



The Effect of Pelvic Area on Lambing Ease in Maiden Dorper Ewes

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Abstract

The aim of this study was to measure pelvic area in maiden Dorper ewes and to determine its effect on lambing ease, birth aid, parturition period and pelvic area to lamb weight ratio. The ewes' pelvic dimensions as well as the newborn lambs' external body measurements were taken. The young Dorper ewes (369) 9.31 months old, weighing approximately 52.32 kg were used for this study. Pelvic area of the young Dorper ewes measured $33.45 \pm 3.12 \text{ cm}^2$. The formula used to calculate the pelvic area was $\pi \times (\text{Pelvic height}/2) \times (\text{Pelvic width}/2)$. The pelvic area of ewes born as one of twins measured bigger than that of a single born lamb. Young Dorper ewes took $52.22 \pm 37.34 \text{ min}$ (67% assistance) to lamb. Pelvic area to birth weight ratio was 9.69 cm^2 to 1 kg lamb born in the Dorper ewes. Significant correlations between lambing ease score and other parameters were recorded in ewes and lambs. It was concluded that Dorper lamb parameters correlated between 20% to 80% with one another and the effect on lambing ease was influenced the most by the lambs' head circumference and birth weight of the ewe with an R^2 of 0.243.

Keywords: Birth aid; Dorper maiden ewes; Lambing ease; Parturition period; Pelvic area

INTRODUCTION

Reproduction worldwide in sheep is being hampered by lamb mortality and up to 80% of losses may occur during the perinatal period (within seven days of birth, just before or during) [1]. The Dorper breed has recently received negative publicity for its increasing levels of dystocia, especially amongst young maiden ewes. Dystocia according to Mee. [2] can be described as the incompatibility of the maternal pelvis size and the lamb size. [3] Reported that a disparity between the newborn's weight at birth and the dam's pelvic area causes dystocia. Small maternal pelvic size has been associated with dystocia, still-birth and mal-presentation [4]. According to Dywer. [5] prolonged parturition period reduces lamb survival. Selection of replacement ewes that were born as one of a twin or multiple birth can decrease dystocia due to the larger pelvic area of these ewes [6]. Van Rooyen et al. [7] found a low correlation of 26% between body weight and pelvic area of the ewe, and therefore heavier ewes would not necessarily have larger pelvic areas. A natural birth without complication due to an optimum birth weight is ideal because the increase of neonatal mortalities is associated with low birth weights, while dystocia and maternal deaths are related to high birth weights [8]. Van Rooyen et al. [7] found a non-significant relationship between the slope of the rump and the pelvic area in yearling ewes. In 50% of dystocia cases which was reported by Cloete et al. [4] the South African Mutton Merino sheep breed suffered from a feto-pelvic area disproportion.

Measuring pelvic areas is beneficial regarding perinatal instability for both ewes and lambs and can serve as a tool for ewe selection to lessen dystocia. Pelvic area is between 50 – 60% heritable [9,10] found a Low Lambing Ease (LE) heritability of between 3.8% and 9.7%. Fourie and Van Rooyen [7] found that the lambing ease in Dorper ewes was influenced

by the birth status of the ewe. Furthermore, Fourie and Van Rooyen [7] reported that the birth status seems to correlate with the pelvic area and reported that 36% of ewes born as a single lamb has been assisted as opposed to 32% of ewes that were born as one of twins or multiple birth. Therefore, LE should be included in the selection criteria for replacement ewes. It should also be considered that lamb's birth weight is amongst other, influenced by the body condition score of ewes before conception [8].

The aim of this study was to use pelvic area measurements, birth weight, parturition period, and external body measurement of newborn lambs to identify the main sources of dystocia in maiden ewes.

MATERIALS AND METHODS

Three hundred and sixty-nine (369) young Dorper ewes, 9.31 months old, weighing 52.32 kg were used for this study and multiple sire mating was applied. The Dorper ewes were stud animals and their Body Condition Score (BCS) ranged between 3 and 4. The Dorper ewes were inseminated laparoscopically in seven groups over a period of two years. During late pregnancy the ewes were managed semi-intensively although care was taken to prevent that animals became under or over conditioned. The ewes stayed in the pens (partially open shed with the northeastern side closed) during the last week of pregnancy and received a feed supplement containing 14.83% CP and 9.4 MJ ME/kg DM (3% of body weight per ewe per day) and clean drinking water.

