistance and related characterisitcs in newborn Merino lambs. Aust. J. Exp. Agr. 31: 175-182.

Soltani-Ghombavani, M. Dukkipati, V.S.R. Blair, H.T, 2017. Genetic association of skin thickness with lamb survival from birth to weaning, and growth and wool traits in New Zealand Romney sheep. Proc. AAABG. 22: 1-4.

Wodzicka, M., 1958a. Studies on the thickness and chemical composition of the skin of sheep II – Variations during growth. New Zeal. J. Agr. Res. 1: 592-600.

Wodzicka, M., 1958b. Studies of the thickness and chemical composition of the skin of sheep. III Effect of shearing. New Zeal. J. Agr. Res. 1: 601-606.

Wodzicka-Tomaszewska, M., 1960. Effect of cold on the thickness and chemical composition of the skin in sheep. Proc. Aust. Soc. Anim. Prod. 3: 195-198.