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Reproductive performance of singleton and twin female offspring born to ewe-lamb dams and mature adult dams

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Abstract

This study was undertaken to compare the reproductive and live weight performance of female singleton and twin ewes born to either mature or young dams from 18 months to 2.5 years of age. One hundred and fifteen singleton- and twin-born female offspring born to either ewe-lamb (8 months at breeding) or adult ewe dams were maintained as one cohort under commercial New Zealand grazing conditions. Ewe live weights and body condition scores were recorded, as were ovulation rates at a synchronised breeding and number of fetuses present at pregnancy scanning. The live weight of ewes born to ewe-lambs were lighter ($P<0.05$) than those born to adult ewes at breeding and during their first pregnancy but not ($P>0.05$) at the weaning of their lambs. Twin-born ewes were lighter ($P<0.05$) than their singleton-born counterparts. There was no difference in corpora lutea number ($P>0.05$) at breeding or number of fetuses at pregnancy scanning. Lambs whose grand dam was a ewe-lamb were heavier at birth ($P<0.05$) but not at weaning ($P>0.05$) compared to those lambs whose grand dams was an adult ewe. This data suggests there are few negative impacts from selecting progeny born to ewe lambs as replacement ewes. However, before this hypothesis can be supported, lifetime data of these ewes needs to be collected.

Keywords: ewe lamb; hoggett; reproductive performance; mature ewe

Introduction

In New Zealand, the majority of ewes are bred for the first time at 18 to 19 months of age (see review Kenyon et al. 2014), however, breeding ewe-lambs (at 7 to 9 months of age) can increase lifetime production efficiency and increase profitability (Young et al. 2010). In addition, selecting progeny born to ewe-lambs as replacements can increase genetic gain by reducing the generation interval (Dýrmundsson 1973). There is, however, sparse information on the performance of offspring born to ewe-lambs compared with those born to mature adult ewes (Loureiro et al. 2011). Ewe-lamb progeny are typically lighter to at least one year of age compared to progeny born to adult ewes (Loureiro et al. 2011, 2012, 2015; Corner et al. 2013; Kenyon et al. 2014; Pain et al. 2015). Loureiro et al. (2012) and Pain et al. (2015) demonstrated that singletons born to ewe-lambs were lighter up to one year of age compared with those born to adult ewes, but their reproductive and lactational performance to four years, when first bred at 18 months of age, did not differ. This suggests that singletons born to ewe-lambs appear to be just as suitable as replacement ewes as those born to adult ewes. To date this relationship has not been examined in twins born to either adult ewes or ewe-lambs. In general, twins are lighter at birth and can remain lighter as mature animals in comparison to singletons (Kenyon et al. 2014) thus, the penalty in live weight observed in singletons born to ewe-lambs might be amplified in twins, which could impair their performance. Therefore, the aim of this study was to compare the live weights and the reproductive performance of singleton- and twin-born primiparous ewes born to either ewe-lambs or mature adult ewes.

Materials and methods

This study was conducted at Massey University's Keeble farm (latitude 41º 10'S, longitude 175º 36'E) 5 km south of Palmerston North, New Zealand, from April 2010 to December 2012 with the approval of the Massey University Animal Ethics Committee.

Background

This study utilized 115 Romney ewes born in September 2009 to either ewe-lamb or adult ewe dams (Loureiro et al. 2011; Corner et al. 2013). The ewes were themselves either singleton or twin born. This paper reports the performance of these offspring from 18 months (first breeding, April 2011) to 100 days after the weaning of their first set of lambs (December 2011). Four progeny groups were compared: singleton ewe progeny of ewe-lamb dams (n = 28); twin ewe progeny of ewe-lamb dams (n = 29); singleton ewe progeny of adult ewe dams (n = 17) and twin ewe progeny of adult ewe dams (n = 41). All ewe progeny were maintained as one cohort under commercial New Zealand grazing conditions from birth to the end of this study.