The pelvic areas of the ewes were measured (using a pelvic meter, Patent P59736ZP00) pre-insemination to calculate the pelvic area. The calculation used to determine the pelvic area was $\pi \times (\text{PH}/2) \times (\text{PW}/2)$, with the pelvic width (PW) measured as the greatest distance between the shafts of the iliae and the Pelvic Height (PH) measured as the distance between the pubic symphysis and the sacral promontory [7,11,12].

The pelvic measurements were taken using the following technique. Firstly, the animal was restrained in a light manual crush by helpers while maintaining a comfortable, normal standing position. Secondly, remaining faecal matter was removed from the rectum if present, after which the apparatus was cautiously inserted intra-rectally Van Rooyen et al. [7]. Once the disinfected apparatus was treated with lubricant it was introduced gently into the ewe's rectum. Light force on the handgrip of the apparatus assisted the researcher to recognize pecten of the pubis by feel, which was then used as a location to measure the distance between pubic symphysis and sacral promontory for pelvic height. The pelvic width was then determined by turning the apparatus 90° sideways to determine the distance between the shafts of the iliae [4,7,11-13]. The last measurement was done by pulling the apparatus slightly backwards

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with a turning motion and then measuring the distance between the two ischial tuberosities points also known as sit bones. Once the measuring process was completed the apparatus was removed gradually from the animal. Finally, the apparatus was thoroughly washed with clean water and antiseptic solution before use in the next animal Van Rooyen et al. [7]. All dimensions were taken in centimeters. The following measurements were recorded: body weight before mating, ewe's own birth status, pelvic area of the ewe, gestation length in days and lambing ease on a scale from 1-6 (Table 1). [14]

Table 1: Score and description for lambing ease

Score	Code	Description
1	No assistance	Ewe can lamb in the veld or pen without any assistance.
2	Gently pull	Ewe is assisted. Lamb is pulled gently and is pulled out easily
3	Hard pull	Ewe is assisted. Lamb is pulled hard and difficult to get out but comes out live.
4	Cannot lamb	Ewe cannot lamb. Lamb must be removed from the ewe in an alternative way.
5	Lamb dead	Lamb is dead. Lamb died during birth or died within 48 hours after birth because of difficult birth (not killed by predator).
6	Abnormal foetus position	Lamb is backwards or in an abnormal position

The following measurements were taken from the newborn lambs within 24 hours after the ewes lambed. The body weight (BWL), birth status (BSL), Gender (G), circumference of the lamb's head (LHC), width of the lamb's shoulders (LSW), chest circumference (LCC) on the widest point (mid sternum), and pastern circumference (LPC). The monitoring of the birth process was done by making use of CCTV (closed-circuit television) day/night camera. Loveday's infrared camera was installed at a height of 2 m above the lambing pen. This data was recorded to a Loveday DVR with an internal capacity of 2 Gigabyte. Continuous video was taken of the ewes from a week prior the expected lambing date until the lambing process was completed. Parturition time and ewe behavior during the lambing process was available. Ewes were assisted if they could not give birth on their own after one hour. Analysis of variance were conducted to determine the statistical significance of the variables using SPSS. A stepwise regression analysis to determine the individual influence of parameters on LES. A Pearson correlation was carried out to determine the relationship between variables. Statistical significance was set at ($P < 0.05$).

RESULTS AND DISCUSSION

The pelvic area of Dorper ewes (DO) measured $33.45 \pm 3.12 \text{ cm}^2$. Van Rooyen et al. [7] reported a mean pelvic area in yearling Dorper ewes of 35.55 cm^2 and found in Dorper rams the growth curve of the pelvic area stabilize on a 12 to 13-month animal.

Pelvic height and width measured $6.58 \pm 0.36 \text{ cm}$ and $6.46 \pm 0.36 \text{ cm}$ respectively. Briedenhann [15] stated that the width of the pelvic is more significant in *Bos taurus* cattle while pelvic height is more significant in *Bos indicus* cattle.

The ratio between pelvic area and birth weight of the lamb was 9.69 cm^2 : 1 kg lamb born. Jacobsz and Fourie [16] reported a ratio of 7.64 cm^2 : 1 kg lamb born in Dohne Merino ewes. Despite the more favourable ratio in the Dorper ewes, 67% needed assistance (Table 2). Deutscher [17] also

emphasised the importance of pelvic area to calf birth weight ratio, these ratios are useful in predicting which heifers may require assistance during calving. Although norms do not exist, the young Dorper ewes which did not experience dystocia had a ratio of 10.98 cm^2 : 1 kg lamb born.

