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BRIEF COMMUNICATION: The effect of dam age and lamb birth rank on the growth rate, faecal egg count and onset of puberty of single and twin female offspring to 12 month of age

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INTRODUCTION

Breeding ewe lambs at eight to nine months of age has gained popularity on New Zealand sheep farms in recent years. This is predominantly because of the many production advantages it offers: greater net profits, increased number and weight of lambs produced per ewe productive lifetime, better use of spring herbage, early recognition of fertility potential, increased rates of genetic gain and flock efficiency (Gootwine *et al*., 2007; Kenyon *et al.*, 2004). Despite these advantages there are a number of concerns about breeding ewe lambs. There is substantial evidence that young primiparous ewes give birth to lighter lambs compared to the mature multiparous ewe (Gardner *et al.*, 2007), and that this effect is due to the dam's stage of maturity rather than her parity (Redmer *et al*., 2004, Wu *et al.*, 2006). The current theory being that there is competition for nutrients between a growing adolescent mother and her growing conceptus, with nutrient partitioning tending to favour continued growth of the dam at the expense of the fetus (Wallace, 2000).

To date, few studies have compared progeny born to either adult ewes or ewe lambs, when both age groups were bred together. Therefore this study was designed to examine the growth trajectories of single and twin ewe offspring born to these two age groups of ewes, which had been bred together. This study also examined faecal egg count (FEC) as an indicator of internal parasite burden and puberty attainment of the ewe offspring born to these two ewe age groups.

MATERIAL AND METHODS

The study used 104 naturally mated Romney ewes (30 single-bearing primiparous ewe-lambs (EL-S; eight- to nine-months-old at breeding, average live weight (LW): 46.2 ± 0.7 kg (standard error of mean)); 18 single-bearing multiparous adult ewes (AE-S; three- to five-years-old, average LW: 66.0 ± 0.9 kg); 24 twin-bearing primiparous ewe-lambs (EL-T, average LW: 47.4 ± 0.7 kg) and 32 twin-bearing multiparous adult ewes (AE-T, average LW: 67.3 ± 0.9 kg)) which were naturally bred as one cohort with eight mature crayon-harnessed mixed aged Romney composite rams. Crayons were changed seven days after ram introduction. Using crayon marks on the ewe's rump as an indicator of mating activity, only ewes that were marked with the colour of the first crayon and subsequently identified as pregnant were used in the study.

Ewes were managed together under commercial New Zealand grazing conditions with a minimum post grazing cover of 900 kg dry matter (DM)/ha from breeding to weaning. The offspring were

TABLE 1: Profile of mean live weight ± standard error of the mean (kg) between birth (D1) and D345 (one year of age) of female single and twin progeny born to ewe-lamb dams and adult ewe dams. Lambs were born on D1 and weaned on D107. Number of lambs in subgroup is shown in parenthesis after the mean value.

Lamb age (days)	Dam age		Birth rank	
	Ewe lamb	Adult ewe	Single	Twin
D1	3.7 ± 0.1^a (63)	4.6 ± 0.1^b (61)	4.4 ± 0.1^a (48)	3.8 ± 0.1^b (76)
D48	14.9 ± 0.3^a (63)	18.1 ± 0.3^b (61)	18.6 ± 0.3^a (48)	14.4 ± 0.3^b (76)
D107*	27.6 ± 0.5^a (63)	32.4 ± 0.6^b (60)	32.9 ± 0.6^a (48)	27.2 ± 0.4^b (75)
D141*	27.2 ± 0.5^a (58)	33.0 ± 0.5^b (59)	33.2 ± 0.6^a (45)	27.0 ± 0.4^b (72)
D170*	26.9 ± 0.5^a (58)	32.4 ± 0.6^b (60)	31.9 ± 0.6^a (45)	27.3 ± 0.4^b (73)
D196	27.9 ± 0.5^a (59)	32.8 ± 0.6^b (60)	32.1 ± 0.6^a (46)	28.5 ± 0.5^b (73)
D229	32.3 ± 0.5^a (56)	36.6 ± 0.6^b (59)	36.4 ± 0.6^a (45)	32.6 ± 0.5^b (70)
D260	31.8 ± 0.8^a (54)	36.5 ± 0.5^b (57)	36.0 ± 0.6^a (43)	32.4 ± 0.4^b (68)
D293	34.6 ± 0.6^a (53)	38.8 ± 0.6^b (52)	38.5 ± 0.7^a (40)	35.0 ± 0.5^b (65)
D321*	33.6 ± 0.6^a (56)	37.6 ± 0.7^b (56)	37.2 ± 0.7^a (43)	33.9 ± 0.5^b (69)
D345	39.8 ± 0.6^a (56)	44.6 ± 0.7^b (57)	44.1 ± 0.7^a (44)	40.3 ± 0.6^b (69)