Experimental design

At 18 months of age the ewe progeny were oestrous synchronised utilising intravaginal progesterone devices (CIDR, Pharmacia & Upjohn, New Zealand) fourteen days prior to being naturally mated by eight Romney rams. Ovarian activity was checked nine days after CIDR removal using a real-time B-mode scanner (Mindray™, DP-6600 Vet, Nanshan, China) with a transrectal probe of 7.5 MHz (Viñoles et al. 2004). The number of corpora lutea (CL, as an indicator of ovulation rate) present on both ovaries was recorded per ewe. Pregnancy diagnosis was undertaken 54 days after the end of breeding, via ultrasound and the number of fetuses present was recorded in order to calculate pregnancy scanning percentage.

The ewes were weighed within an hour off pasture at ram introduction and on days 75 and 139 after ram introduction. In addition their body condition score (BCS; Jeffries, 1961) was determined at ram introduction and 139 days after ram introduction.

Lambs were weighed within 12 hours of birth, during twice daily lambing beats, and their birth rank and sex recorded. All lambs were born over a 23-day period (mid-point defined as L1). Lambs were weighed again at L100 (weaning).

Statistical analysis

The aim of the present study was to examine the productive consequences of being born to either a ewe-lamb dam or adult ewe dam, and to determine if any effects were influenced by their birth rank (singleton vs. twin). Therefore, in all models, even if the interaction between dam age and ewe birth rank was non-significant (P>0.05), the two-way interaction remained in the model to allow for testing of the study design. Statistical analysis was performed with Minitab® (version 16, Minitab Inc., Cary NC, USA) and SAS (SAS, Enterprise Guide® 5.2). Ewe live weights were analysed using the GLM procedure in Minitab and BCS via the MIXED procedure in SAS. Both models included the fixed effects of dam type and ewe birth rank, number of fetuses carried and the interaction between dam type and ewe birth rank. Date of lambing was tested as a covariate but removed from the model because it was not significant (P>0.05).

The number of CLs per ewe was analysed using a Poisson regression with a log-linear model, in SAS and back-transformed percentages presented. In the analyses, dam type and ewe birth rank and their interaction were included as fixed effects. Live weight during breeding was not significant (P>0.05) and, thus, was not retained in the final model.

The number of fetuses at pregnancy diagnosis (scanning percentage) and percentage of lambs weaned were analysed based on all ewes presented for breeding, in SAS, using GENMOD procedure with a Poisson regression analysis using a log-linear model. The analysis included dam type and ewe birth rank and their interactions as fixed effects. Live weight during breeding was not significant (P>0.05) and thus not retained in the final models. Least square means are presented as back-transformed values with back-transformed 95% confidence limits.

Lamb birth weight was analysed using the GLM model in Minitab. The model included date of birth as a covariate and lamb birth rank, grand dam type (ewe lamb vs adult ewe), ewe birth rank and the grand dam type and ewe birth rank interaction as fixed effects. Live weight at weaning (W100) was analysed with grand dam type, ewe birth rank and their two-way interaction as fixed effects, with and without date of birth and birth weight as covariates. Lamb birth rank was also included as a fixed effect.

During the study, two twin ewes born to adult ewes, one singleton born to a ewe-lamb and three twin ewes born to ewe-lambs were removed from the study due to illness or death. These losses occurred after day 139 of pregnancy. Therefore, their data is utilized in all analysis except for ewe live weight and BCS at weaning. No ewes used in the study were identified as triplet bearing/rearing.

Results

Ewe live weight and body condition score (BCS)

There was no significant interaction (P>0.05) between dam type and ewe birth rank for live weight or BCS (Table 1) at D0, D75 or D139. At D0, D75 and D139 twin born ewes were lighter (P<0.05) than singleton-born ewes and ewes born to ewe-lambs were lighter (P<0.05) than those born to adult ewes. There was no effect (P>0.05) of dam type or birth rank on ewe BCS.

At weaning, ewes born to ewe lambs were lighter (P<0.05, 63.6 ±1.07 vs 67.3 ±1.14 kg) than those born to adult ewes but displayed greater BCS (P<0.05, 2.7 ±0.06 vs 2.4 ±0.06). Twin born ewes had higher BCS than those born as singletons (P<0.05, 2.6 ± 0.05 vs 2.4 ± 0.07) but did not differ in live weight (P>0.05, 64.5 ±0.99 vs 66.4 ±1.25kg). There was no significant (P>0.05) interaction between dam type and ewe birth rank for either ewe live weight or BCS at weaning (data not shown).

