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DOES THE LAMB BIRTH WEIGHT RESPONSE TO MID PREGNANCY SHEARING DIFFER IN TWO BREEDS OF DISPARATE SIZE?

P.R. Kenyon, H.T. Blair and C.M.C. Jenkinson

Sheep Research Centre, Institute of Veterinary, Animal and Biomedical Sciences, Massey University, Palmerston North, New Zealand.

SUMMARY

Shearing ewes in mid-pregnancy has consistently been shown to increase lamb birth weight. To date no one has examined the birth weight response in differing breeds managed under the same conditions. Crossbreeding and embryo transfer studies have previously shown that the Cheviot ewe constrains embryo and fetal growth resulting in lighter lamb birth weights compared to the Suffolk ewe. Therefore, it was hypothesised that the mid-pregnancy shearing response would be greater Cheviots than in Suffolks, as mid-pregnancy shearing is more effective when lamb birth weight is being otherwise constrained. Cheviot (n=76) and Suffolk (n=59) ewes were either shorn in mid-pregnancy of left unshorn. The birth weight response to mid-pregnancy shearing was observed in Cheviots ($P<0.05$, 5.2 ± 0.1 vs. 4.6 ± 0.1 kg shorn vs. unshorn, respectively) but not in Suffolks ($P>0.05$, 5.9 ±0.2 vs. 6.1 ±0.1 kg). This study indicates that the lamb birth weight response to mid- pregnancy shearing can be breed specific. The breed model used in this study could be used to help unlock the mechanisms responsible for the birth weight response from mid-pregnancy shearing.

INTRODUCTION

Shearing ewes in mid-pregnancy (between days 50 and 130) has been shown to increase lamb birth weight by up to 20% across more than 30 studies under both indoor controlled and outdoor pastoral conditions (see reviews Dyrmundsson 1991, Kenyon *et al*. 2003). Other reported effects from mid-pregnancy shearing include: increased ewe milk production, improved lamb vigour at birth, higher lamb growth rates and survival to weaning, and altered lamb wool fibre characteristics (Cam and Kuran 2004, Kenyon *et al*. 2004, Kenyon *et al*. 2006, Banchero *et al*. 2010, van Reenen *et al.* 2010).

However, there are also a few studies which have failed to report a lamb birth weight response (see reviews Dyrmundsson 1991, Kenyon *et al*. 2003). Kenyon *et al*. (2002a; 2002b) concluded that in order for mid-pregnancy shearing to increase lamb birth weight, the ewe required both the potential and the means to respond. That is, the ewe must be otherwise destined to give birth to lambs of relatively low birth weight, she must have adequate body reserves and be provided with adequate nutrition. Although a number of parameters have been investigated (e.g. gestation length, ewe intake, changes in maternal hormones and metabolites) the driving mechanism(s) for the birth weight response has, as yet, not been identified.

The Suffolk breed is larger and heavier than the Cheviot. Studies involving both crossbreeding and embryo transfer have shown that the Cheviot ewe constrains fetal growth and lamb birth weight (Jenkinson *et al*. 2007, Sharma *et al*. 2009, 2010). Although, mid-pregnancy shearing studies have been undertaken utilising a number of breeds, to date, no study has specifically examined that response in two differing ewe breeds managed under the same conditions.

It was hypothesised that the birth weight response to mid–pregnancy shearing is more likely to occur in the Cheviot than in the Suffolk, as the Cheviot ewe is more likely to give birth to lambs of low birth weight. If this was found to be the case, this breed comparison could provide a genetic model which may help unlock the mechanism(s) responsible for increased fetal growth and lamb birth weight.

