Indian Journal of Animal Sciences **94** (10): 852–855, October 2024/Short communication
https://doi.org/10.56093/ijans.v94i10.152293

Systemic investigation of pelvimetric profile in three strains of Deoni cattle

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Received: 1 June 2024; Accepted: 27 August 2024

Keywords: Deoni, Dystocia, Pelvimetry

Deoni is one of the important dual-purpose breeds of India. Based on coat colour variation Balankya, Wannera and Shevera are the three important strains of Deoni cattle. The Balankya strain is characterised by white coat colour with black spots on the lower side of the body. The Wannera strain is characterised by clear white and black colour on the side of the face, while the Shevera strain has a white body with irregular black spots (Dongre *et al*. 2017). Several studies have been carried out on different aspects of productive and reproductive performances of three sub-breeds of Deoni (Basak and Das 2018), but the scientific research on the pelvimetric profile of the Deoni cattle is in dearth, which can act as an important marker for selection of females for breeding.

Pelvimetry is the branch of obstetrics that deals with the pelvic diameters. Hiew and Constable (2015) described the use of pelvimetry to predict the eutocia/dystocia. Dystocia, i.e. difficulty in parturition is one of the most important causes of prenatal death of the foetus due to abnormally small and misshaped pelvis resulting in foetopelvic disproportion or incompatibility. The pelvimetric measurements could be used accurately for prediction of eutocia/dystocia in various breeds. The invasive nature of internal pelvimetry raises the issue of animal welfare, as there is a potential risk of damaging rectal mucosa. However, this data must be known in order to start the selection of the heifers/ cows with wider pelvic sizes. Therefore, the possible way is to determine the internal pelvic size from the external pelvimetry.

Extensive pelvimetric studies were carried out in indigenous cattle (Waziri *et al*. 2011, Lalrintiuanga and Lallianchhunga 2012, Perumal and Rajkhowa 2013), river buffaloes (Oliveira *et al*. 2001), swamp buffalo (Perumal 2013), tho tho cows (Perumal and Rajkhowa 2013), Mithun cows (Perumal *et al.* 2013), crossbred cows of Andaman and Nicobar Islands (Perumal *et al*. 2019) and in Marathawadi buffaloes during the transition period (Swami 2017). Considering the importance of the pelvimetric measurements and the current gap in scientific research in Deoni cattle, the present research work was designed with the objective to study and establish the baseline data on pelvimetry of three different strains of Deoni cattle and to provide the pelvimetric basis for the selection of Deoni heifers and cows for future breeding programmes.

A research study was conducted under the Jurisdictional area of the College of Veterinary and Animal Sciences, Udgir, District Latur, which is under the Maharashtra Animal and Fishery Sciences University, Nagpur, Maharashtra.

Deoni cattle (270) of Wannera, Balankya and Shevera strain were selected for this study. The animals were divided into six groups based on the age of the animal and grouped as: Group I (12 to 24 months), II (25 to 36 months), III (37 to 48 months), IV (49 to 60 months), V (61 to 72 months) and VI (73 to 84 months), respectively with 45 animals in each group. Each group was further sub-divided into three strains of Deoni cattle, i.e. Wannera, Balankya and Shevera with 15 animals of each strain. Different pelvimetric parameters were calculated to determine the pelvic area of all the selected cattle under this study. Self-constructed pelvimetric calliper along with measuring tapes and scales (Fig. 1) were used to measure different body parameters such as, the distance between two angles of haunch (Fig. 2A), the distance between two ischial

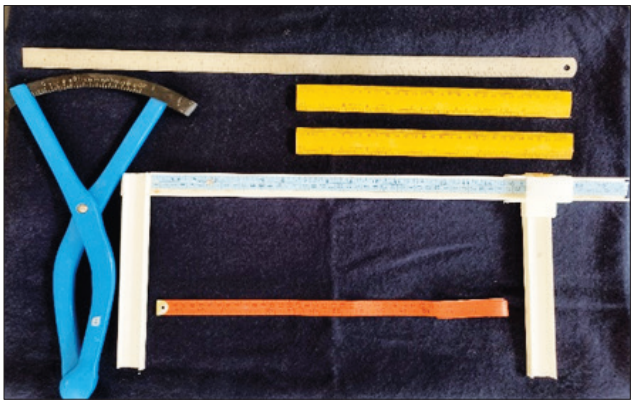

Fig. 1. Self-constructed Pelvimetric Calliper, rice pelvimeter and measuring tape.