Table 1 Live weight (kg) and body condition score of singleton and twin ewes born to ewe-lamb dams or adult ewe dams at breeding (D0), 75 days post the first day of breeding (D75) and at D139. Data presented are least square means ± standard error of the mean.

			Live weight (kg)			Body condition score	
		n	D0	D75	D139	D0	D139
Dam type	Ewe-lamb	57	58.3±0.71[a]	58.7±1.05[a]	68.7±1.23[a]	3.7 ± 0.06	3.0±0.07
	Adult ewe	58	63.7±0.77[b]	64.1±1.18[b]	74.6±1.38[b]	3.7 ± 0.06	3.0±0.07
Birth rank	Singleton	45	62.9±0.83[b]	63.3±1.18[b]	73.5±1.38[b]	3.7 ± 0.06	3.0±0.07
	Twin	70	59.1±0.66[a]	59.5±1.06[a]	69.9±1.25[a]	3.7 ± 0.05	3.0±0.06
Dam type*Birth rank[1]	Ewe-lamb*Singleton	28	60.7±1.0[b]	61.1±1.30[b]	71.0±1.53[ab]	3.6 ± 0.08	3.0±0.09
	Ewe-lamb*Twin	29	55.9±1.01[a]	56.4±1.29[a]	66.5±1.51[a]	3.8 ± 0.08	3.0±0.09
	Adult ewe*Singleton	17	65.2±1.30[c]	65.5±1.58[b]	75.9±1.86[b]	3.8 ± 0.08	3.0±0.11
	Adult ewe*Twin	41	62.2±0.84[ab]	62.7±1.20[b]	73.2±1.42[b]	3.6 ± 0.06	2.9±0.07

[ab] different superscripts within sections and columns indicate values that significantly differ (*P* <0.05)

[1] Dam type by Birth rank interaction

Table 2 Number of corpora lutea present (CL), pregnancy scanning percentage and percentage of lambs weaned for singleton and twin ewes born to ewe-lamb dams or adult ewe dams. Data presented are back transformed values with the back-transformed 95% confidence limits in parentheses.

		n	Number of CL	Pregnancy scanning % †	% lambs weaned †
Dam type	Ewe-lamb	57	1.49 (1.20 – 1.84)	152.6 % (132 – 189)	118.2 % (93 – 150)
	Adult ewe	58	1.32 (1.03 – 1.70)	167.7 % (135 – 209)	143.3 % (114 – 180)
Birth rank	Singleton	45	1.38 (1.06 – 1.79)	156.2 % (122 – 199)	139.3 % (108 – 180)
	Twin	70	1.43 (1.17 – 1.75)	163.8 % (136 – 198)	121.5 % (98 – 151)
Dam type*Birth rank[1]	Ewe-lamb*Singleton	28	1.54 (1.14 – 2.07)	148.1 % (108 – 201)	122.2 % (87 – 172)
	Ewe-lamb*Twin	29	1.45 (1.07 – 1.96)	157.1 % (117 – 211)	114.30% (80 – 161)
	Adult ewe*Singleton	17	1.24 (0.80 – 1.89)	164.7 % (113 – 238)	158.8 % (109 – 231)
	Adult ewe*Twin	41	1.41 (1.09 – 1.83)	170.7 % (135 – 215)	129.2 % (99 – 169)

[1] Dam type by Birth rank interaction
† based on all ewes presented to breeding

Ewe reproductive measures

Neither dam type or ewe birth rank (P>0.05) affected the number of CL present post CIDR removal (Table 2). In addition, the number of fetuses per ewe at pregnancy scanning and number of lambs weaned did not differ (P>0.05) due to dam type or ewe birth rank. There was no significant (P>0.05) interaction between dam type and ewe birth rank for any reproductive measures.

