# Preliminary note on mature pelvic dimensions and rearing efficiency in Merino ewes

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Radiographic pelvimetry was used to obtain estimated pelvic dimensions for Merino ewes, born in 1981 and available for five lambing opportunities in the Tygerhoek flock. Estimated pelvic dimensions accurately predicted dissected measurements obtained from 37 ewes that were slaughtered, as reflected by correlation coefficients higher than 0,97. In a group of 72 ewes which lambed at least four times in five opportunities, transverse and conjugate diameters were virtually uncorrelated. These ewes were classified according to their rearing efficiency as 'good' or 'poor' mothers. It was established that the 27,8% 'poor' mothers were responsible for 60,7% of the failures to rear at least one lamb to 100 days. The conjugate diameter of 'good' mothers tended ($P = 0,06$) to be larger than in 'poor' mothers. This tendency is supported by evidence in literature cited, which highlights the importance of pelvic measurements in rearing efficiency of ewes. Further research in this field appears to be warranted.

Radiografiese pelvimetrie is gebruik om geskatte pelvismates in 'n groep Merino-ooie, gebore in 1981 en beskikbaar vir vyf lamgeleenthede in die Tygerhoekkudde, te verkry. Die geskatte pelvismates het werklike pelvisafmetings van 37 ooie, wat vir dié doel geslag is, akkuraat voorspel, soos weerspieël in korrelasiekoëffisiënte van hoër as 0,97. Die transversaal- en konjugaatdeursneë van 72 ooie wat minstens vier keer uit vyf geleenthede gelam het, was grootliks ongekorreleerd. Hierdie ooie is op grond van vermoë om hulle lammers tot 100 dae groot te maak as 'goeie' en 'swak' moeders geklassifiseer. Daar is vasgestel dat die 27,8% 'swak' moeders betrokke was by 60,7% van die geleenthede waarby geen lammers tot 'n ouderdom van 100 dae grootgemaak is nie. Die konjugaatdeursneë van 'goeie' moeders het geneig ($P = 0,06$) om groter te wees as by 'swak' moeders. Hierdie neiging word ondersteun deur resultate in aangehaalde literatuur, wat dui op die belang van pelvisafmetings ten opsigte van die vermoë van ooie om hulle lammers groot te maak. Verdere ondersoeke in hierdie gebied blyk geregverdig te wees.

**Keywords:** Pelvic dimensions, radiographic pelvimetry, rearing ability

In the past, research on lamb mortalities was largely centred on the role of environmental factors, and those inherent to the lamb in survival, without reference to the ability of ewes to rear their progeny. The survival of lambs to weaning is presently seen as a successful partnership between mother and offspring during pregnancy, birth and lactation (Haughey, George & McGuirk, 1985). In Australian sheep flocks, it has been demonstrated that a minority of ewes failing repeatedly accounted for the majority of rearing failures. According to Haughey *et al.*, (1985) repeated rearing failure was associated with small maternal pelvic size in two out

**Table 1** Mean values for, and statistical information regarding the linear regressions of dissected pelvic measurements on estimated dimensions (n = 37)

| Pelvic dimension | Estimated (X) ($\bar{x} \pm SD$) | Dissected (Y) ($\bar{x} \pm SD$) | Regression equation (y = a + bx) | Correlation coefficient (r) |
|---|---|---|---|---|
| Transverse diameter (cm) | 8,7±0,53 | 8,5±0,49 | y=0,631+0,898x | 0,975** |
| Conjugate diameter (cm) | 11,6±0,87 | 11,4±0,82 | y=0,696+0,929x | 0,979** |
| Pelvic area ($cm^2$) | 101,3±11,2 | 97,2±10,3 | y=5,021+0,910x | 0,983** |

** Significant ($P \leq 0,01$).

of three flocks. Dystocia studies, involving smaller numbers of sheep, also demonstrated that the pelvic outlets of ewes with a known history of malpresentations, assistance at birth and stillbirths were markedly smaller than in contemperaries with good rearing records (Quinlivan, 1971; Fogarty & Thompson, 1974). Data of a South African Merino flock were thus analysed, to determine if similar patterns existed locally.