[a,b]Different superscripts within rows indicate values that differ significantly ($P < 0.05$).
*Significant interaction between ewe age and birth rank ($P < 0.05$).

managed together from weaning to one year of age.

Lambing commenced on Day 1 (D1). Single and twin female offspring were weighed at birth and approximately monthly until one year of age on D49, D107, D141, D170, D196, D229, D260, D293, D321, D345. All animals were weighted within an hour directly off pasture. Oestrus activity during a 17 day period beginning on D229 (10 May), was recorded as an indicator of puberty using crayon-harnessed vasectomised rams. Faecal egg counts (FEC; *Nematodirus sp*. and Strongylid eggs per gram faeces) were performed at D260 (10 June).

Data were analysed using a General Linear Model in Minitab® (version 16, Minitab Inc, Pennsylvania, USA). The model used to analyse offspring live weights, offspring rate of weight gain and FEC included the fixed effects of dam age and birth rank, and their interactions. *Nematodirus sp.* FEC data were normalised using a $\log_{10}$ (*Nematodirus sp*. count + 25) transformation and Strongylid FEC data were normalised using a square root transformation. Only significant interactions (P <0.05) are reported. Birth weight and date of birth were fitted as covariates. The percentage of female offspring displaying oestrus activity during D229 to D246 was analysed with GENMOD procedure in SAS 9.2 (SAS Institute, Carry North Carolina, USA) with a linear model that included fixed effects of dam age and birth rank and their interaction. Live weight at D229 was used as a covariate.

RESULTS AND DISCUSSION

Lambs born to AE were heavier at birth than those born to EL (P <0.05) and S-born lambs were heavier than T-born (Table 1). There was no interaction (P >0.05) between dam age and birth rank for lamb birth weight. At weaning there was an interaction (P <0.05) between dam age and birth rank for lamb live weight with AE-S born lambs being heavier (34.5 ± 0.95 kg, P <0.05) than all other groups and EL-T born lambs (24.0 ± 0.72 kg, P <0.05) being lighter than all other groups. EL-S born lambs and AE-T born lambs did not differ from each other (31.2 ± 0.73 kg 30.3 ± 0.58 kg, respectively; P >0.05). Notter *et al*, (2005) found that both lamb birth weight and lamb weaning weight increased linearly with increasing dam age, from 18 months-old to six years-old. Numerous studies have reported singletons having heavier live weights at birth and weaning compared to twins (Gardner *et al*., 2007; Gootwine *et al*., 2007; Kenyon *et al*., 2008b).