The Dorper ewes' mating age and weight were 15.31 ± 1.68 months and $52.32 \pm 6.35 \text{ kg}$ respectively. Van Rooyen et al. [7] recorded a similar mating weight of 48 kg at the age of 12 months for young Dorper ewes. The ewes took $52.22 \pm 37.34 \text{ min}$ (67% human intervention) on average to expel the new-born lamb as measured from the start of stage two of parturition (Table 2). In the case of short uncomplicated births, the ewes are more likely to accept the new-born whereas a lengthy parturition periods rejection are more likely to occur [5,18]. Gestation length was (146.21 ± 1.81 days). The Birth Status (BS) and PA of ewes are illustrated in Figure 1. There was a difference ($p < 0.01$) in PA between the ewes which had been born as a single lamb, as opposed to those born as one of twins or born as one of triplets.

Table 2: Pelvic parameters mean (\pm SD) of the young Dorper ewes.

Parameters	Mean \pm SD
Pelvic Height	6.58 ± 0.36
Pelvic Width	6.46 ± 0.36
Pelvic Area (cm^2)	33.45 ± 3.12
Pelvic Area : Birth Weight ratio	9.69
Age at lambing (months)	15.31 ± 1.68
Mating weight / kg	52.32 ± 6.35
Parturition period stage 2	52.22 ± 37.34
Gestation length (days)	146.21 ± 1.81
Percentage ewes assisted	67

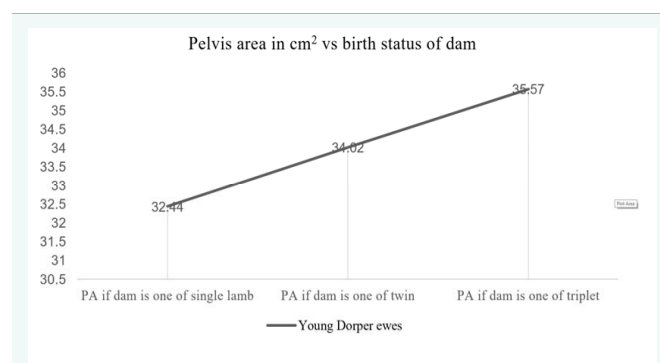


Figure 1 The size of the pelvic area in cm^2 and birth status of the dam.

Dorper ewes' PA's measured in cm^2 were as follows: a single 33.44 cm^2 , twin 34.02 cm^2 and triplet 35.57 cm^2 . The Dorper ewes measured linearly larger when the ewe was one of a multiple birth. These results are in agreement with Fourie and Van Rooyen [6] who found that Dorper ewes that were born one of a twin or multiple lamb experienced less dystocia when they lambed themselves. The birth weight of Dorper lambs measured $3.70 \pm 0.85 \text{ kg}$. Birth weight in sheep is 30% heritable according to Massey and Vogt [19]. Shoulder width measured ($8.19 \pm 9.04 \text{ cm}$), the lambs' pastern circumference measured $8.34 \pm 0.89 \text{ cm}$ while the lambs' head circumference and chest circumference measured $25.03 \pm 1.70 \text{ cm}$ and $36.02 \pm 4.36 \text{ cm}$ respectively (Table 3).

Dorper ewes recorded correlations from very low (0.19) to very high (0.89) between ewe parameters (Table 4). Pelvic Area (PA) and Pelvic Width (PW) has a very high correlation of 0.89 ($p < 0.01$) similar to PA and pelvic height (PH) with a correlation of 0.81 ($P < 0.01$) which is expected as PA is a function of PH and PW. Van Rooyen et al. [7] also found the correlations between PA to PW and PH to be high, 84% for pelvic height and a very high 94% for pelvic width. Kinne [9] found that pelvic area is



between 50 – 60% heritable, about twice the heritability of birth weight of 30%. Birth Status of the Ewe (BSE) and PA have a low positive correlation of 0.38 ($p < 0.01$). Average Birth Time (ABT) and Birth Weight of the Lamb (BWL) are positively correlated (0.50; $p < 0.01$), the less the lamb weighs the quicker the ewe will deliver the lamb (Table 4). Dwyer and Lawrence [20] also stated that lamb survival is influenced by the birth weight of the new-born lamb.

Table 3: Body measurements (Mean ± SD) of new-born Dorper lambs.

Parameters	Mean ± SD
Lamb birth weight (kg)	3.70 ± 0.85
Lambs' shoulder width (cm)	8.19 ± 9.04
Lambs' head circumference (cm)	25.03 ± 1.70
Lambs' chest circumference (cm)	36.02 ± 4.36
Lambs' pastern circumference (cm)	8.34 ± 0.89

Table 4: Correlations of parameters for young Dorper ewes, (significant in bold).