Ewes of the Tygerhoek Merino flock, born in 1981 and surviving five lambing opportunities from 1983 through 1987, were used in this study. The origin of the flock and selection procedures implemented therein have been adequately documented (Heydenrych, 1975; Heydenrych, du Plessis & Cloete, 1984). Estimates of the transverse and conjugate diameters, as well as the area of the pelvic inlet, were obtained by radiographic pelvimetry, using Method C based on similar triangles described by Haughey & Gray (1982). The transverse diameter was defined as the greatest distance between the shafts of the ilia of the pelvis, the conjugate diameter as the distance between the pecten of the pubis and the sacral promontory, and the area of the pelvic inlet as the product of the transverse and the conjugate diameter. Dissected measurements, obtained from 37 ewes that were slaughtered to obtain regression equations for the correction of radiographic estimates, were regressed on these estimates.

Further analyses were done on 72 of the total number of ewes – including a number of ewes that were slaughtered – which lambed at least four times out of five opportunities. Phenotypic correlations amongst corrected pelvic dimensions and live mass at radiography and 18 months were calculated. These ewes were also arbitrarily divided in two groups, according to rearing ability (the ability to rear at least one lamb to an age of 100 days) and/or rearing performance (the ratio of lambs weaned to 100 days per lamb born). The group of ewes with a 'poor' rearing performance was defined as ewes failing to rear at least one lamb on two or more lambing opportunities, or that reared 50% or less of lambs born. Ewes with a 'good' performance correspondingly failed to rear one lamb at a maximum of one opportunity, and reared more than 50% of lambs born. Least-squares procedures (Harvey, 1977) were used to compare the mean pelvic dimensions of these groups.

Statistical information regarding the linear regressions of dissected pelvic measurements on estimated dimensions is presented in Table 1. Dimensions estimated by radiography tended to overestimate dissected measurements slightly, as was also reported by Haughey & Gray (1982). Dissected measurements could nevertheless be predicted accurately from the radiographs, as reflected by the high r-values reported in Table 1. These results are consistent with those presented by McSporran & Wyburn (1979) and Haughey & Gray (1982).

Corrected transverse and conjugate diameters were practically uncorrelated (Table 2), as was also reported by Fogarty & Thompson (1974) and Haughey *et al.*, (1985). Both dimensions were correlated with the area of the pelvic inlet, as expected. The corrected transverse diameter and pelvic area were also correlated ($P \leq 0,05$) with live mass at radiography. No significant correlation was obtained between corrected conjugate diameter and live mass at radiography, as was also reported by Fogarty & Thompson (1974). All pelvic dimensions were significantly ($P \leq 0,05$) correlated with live mass at 18 months. The lower correlations of pelvic dimensions with mature live mass are possibly due to the confounding effects of body condition and skeletal size in this trait, opposed to 18 months mass which is more likely to be dependent on skeletal size alone.

Ewes classified as 'good' or 'poor' mothers were similar with regard to number of lambings/ewe, lambs born/lambing and lambs born/ewe (Table 3). The large differences regarding rearing efficiency were expected,

**Table 2** Phenotypic correlation matrix for pelvic dimensions and live mass (n = 72)

| Trait | Trait | | | |
|---|---|---|---|---|
| | Conjugate diameter (cm) | Pelvic area ($cm^2$) | Live mass (kg) at radiography | Live mass (kg) at 18 months |
| Transverse diameter (cm) | −0,022 | 0,646** | 0,298* | 0,455** |
| Conjugate diameter (cm) | | 0,744** | 0,109 | 0,264* |
| Pelvic area ($cm^2$) | | | 0,286* | 0,488** |
| Live mass at radiography (kg) | | | | 0,644** |

* Significant ($P \leq 0,05$).