MATERIALS AND METHODS

Fifty nine Suffolk and 76 Cheviot ewes (2 to 8 years of age) were utilised in the present study. All ewes had conceived during a 22 day breeding period (P1 = first day of breeding period) after progesterone synchronisation. During this breeding period Cheviot and Suffolk ewes were separated and bred with rams of their respective breed (n = 6 per breed) but offered similar grazing conditions. At the end of breeding (P22) the two groups of ewes were merged and managed under commercial conditions for the remainder of the study. Approximately half of the ewes within each breed were shorn at P72 using a cover comb (Sunbeam New Zealand Ltd, maximum stubble depth 7-9 mm). The study was conducted at Massey University's Tuapaka Farm, 15 km south-west of Palmerston North, New Zealand (40^{o} south, 175^{o} east) during the period March to November 2009 with approval from the Massey University Animal Ethics committee.

Animal measurements. Ewe live weights and condition scores (Jefferies 1961) were recorded at P1, P71 and P142. Fleeces were weighed on all ewes shorn at P72 to allow for correction of live weights. All lambs were identified to their dam, their sex determined and recorded for birth-rank and they were weighed, their crown rump length and abdominal girth circumference measured and tagged within 12 h of birth. At 41 and 96 days after the mid-point of the lambing period (L41 and L96) all lambs alive were reweighed.

Data analysis. Ewe liveweight and condition score were analysed with the generalised linear model procedure in Minitab (Minitab 2002) and models tested for the effects of ewe breed, ewe shearing treatment and numbers of lambs born (or lambs reared in lactation) and two-way interactions between these parameters. Non-significant (P>0.05) interactions involving numbers of lambs born (or reared) were removed. The interaction between ewe breed and shearing treatment remained in the model even if not significant (P>0.05). Ewe age was used as a fixed effect. The models used to analyse lamb birth weight and size measurements were analysed with sex of the lamb as a fixed effect and date of birth as a covariate. In the models used to analyse lamb live weights at L41 and L96 the effects of rearing rank was tested (not birth rank) in addition to dam breed and shearing treatment, and the interaction with sex of the lambs as a fixed effect.

RESULTS

Ewe live weight and condition score. Suffolk ewes were heavier (P<0.05) than Cheviot ewes at P1, P71 and P142 (80.1 ±1.3 (s.e.) vs. 66.6 ±1.0, 73.4 ±1.1 vs. 61.4 ±0.9 and 79.3 ±1.3 vs. 66.1 ±1.0 kg respectively). Shearing treatment had no effect (P>0.05) on ewe liveweight nor was there an interaction (P>0.05) between ewe breed and shearing treatment at any time point (data not shown). At P1 there was an interaction (P<0.05) between ewe breed and shearing treatment for ewe condition score such that the condition score of unshorn ewes did not differ (P>0.05) between breeds (3.9 ±0.1 vs. 3.8 ±0.1 kg for Suffolk and Cheviot ewes, respectively). In contrast, mid-pregnancy shorn Suffolk ewes had greater (P<0.05) condition scores than Cheviot ewes (4.2 ±0.1 vs. 3.5 ±0.1 kg respectively.). Within breed, there was no difference (P>0.05) in condition score between shorn and unshorn ewes at P1. There was no effect of ewe breed on condition score at P71 or P142 (2.9 ±0.1 vs. 2.9 ±0.1 and 2.4 ±0.1 vs. 2.5 ±0.1, respectively). Similarly, there was no effect (P>0.05) of shearing treatment on ewe condition score at P71 or P142 nor were there interactions between breed and shearing treatment (data not shown).

Lamb live weight. There was an interaction (P<0.05) between ewe breed and shearing treatment for lamb birth weight such that Cheviot lambs born to shorn ewes were heavier (P<0.05) than their counterparts born to unshorn ewes (Table 1). No such relationship (P>0.05) was observed in Suffolk lambs. Singleton lambs were heavier (P<0.05) than twins at birth. Suffolk lambs were heavier (P<0.05) than Cheviot lambs at L41 and L96. At L41 twin-born and reared lambs were lighter (P<0.05) than singleton-born lambs. While, at L96 twin-born and reared lambs, were lighter (P<0.05) than lambs being reared as a singleton, regardless of birthrank. Shearing treatment had no (P>0.05) effect on lamb live weight at L41 or L96.

