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# Effect of rump measurements and related body indices at pre-breeding age on the incidence of utero-vaginal prolapse in buffalo cows

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**Key words:** Buffaloes, Rump index, Prolapse.

## Abstract

A study assigning 245 Bulgarian Murrah buffaloes, bred on the Institute's farm during 1980-2007, was initiated to test the effect of rump measurements and rump indices at 18-month age on the incidence of utero-vaginal prolapse. The data were processed with the conventional statistical procedure by levels of rump length ($L_R$) and width ($W_R$), rump-length index ($I_{RL}$) and body-balance index ($I_{BB}$). The effect of $I_{RL}$ on incidence of prolapse was tested using dispersion analyses for qualitative traits, also including the effects of period and season of calving. The results indicated that the buffalo cows with prolapse had by 3.1 cm significantly greater $L_R$ at 18 months, compared to the normally calved ($P< 0.01$), $W_R$ being practically identical. Prolapse at first parity in particular is associated with even more disproportional rump. The effect of $I_{RL}$ was established to be significant at $P< 0.01$, the buffaloes with proportionally longest rump having a significantly higher incidence of prolapse (26.0%), compared to the animals with low (8.6%) and moderate (11.5%) index ($P< 0.001$). Of all 37 prolapsed buffaloes 19 have suffered this obstetrical pathology at first calving, 13 of them having been with the highest value of the index at 18 months. To sum up, it is preferably the Bulgarian Murrah heifers to have more slender body constitution, the difference between the two rump dimentions to be as small as possible, and the rump length – less than 40% of body length.

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## Introduction

Utero-vaginal prolapse is viewed as one of the main reproductive disorders in the *Bubalus bubalis* species in countries with traditions in buffalo breeding, like India (Nanda and Sharma, 1982; Mishra *et al.*, 1998), Pakistan (Samad *et al.*, 1987; Arthur *et al.*, 1989), and Italy (Zicarelli *et al.*, 2000; Campanile *et al.*, 1997). It is a serious scourge for the buffalo breeding on national scale as well, where, according to Peeva and Ilieva (2007), it constitutes 11% of all causes for culling, substantial percentage of the prolapsed primiparous buffaloes (69%) being immediately rejected from main herd (Ilieva and Peeva, 2008), which is indicative of dramatic economic and genetic losses. Some studies demonstrate the economical significance of this obstetrical problem (Seth, 1970; Khan *et al.*, 1984; Rabbani *et al.*, 2010) by analyzing and classifying its consequences by importance: lethal outcome in dams, milk yield drop, rebreeding failure, and extra expenses on veterinary service.

The etiology of this abnormalcy is not well studied, the array of presumable causes being rather long, e.g. uterus atony, hormonal imbalance, calving traumas, megasomia, inflammatory abnormalcy and infection processes (Zicarelli, 2000; Pandey *et al.*, 2007). Genital prolapse might also ensue from high hormonal treatment, poor hygiene and especially misbalanced mineral feeding during dry-off period (Campanile *et al.*, 1997; Akhtar *et al.*, 2008; Khan *et al.*, 2014), the established influence of live weight at calving being also significant (Medina and Landicho, 2001). These are causes in direct relation to the *per se* condition of the dam during the peripartum period.

On the other hand, the studies attempting to associate prolapse with farthest causes like lineage and postnatal growth and development are scarce. Zicarelli (2000) states the opinion that, although genital prolapse is not inheritable, some bulls predispose their offspring to this obstetrical condition by transmitting certain features of body constitution, chiefly back line and pelvis construction. In the Bulgarian Murrah breed this is supported by the established significant effect of genealogical lineage on the incidence of prolapse (Peeva and Ilieva, 2007). As for the causes related to individual growth, there is a practical observation emphasizing the importance of mineral feeding in the pre-weaning period, unsuitable milk replacers with inadequately balanced Ca and P affecting skeletal system and hence leading to an after-effect of high incidence of prolapse at calving (Zicarelli, 2000). In addition, intensive raising systems with no pasture involved boost skeletal growth (Terzano *et al.*, 2007) and contribute to the high incidence of this pathology (Zicarelli, 2000; Patidar *et al.*, 2010). All this provokes more profound research on the role of the proportionate development of reproduction-related bone system in the prophylaxis of this pathology in buffaloes.

The present study was initiated with the objective to test the effect of rump measurements and rump-related body indices at the pre-breeding age of 18 months on the incidence of utero-vaginal prolapse in Bulgarian Murrah buffalo cows.

## Material and methods

*Measurements, indices, and clinical records*

Subject of the study were 245 Bulgarian Murrah buffalo cows with available records for body measurements at 18 months of age, bred on the farm of Agricultural Institute – Shumen during the period 1980-2007.

The data for the following body measurements and indices were subjected to processing:

- Rump length ($L_R$) in cm (from hook to pin), by measuring compasses;
- Rump width ($W_R$) in cm (between hooks), by measuring compasses;
- Rump-length index: $I_{RL} = 100 \times L_R / L_B$;
- Body-balance index: $I_{BB} = L_R \times W_R / G_H$,

where $L_B$ is body length (between shoulder joint and pin, a.k.a 2/3 top line) measured in cm by a measuring stick, and $G_H$ – heart girth in cm, by a measuring tape.

Utero-vaginal prolapse was considered any dropping out of parts of the vagina or the uterus outside the vulvic orifice at parturition or within few days postpartum. Within the study 32 of the prolapsed animals (out of 37) were culled after calving.