Progeny weights

Birth weight of lambs was affected by the lamb birth rank, singletons being heavier than (P<0.05) twins (Table 3). Lambs with a ewe-lamb grand dam were heavier (P<0.05) than lambs with a adult ewe grand dam when analysed both with and without date of birth as a covariate (data not shown). Dam birth rank did not (P>0.05) affect lamb birth weight. There was no interaction between grand dam type and ewe birth rank (P>0.05) for lamb birth weight.

At weaning, lambs born as singletons were heavier than twins, but there was no effect of grand dam type or dam birth rank. There was a significant (P<0.05) interaction between grand dam type and ewe birth rank at weaning (P<0.05), however pairwise comparison did not show differences between individual groups.

Discussion

The aim of this study was to compare the live weight and reproductive performance of singleton- and twin-born primiparous ewes born to either ewe-lambs or mature adult ewes. Ewes born to primiparous ewe-lamb dams were lighter to the weaning of their first lambs at approximately 27 months of age. This is a continuation of their lighter live weight reported to 12 months of age (Loureiro et al. 2011) and supports the results of a similar study that only included singleton born ewes (Loureiro et al. 2012; Pain

Table 3 Birth and weaning weights of singleton and twin lambs born to singleton and twin ewes born to ewe-lamb dams or adult ewe dams. Data presented are least square means ± standard error of the mean.

		Birth weight		Weaning weight	
		n	kg	n	kg
Lamb birth rank	Singleton	40	6.0±0.13[b]	26	33.8±0.77[b]
	Twin	138	4.5±0.07[a]	134	29.7±0.39[a]
Dam birth rank	Singleton	68	4.9±0.12	61	30.4±0.54
	Twin	110	4.8±0.10	85	30.5±0.48
Grand dam type	Ewe-lamb	81	5.1±0.11[b]	65	30.4±0.54
	Adult Ewe	97	4.7±0.11[a]	81	30.6±0.50
Grand dam type*Dam birth rank[1]	Ewe-lamb*Singleton	39	5.1±0.16	33	31.1±0.75
	Ewe-lamb*Twin	42	5.1±0.17	31	29.7±0.77
	Adult ewe*Singleton	29	4.7±0.19	28	29.8±0.80
	Adult ewe*Twin	68	4.6±0.12	53	31.4±0.60

[ab] different superscripts within sections and columns indicate values that significantly differ (P<0.05)
[1] Grand dam type by dam birth-rank interaction

et al. 2015). If the ewes born to ewe-lambs remain lighter for the remainder of their lifetime, without a proportional decrease in productive lamb performance, this could have implications for ewe productive efficiency. Pain et al. (2015) reported no difference in productive efficiency in singletons born to either ewe-lambs or adult ewes.

Progeny born to ewe-lambs gave birth to heavier lambs compared with ewes born to adult ewes, which concurs with the findings of Loureiro et al. (2012). In contrast, when the ewes used in this study were themselves born, those born to adult ewes were heavier than those born to ewe-lambs (Corner et al. 2013). It is unclear what drives this birth weight reversal effect. The differences in birth weight were not apparent at weaning, also supporting the results of Loureiro et al. (2012).

The reproductive performance, including ovarian activity, number of fetuses identified at pregnancy scanning and number of lambs weaned did not differ between the ewe groups, although caution is required in interpreting these results due to the relatively low numbers of ewes. These reproductive data, combined with the lack of difference in weight of lambs weaned, supports the findings of Loureiro et al. (2012) and Pain et al. (2015) showing that selecting ewe progeny born to ewe-lambs as replacement ewes does not affect flock performance. However, it is acknowledged that in all studies the ewe progeny were bred at 18 months of age and ewes born to ewe-lambs may have greater difficulty in achieving suitable weights for ewe-lamb breeding themselves.

Conclusions

Under the conditions of the present study, ewe-lamb progeny were lighter than the mature ewe progeny from their first breeding to the weaning of their lambs. Despite this apparent live weight disadvantage, there was no difference in the reproductive parameters measured and in weight of lambs weaned. These findings demonstrate that notwithstanding the differences in live weight, ewes born to ewe-lambs are suitable to be kept as replacement breeding ewes. However, before this can be confirmed, the lifetime performance of these ewes needs to be monitored and ideally the ewe-lamb progeny should be bred as ewe-lambs themselves.

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