Lamb dimensions at birth. Suffolk lambs had longer crown-rump lengths (P<0.05) than Cheviot lambs (57.5 ±0.4 vs. 53.9 ±0.6 cm, respectively) although, this was not apparent (P>0.05) after correction for liveweight (data not shown). There was a significant (P<0.05) interaction between ewe breed and shearing treatment for abdominal girth circumference such that Cheviot lambs born to unshorn ewes had smaller girths (P<0.05) than those born to shorn ewes (38.2 ±0.4 vs. 39.9 ±0.4 cm respectively). No such relationship (P>0.05) was observed in Suffolk lambs (41.9 ±0.5 vs. 41.6 ±0.5 cm for unshorn and shorn, respectively). This interaction was no longer apparent (P>0.05) after correction for live weight (data not shown). Singleton-born lambs had greater (P<0.05) crown-rump lengths and girth circumferences than twin-born lambs, again, this difference was no longer apparent (P>0.05) after correction for liveweight (data not shown).

Table 1. The effect of ewe breed (Suffolk vs. Cheviot), shearing treatment (Unshorn vs Shorn), birth or rearing rank (Singleton vs. Twin) on lamb live weight (kg) at birth, L41 and L96 (mean ±s.e). Means within main effects and columns with letters in common or without superscripts are not significantly different (P>0.05)

	Lamb live weight						
	Birth			L41			L96
	n			n		n	
Breed							
Suffolk	99	$6.0^{b} \pm 0.1$		80	$16.1^{b} \pm 0.4$	79	$30.6^{b} \pm 0.6$
Cheviot	118	$4.9^{a} \pm 0.1$		93	$12.5^{a} \pm 0.3$	90	$24.0^{a} \pm 0.5$
Shearing treatment							
Unshorn	107	5.3 ± 0.1		84	14.0 ± 0.3	83	26.8 ± 0.6
Shorn	110	5.6 ± 0.1		89	14.6 ± 0.3	86	27.8 ± 0.6
Pregnancy rank			Rearing rank				
Singleton	53	$5.8^{b} \pm 0.1$	Singleton	42	$16.0^{b} \pm 0.4$	40	$30.3^{b} \pm 0.7$
Twin	164	$5.0^{a} \pm 0.1$	Twin-Single	25	$14.6^{ab} \pm 0.5$	29	$28.5^{b} \pm 0.9$
			Twin-Twin	106	$12.1^{a} \pm 0.3$	100	$23.1^{a} \pm 0.5$
Breed x shearing treatment interaction							
Suffolk Unshorn	51	$6.1^{c} \pm 0.1$		40	16.1 ± 0.4	39	$30.1^{b} \pm 0.8$
Suffolk Shorn	48	$5.9^{c} \pm 0.2$		40	16.0 ± 0.5	40	$31.4^{b} \pm 0.8$
Cheviot Unshorn	56	$4.6^{a} \pm 0.1$		44	11.8 ± 0.4	44	$23.4^{a} \pm 0.7$
Cheviot Shorn	62	$5.2^{b} \pm 0.1$		49	13.1 ± 0.4	46	$24.5^{a} \pm 0.7$

DISCUSSION AND CONCLUSION

Mid-pregnancy shearing increased birth weights of Cheviot lambs, by approximately 13%, but did not increase the birth weights Suffolk lambs, which supported the hypothesis. The increase in birth weight in Cheviot lambs was accompanied with an increased in abdominal girth circumference. This associated change in girth has previously been reported (Corner *et al*. 2006; de Nicolo *et al*. 2008) and may suggest these lambs are born with a greater level of body reserves which may explain the increased survival reported in large studies. The numbers of lambs in the present study limit its ability to examine for a lamb survival response.