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Fig. 2. Measurements of Distance between two angles of haunch (A); Distance between two tuber ischia (B); Distance between point of croup and level of hip joint (C); Distance between tuber ischia and tuber coxae (D).

tuberosities (Fig. 2B), the distance between point of croup and level of hip joint (Fig. 2C) and the distance between tuber coxae and tuber ischia of the same side, i.e. pelvic length (Fig. 2D). The body length and chest girth were also measured to calculate the body weight of the cattle using Shaeffer's formula.

The transverse and vertical diameters of the pelvic inlet and outlet were determined using the formula described by Fleming and Craig (1930):

Transverse diameter of the pelvic outlet (TDPO) = [Distance between two angles of haunch + Distance between two ischial tuberosities] / 4

Vertical diameter of the pelvic outlet (VDPO) = ¾ [Distance between the point of croup and level of the hip joint]

Transverse diameter of the pelvic inlet (TDPI) = 12.2/10 [Transverse diameter of the pelvic outlet (TDPO)]

Vertical diameter of the pelvic inlet (VDPO) = 13/10 [Vertical diameter of the pelvic outlet (VDPO)]

Based upon these, transverse and vertical diameters of the pelvic inlet and outlet, the pelvic area was determined as follows:

Pelvic area of the outlet (PAO) = TDPO × VDPO

Pelvic area of the inlet (PAI) = TDPI × VDPI

The results of body weights (Mean±SE) for different age groups and strains highlighted a general increase in body weight from Group I to VI, with highly significant (p<0.01) differences between the age groups. The mean observed weight for three different strains of Deoni cattle are shown in Table 1 and the correlation between different pelvimetric parameters in different age groups is given in Table 2.

The data shows gradual increase in body weight between consecutive groups with the lowest at younger age and higher as age advanced. The body weight of Deoni cattle showed a positive correlation (r=0.59) with pelvic area, reflecting that the pelvic area increases as the body weight increases. Perumal *et al*. (2013) found similar results in Mithun cows where the body weight differed significantly (p<0.05) between the different age groups. Smeaton (2004) reported significant correlation (r^2 = 0.56, p<0.05) between live weight and the pelvic area of Holstein Friesian and Jersey cows which is in consonance with current findings. Bila *et al.* (2021) found that body weight has highly positive significant correlation with pelvic area in Sussex heifers.

The pelvic outlet and inlet area (Mean±SE) are given are in Table 1. The statistical analysis showed highly significant (p<0.01) differences in pelvic inlet and outlet area among the different age groups of Deoni cattle representing that the age is positively correlated with body weight (r=0.66) and pelvic area (r=0.85). The results also revealed that the mean

Table 1. Comparison of body weight and pelvimetric parameters of three strains of Deoni cattle in various age groups

Parameter	Group						p-value
	I	II	III	IV	V	VI	
Body weight (kg)	181.09^{d}±5.69	229.08^{c}±5.27	261.24^{b} ± 6.29	286.83^{a}±6.02	295.61^{a}±7.71	305.40^{a}±0.55	0**
A (cm)	27.37^{f}±0.21	28.54^{e}±0.25	31.60^{d} ± 6.29	33.18^{c}±0.31	36.74^{b}±0.25	38.27^{a}±0.55	0**
B (cm)	13.10^{d}±0.13	13.09^{d}±0.26	14.24^{c} ± 0.21	15.90^{b}±0.20	15.69^{b}±0.17	17.61^{a}±0.24	0**
C (cm)	15.63^{d}±0.27	16.02^{d} ±0.20	16.99^{c} ± 0.21	18.00^{b}±0.18	18.41^{ab}±0.14	18.76^{a}±0.24	0**
D (cm)	33.07^{d}±0.45	36.42^{c}±0.54	37.31^{c}±0.58	40.20^{b}±0.42	40.09^{a}±0.37	41.87^{a}±0.49	0**
TDPO (cm)	10.12^{e}±0.06	10.41^{e}±0.10	11.46^{d}±0.09	12.27^{c}±0.09	13.11^{b}±0.08	13.97^{a}±0.19	0**
TDPI (cm)	12.34^{e}±0.07	12.70^{e}±0.12	13.98^{d}±0.12	14.97^{c}±0.11	15.99^{b}±0.10	17.04^{a}±0.23	0**
VDPO (cm)	11.73^{d}±0.21	12.02^{d}±0.15	12.74^{c}±0.12	13.50^{b}±0.14	13.81^{ab}±0.10	14.07^{a}±0.18	0**
VDPI (cm)	15.24^{d}±0.27	15.62^{d}±0.20	16.56^{c}±0.16	17.55^{b}±0.18	17.95^{ab}±0.13	18.29^{a}±0.23	0**
PAO (cm^2)	118.65^{f}±2.24	125.31^{e}±2.36	146.04^{d}±1.83	165.66^{c}±2.06	181.09^{b}±1.94	196.34^{a}±3.44	0**
PAI (cm^2)	188.18^{f}±3.55	198.74^{e}±2.36	231.62^{d}±2.90	262.73^{c}±3.26	287.21^{b}±3.08	311.40^{a}±5.46	0**