** Significant ($P \leq 0,01$).

**Table 3** The lambing and rearing efficiency, live mass and pelvic dimensions of ewes classified as 'good' or 'poor' mothers

| | 'Good' mothers | 'Poor' mothers |
|---|---|---|
| No of ewes | 52 | 20 |
| No of lambing opportunities | 5 | 5 |
| No of lambings | 243 | 90 |
| **Lambing performance** | | |
| Lambings/ewe | 4,7 | 4,5 |
| Lambs born/lambing | 1,37 | 1,42 |
| Lambs born/ewe | 6,4 | 6,4 |
| **Rearing performance** | | |
| Rearing successes/lambing | 0,75[a] | 0,41[b] |
| Partial failures/lambing (1 twin died, 1 twin reared) | 0,15 | 0,18 |
| Total failures/lambing | 0,10[a] | 0,41[b] |
| **Live mass (kg)** at | | |
| 18 months | 44,7 | 45,0 |
| radiography | 57,7 | 59,8 |
| **Pelvic dimensions** | | |
| Transverse diameter (cm) | 8,6 | 8,7 |
| Conjugate diameter (cm) | 11,8 | 11,4 |
| Pelvic area ($cm^2$) | 101,3 | 98,8 |

[a,b] Denote significance ($P \leq 0,05$) by chi-square test.

as it was considered in the classification of the ewes. It is nevertheless evident that the 'good' mothers reared at least one lamb at 90% of their lambings, while the 'poor' mothers did so at only 59% of occasions. It is also clear from Table 3 that the 27,8% (20 out of 72) 'poor' mothers were responsible for 60,7% (37 out of 61) of the total rearing failures. This finding is in good agreement with corresponding results reported by Haughey *et al.*, (1985).

The total number of ewes available for this preliminary investigation (72) was small, especially if the numerous causes of preweaning lamb mortality and rearing failure are considered. No difference was obtained in the live mass of ewes at 18 months, although 'poor' mothers tended to be heavier than 'good' mothers at radiography (Table 3). This tendency could possibly be ascribed to a better condition in the former – since they reared fewer lambs – and not to differences in skeletal size. Biased pelvic dimensions owing to differences in skeletal size is, in fact, highly unlikely when seen in relation to group means for 18 months live mass. The corrected transverse diameter of 'good' and 'poor' mothers was similar (Table 3). The corrected conjugate diameter of 'good' mothers tended ($P = 0,06$) to be larger than in 'poor' mothers. When seen in relation to results reported by Haughey *et al.*, (1985), where the conjugate diameter was identified as the important dimension determining rearing efficiency in ewes, it is evident that the same principles are likely to be involved in South African sheep flocks. The corrected area of the pelvic inlet of 'good' and 'poor' mothers did not differ significantly, but tended to be larger for 'good' ewes.

It can be concluded that repeated failure by a small proportion of ewes largely contributed to the total number of rearing failures in the group of ewes concerned. According to the literature, repeated rearing failure is commonly associated with small maternal pelvic size, and particularly a small conjugate diameter (Quinlivan, 1971; Fogarty & Thompson, 1974; Haughey *et al.*, 1985). In this study, the difference in conjugate diameter of ewes classified as 'good' or 'poor' mothers approached significance ($P = 0,06$) even on the small sample of ewes included, thus supporting the above evidence. Pelvic size appears to be but one of the factors influencing successful rearing of lambs by ewes. Other factors that may also be involved include aberrant maternal or fetal behaviour (Alexander, 1984), heritable fetal oversize due to prolonged gestation (Haughey, 1984), low tolerance to cold (Slee, 1981), inadequate milk supply, teat and udder abnormalities (Moule, I954), and mismothering induced by high stocking rates (Alexander, Stevens & Mottershead, 1983). Evidence that at least some of these aspects are genetically determined is reflected in reports of selection responses in lamb mortality and/or ewe rearing efficiency (Atkins, 1980; Donnelly, 1982; Haughey, 1984). Presently, very little is known of the importance of the afore-mentioned effects in local sheep flocks, and research in this field is warranted.

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