At D345, AE born lambs were still heavier than lambs born to EL (P <0.05; Table 1) and single offspring were heavier than twins (P <0.05; Table 1). However, whilst there was no interaction between dam age and birth rank on offspring live weight measured at D345 (P >0.05), pairwise comparisons of the means showed that EL-T born lambs were lighter than all other groups (37.7 ± 0.91 kg; P <0.05) and AE-S (46.2 ± 1.14 kg; P <0.05) were heavier than both, AE-T and EL-S which did not differ from each other (42.9 ± 0.68 kg versus 41.9 ± 0.85 kg, respectively). Also, when twin offspring data were analysed in isolation, EL-T where significantly lighter than AE-T (37.8 ± 0.88 kg versus 43.0 ± 0.70 kg,

TABLE 2: Least square means ± standard error of the mean of $\log_{10}$ (*Neamtodirus sp.* count + 25) transformation of the count of *Nematodirus sp*. eggs per gram of faeces and the square root transformation of the count of Strongylid eggs per gram of faeces of female single and twin progeny born to ewe-lamb dams and adult ewe dams. There was a significant dam age by birth rank interaction (P <0.05). Back transformed values are shown in parenthesis.

Internal parasite	Female progeny born to:			
	Ewe-lamb dam		Adult ewe dam	
	Single	Twin	Single	Twin
Nematodirus sp.	1.45 ± 0.04 (3.2)	1.55 ± 0.05 (10.6)	1.49 ± 0.07 (5.8)	1.44 ± 0.04 (2.6)
Strongylid	26.0 ± 2.8 (678)	34.8 ± 3.1 (1210)	29.6 ± 4.2 (875)	25.5 ± 2.2 (650)
Number of samples measured	26	26	13	38

TABLE 3: Percentage of female single and twin progeny born to ewe-lamb dams and adult ewe dams that attained puberty as a yearling by D246 (27 May). There was a significant dam age by birth rank interaction (P <0.05). The 95% confidence intervals are shown in parenthesis.

Characteristic	Female progeny born to:			
	Ewe-lamb dam		Adult ewe dam	
	Single	Twin	Single	Twin
Attained puberty (%)	15.5 (15.15-15.78)	22.8 (19.75-26.07)	18.7 (15.39-22.62)	16.0 (13.95-18.26)
Number of animals	30	32	17	43

respectively, P <0.05). Using Romnelets, Vesely *et al*. (1970) reported that offspring born to young ewes were lighter at birth and were still lighter at 12 months of age compared to lambs born to mature ewes. Gootwine *et al*. (2006) demonstrated that Assaf offspring from young ewes remained lighter until two years of age, after which they did not differ in live weight from their adult ewe born counterparts. Contrary to the findings in the present study, Australian Merino twins remained lighter than their single counterparts at 657 days of age in the study of Safari *et al*. (2007). Kenyon *et al*. (2008b) however, showed that Romney twins were lighter than their singleton counterparts only until nine months of age, after which this difference was no longer apparent. These inconsistent outcomes suggest that there is an as yet unidentified factor influencing the growth of young sheep, with one possible factor being lamb genotype.

The FEC at D260 showed no difference (P >0.05) for *Nematodirus sp*. eggs/g faeces but there was an interaction between dam age and birth rank (P <0.05; Table 2) for Strongylid eggs/g faeces. However, pairwise comparison of the means showed no difference between the groups. The FEC results in the present study are inconclusive and further measurements would be required to determine if differences persist.

When analysed with and without D229 live weight as a covariate, neither dam age or birth rank, had any affect on the percentage of ewe progeny displaying oestrus (P >0.05; Table 3). McCall and Hight (1981) reported that the mean live weight at puberty for New Zealand Romney ewes was 30 to 34 kg, which is comparable to the D229 live weights of all groups in the present study. Kenyon *et al*. (2008a) found no differences in puberty attainment between twin and single born ewes despite difference in live weight at puberty.

In conclusion, under the conditions of the present study we have demonstrated that when compared to offspring born to adult ewes, offspring born to ewe-lambs are lighter at birth and remain so until at least 12 months of age. These live weight differences however, do not appear to influence puberty attainment. The lighter live weight of offspring born to hoggets may suggest these offspring themselves are less suited to be bred as hoggets. The offspring in the present study are being followed and additional measures taken to determine if these differences persist into later life. Further studies are required to determine if similar relationships exist in different genotypes and under different environmental conditions.

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