**Significant at 1% level. Means bearing different superscripts (a,b,c,d,e,f) within the same row differ significantly (p<0.01) from each other. A, Distance between two angles of haunch; B, Distance between two ischial tuberosities; C, Distance between point of croup to the level of hip joint; D, Distance between tuber coxae to tuber ischia; TDPO, Transverse diameter of the pelvic outlet; TDPI, Transverse diameter of the pelvic inlet; VDPO, Vertical diameter of the pelvic outlet; VDPI, Vertical diameter of the pelvic inlet; PAO, Pelvic area of the outlet; PAI, Pelvic area of the inlet.

Table 2. Correlation between different pelvimetric parameters in different age groups

Parameter	Transverse diameter (TD)	Vertical diameter (VD)	Pelvic area (PA)
Number of calvings	0.83	0.60	0.82
Body weight	0.61	0.44	0.59
A	0.96	0.55	0.88
B	0.81	0.49	0.75
C	0.58	1.00	0.85
D	0.62	0.47	0.62

BW, Body weight; A, Distance between two angles of haunch; B, Distance between two ischial tuberosities; C, Distance between the point of croup to the level of the hip joint; D, Distance between tuber coxae to tuber ischia.

pelvic inlet area was greater than the mean pelvic outlet area and showed significant differences (p<0.05) between the different age groups. Perumal and Rajkhowa (2013) observed similar results in Tho-Tho cows and Perumal *et al*. (2019) in crossbred cows of Andaman and Nicobar Islands of India, supporting the experimental findings in Deoni Cattle. Van Donkersgoed *et al*. (1990) reported that the increase in pelvic area was linear and continued up to 5 years of age, with the greatest increase (range: 0.25 to 0.38; with average of 0.27 cm^2) occurring between 1 and 3 years of age in four beef cow herds in Saskatchewan, supporting the findings of this experiment. Holm *et al*. (2014) recorded significant difference (p<0.05) in pelvic area between two different years of birth in Bovelder beef heifers which is in accordance of this study. Kolkman *et al*. (2009) and Coopman *et al.* (2003) found the positive correlation of pelvic width and pelvic height with the age in the double muscled Belgian Blue cows which is also in accordance with the findings of the present study.

The hindquarters of the Deoni cattle were not much muscled. In this study, differences in the pelvic area were recorded, which might be due to hormonal changes with the onset of puberty rather than the age, variation in feeding and managemental practices. The present study showed no significant differences in the pelvic area between the three strains of Deoni cattle depicting that the pelvic area does not vary with the strains but the pelvic area dimensions increase with increase in the age and number of calvings.

After reviewing all the available literature, to the best of our knowledge, it can be said that this is the first *in vivo* report on the pelvimetric dimensions and body weights in different age groups of three strains of Deoni cattle by external pelvimetry technique.

From the findings of the present study, it can be concluded that the pelvic area of Deoni cattle increases with the age, and it has significant positive correlation with the parity and body weight. Thus, pelvimetric profile can be used as a marker for selection of young Deoni heifers and cows for breeding purpose to lower the incidences of dystocia.

SUMMARY

The present research work was designed to establish baseline data of the pelvimetric profile in Deoni Cattle. Deoni cattle (270) of three strains, i.e. Wannera, Balankya and Shevera were selected and divided into six age groups: Group I (12 to 24 months), II (25 to 36 months), III (37 to 48 months), IV (49 to 60 months), V (61 to 72 months) and VI (73 to 84 months) with 45 animals in each group. Body weight along with different pelvimetric parameters such as distance between two angles of haunch (A), distance between two ischial tuberosities (B), distance between level of croup and hip joint (C) and distance between tuber coxae and tuber ischia (D) were measured to determine the transverse and vertical diameter of pelvic inlet and outlet which were used to calculate pelvic area of inlet and outlet. The pelvic area values for both inlet and outlet showed highly significant differences within groups, but no significant difference was observed between the three strains of each group. From the results of the study, it can be concluded that the pelvic area of Deoni cattle increases with the age and it has significant positive correlation with the parity and body weight. Thus, pelvimetric profile can be used as a marker for selection of young Deoni heifers and cows for breeding purposes to lower dystocia incidences.

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