The breed specific results of this study suggest it may be a suitable model to use to identify the mechanism(s) responsible for the increased birth weight. Ewes in both breeds were of adequate body condition at breeding and throughout pregnancy. This suggests both breeds had the potential to respond to mid-pregnancy shearing by partitioning body reserves to enhance fetal growth post shearing (Kenyon *et al*. 2002b). In addition, all ewes were managed as one group during the study period except during the breeding period, when they were separated for 22 days but offered similar commercial feeding conditions. Throughout the study, the live weights of Suffolk ewes were greater than that of Cheviot ewes but, within breed the live weights of shorn and unshorn ewes did not differ. It is known that the birth weight response from mid-pregnancy shearing is not driven by a change in ewe feed intake, which often does not occur (Kenyon *et al.* 2004). Ewe metabolic and hormonal concentrations warrant investigation in future studies if this two breed model is to be used to elucidate the mechanism responsible for the mid-pregnancy shearing effect. Changes in ewe glucose, NEFA, insulin, IGF-1, cortisol and thyroid concentrations have all previously been reported to be altered by mid-pregnancy shearing (Kenyon *et al*. 2004; Corner *et al*. 2007, Jenkinson *et al*. 2009) and are all known to affect fetal growth.

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REFERENCES

Banchero G., Vazquez A., Montossi F., de Barbieri I.and Quintans G. (2010) *Anim. Prod. Sci.* 50: 309.

Cam M.A. and Kuran M. (2004) *Asian-Aust J. Anim. Sci.* **17**: 1669.

Corner R.A., Kenyon, P.R., Stafford, J.K., West, D.M.and Oliver, M.H. (2006) *Live. Sci*. **102**: 121.

Corner R.A., Kenyon, P.R., Stafford, J.K., West, D.M. and Oliver, M.H. (2007) *Live. Sci*. **107**: 126.

de Nicolo G., Kenyon, P.R., Morris, S.T., Morel, P.C.H.and Wall, A.J. (2008) *Aust. J. Exp. Agric*. **48**: 957.

Dyrmundsson O.R. (1991) *Icel. Agr. Sci* **5**: 39.

Jefferies B.C. (1961) *Tas. J. Agric*. **32**: 19.

Jenkinson C.M.C., Kenyon P.R., Blair H.T., Breier B.H. and Gluckman P.D. (2007) *Proc. NZ Soc. Anim. Prod.* **67**: 187.

Jenkinson C.M.C., Kenyon P.R., Blair H.T., Breier B.H. and Gluckman P.D. (2009) *NZ J. Agric. Sci.* **52**: 261.

Kenyon P.R., Morel P.C.H. and Morris S.T. (2004) *NZ Vet. J.* **52**: 145.

Kenyon P.R., Morris S.T., Revell D.K. and McCutcheon S.N. (2002a) *Aust. J. Agric. Res.* **53:** 13.

Kenyon P.R., Morris S.T., Revell D.K. and McCutcheon S.N. (2002b) *Aust. J. Agric. Res.* **53:** 511.

Kenyon P.R., Morris S.T., Revell D.K. and McCutcheon S.N. (2003) *NZ Vet. J* **51:** 200.

Kenyon P.R., Revell D.K.and Morris S.T. (2006) *Aust. J. Exp. Agric*. **46**: 821.

Minitab. *Minitab Version 12.1.* Minitab Inc, Pennsylvania, USA (2002)

Sharma R.K., Jenkinson C.M.C., Blair H.T., Kenyon P.R. and, Parkinson T.J. (2009) *Proc. NZ Soc. Anim. Prod.* **69**: 10.

Sharma R.K., Parkinson T.J., Kenyon P.R. and Blair, H.T. (2010) *The 8th Rumin. Repro. Symp.* 107.

Van Reenen E.H., Kenyon P.R., Sherlock R.G., Hickson R.E. and, Morris S.T. (2010) Anim. Prod. Sci. **50**: 603.