Parameter	PA	ABT	BWL	PH	PW	BA	LES	BSE
PA		-0.12	-0.059	0.814	0.892	-0.108	-0.126	0.383
ABT			0.501	-0.121	-0.069	0.457	0.494	-0.192
BWL				-0.072	-0.032	0.461	0.535	0.050
PH					0.499	-0.134	-0.179	0.454
PW						-0.061	-0.045	0.194
BA							0.806	-0.195
LES								-0.122
BSE								

Average birth time and Birth Aid (BA) (less aid required during lambing when parturition period was shorter) were also moderately correlated (0.46; $p < 0.01$). Average birth time and LES were also positively correlated 0.49 ($p < 0.05$) (the shorter the parturition period the easier the ewe lamb with a lower/better score on the LES score card). Dwyer and Lawrence [20] also stated that lamb survival is influenced significantly by the time the ewe takes to deliver the lamb. The BWL and BA were positively correlated (0.46; $p < 0.01$), less aid was therefore needed when BWL was lower (Table 4). Lambing ease score and BWL were positively 0.53 ($p < 0.01$) correlated. Pelvic height and PW also have a positive correlation of 0.49 ($p < 0.01$). Pelvic height and BSE are also correlated moderately positive 0.45 ($p < 0.01$).

The size of the lamb's head ($p < 0.05$) the average birth time ($p < 0.05$) and birth weight of the ewe ($p < 0.05$) made a significant contribution to the regression model of the variability in LES (Table 5).

Table 5: Independent variables that influence lambing ease in both Dorper ewes and lambs.

Variables	LES
Lamb head circumference	0.165
Average birth time	0.007
Birth weight of ewe	-0.255
Pelvic area	N/S
Pelvic height	N/S
Pelvic width	N/S
Gestation length	N/S
Ewes' weight when mated	N/S
Lambs' shoulder width (cm)	N/S
Lambs' chest circumference (cm)	N/S
Lambs' pastern circumference (cm)	N/S
R ²	0.243

From Table 6 it can be derived that Birth Aid (BA) and Lamb Head Circumference (LHC) have a moderate positive correlation of 0.47 ($P < 0.01$) which means the lamb's head circumference significantly contributed to aid during the birth process. Lambing ease score and LHC showed a medium correlation (0.53; $p < 0.01$). Birth aid had a weak positive correlation with Lamb Pastern Circumference (LPC) (0.20; $p > 0.05$). Lamb Chest Circumference (LCC) and BA had a moderate correlation of 0.45 ($P < 0.01$). Lamb chest circumference (LCC) and (LES) correlated positively (0.54; $p < 0.01$).

From these parameters LCC and LHC recorded the highest correlation of (0.79; $p < 0.01$). Lamb pastern circumference (LPC) correlated moderately positive 0.48 ($p < 0.01$) with LCC and (0.37, $p < 0.01$) low positive with LHC. Lamb shoulder width (LSW) had a significant ($p < 0.01$) and positive correlation with the following parameters: 0.49 with BA, 0.45 with LES, 0.48 with LHC, 0.44 with LPC and 0.59 with LCC (Table 6). Sørensen et al. [10] found that lambing ease is a heritable trait and can be used to genetically improve the ewe herd.

Table 6: Correlations of lambing ease score and lamb parameters.

Parameter	BA	LES	LHC	LPC	LCC	LSW
BA		0.806	0.478	0.209	0.457	0.492
LES			0.535	0.236	0.541	0.458
LHC				0.379	0.799	0.489
LPC					0.486	0.448
LCC						0.593
LSW						

BA = Birth Aid, LES = Lamb ease score, LHC = Lamb head circumference, LPC = Lamb pastern circumference, LCC = Lamb chest circumference, LSW = Lamb shoulder width

CONCLUSION

Lambing ease in the Dorper ewes was influenced the most by the lambs' head circumference, average birth time and birth weight of the ewe. Despite the Dorper ewes' favorable pelvic area to lamb birth ratio, a significant percentage of ewes struggled with dystocia. This may be an indication that the Dorper has some form of conformational dysfunctionality resulting in difficult birth. On the other hand, it may be an indication that the practice to mate young Dorper ewes at the age of nine months contributes to the dystocia experienced. The ewes that were born as one of twins recorded larger pelvic areas. This may indicate that by selecting for multiples the pelvic size in replacement ewes may increase over time. It is recommended that ewes be mated at a later age.

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