*Statistical methods*

The sets of data about $L_R$, $W_R$, $I_{RL}$ and $I_{BB}$ were processed by the conventional statistical procedure with constructed two models: CSP-1 with 3 levels – observed genital prolapse at first ($GP_I$) and second-plus calving ($GP_{II}$) and normal calving (NC); and CSP-2 with 2 levels – prolapse at all calvings (ΣGP) and NC.

For the purpose of testing the effect of $I_{RL}$, a dispersion analysis of non-orthogonal complex of qualitative traits (Eftimov *et al.*, 1972) was implemented, including additionally the effects of period and season of calving. The classes of $I_{RL}$ were formed as follows: up to 34.000; from 34.001 to 40.000; and over 40.000, for shortness referred to as <34, 34-40, and >40 respectively. Two models were constructed: for the general set of records of prolapse in all animals at any parity (all-calvings model); and for the subset of data for that particular part of them with registered prolapse at first parity (first-calving model).

In each model the means from the overall three-factor complex in gradations are presented as $p_i$, resulting from the number of the individuals characterized by the qualitative trait genital prolapse ($\Sigma m_x$) out of the total number of individuals in the respective class ($\Sigma n_x$). The effects of the singular factors included in the ANOVA, their co-effects and the all-factors effect (x) are expressed in coefficients of impact ($\eta^2$) and coefficients of significance (F), while the significance of the differences within gradations – in $F_d$-values.

**Results**

Table 1 presents the results of the two conventional statistical procedures (CSP-1 and CSP-2) about rump measurements. With regard to rump width ($W_R$), there are only negligible differences among the groups of animals, regardless of the normalcy and the parity order of the calvings – ranging within 0.8 cm, the variability being up to 10%. Nevertheless, it is apparent that in the general number of buffalo cows with registered prolapse rump length ($L_R$) had been by 3.1 cm larger compared to those with only normal calvings (P< 0.01). In the cases of abnormal outcome of first calving $L_R$ had even higher value – by 3.7 cm (P< 0.01), the variation being lower than in the normally calved. Considering the practically identical values of $W_R$, it renders the rump of the prolapsed animals more disproportional, the difference between the two dimensions coming to 3.3 cm. The buffaloes free from genital prolapse had been characterized by much closer difference between $L_R$ and $W_R$ as heifers – 0.4 cm.

**Table 1.** Rump measurements at 18 months by CSP-1 with levels of prolapse at first ($GP_I$) and second-plus calving ($GP_{II}$) and normal calving (NC), as well as by CSP-2 for prolapse at all calvings (ΣGP) and NC.

| Levels | n | Rump length ($L_R$), cm | | Rump width ($W_R$), cm | |
|---|---|---|---|---|---|
| | | x ± Sx | C | x ± Sx | C |
| $GP_I$ (CSP-1) | (19) | 47.3 ± 1.05 | 9.7 | 44.0 ± 0.79 | 7.9 |
| $GP_{II}$ (CSP-1) | (18) | 46.0 ± 1.51 | 14.0 | 43.8 ± 0.81 | 7.9 |
| ΣGP (CSP-2) | 37 | 46.7 ± 0.91 | 11.8 | 43.9 ± 0.56 | 7.8 |
| NC (CSP-1&2) | 209 | 43.6 ± 0.45 | 15.0 | 43.2 ± 0.30 | 10.1 |
| Mean | 246 | 44.0 ± 0.41 | 14.7 | 43.3 ± 0.27 | 9.7 |
| $t_d$-1 | | $GP_I$-NC** | | N.S. | |
| $t_d$-2 | | ΣGP-NC ** | | N.S. | |

$t_d$-1 and $t_d$-2 – significance of differences among levels in CSP-1 and CSP-2 respectively: ** – P< 0.01; N.S. – P> 0.05.

The data about the proportion between rump length and body length ($I_{RL}$) show similar dependencies (Table 2). In the normally calved buffalo cows the index at 18 months shows that rump length had been 36.1% of body length, while in those with prolapse its value had been by 8.3 percent relatively lower ($P< 0.01$), at first calving in particular – by 11.4 percent ($P< 0.001$). With regard to body-balance index, the study established only small variation among groups of buffaloes, the difference by 0.63 units between pathological and normal calvings in the general model (CSP-2) being statistically proved at $P< 0.05$. This is indicative of relatively proportional body constitution of the heifers assigned in the study. Thus, of the two indices, so far $I_{RL}$ has shown to be more determinative for the incidence of genital prolapse.

**Table 3.** ANOVA of the dispersion analyses of incidence of prolapse for all calvings and first-calving.

| Sources of variance | df | All calvings | | First calving | |
|---|---|---|---|---|---|
| | | $\eta^2$ | F | $\eta^2$ | F |
| Period | 3 | 0.0413 | 3.515 * | 0.0387 | 3.011 * |
| Season | 3 | 0.0128 | 1.091 N.S. | 0.0080 | 0.626 N.S. |
| $I_{RL}$ | 2 | 0.0433 | 5.531 ** | 0.0545 | 6.349 ** |
| Season × $I_{RL}$ | 6 | 0.1720 | 7.318 *** | 0.0925 | 3.595 ** |
| Period × $I_{RL}$ | 6 | 0.1435 | 6.106 *** | 0.0618 | 2.402 * |
| x | 47 | 0.2282 | 1.239 N.S. | 0.1550 | 0.769 N.S. |
| z | 197 | 0.7718 | | 0.8450 | |
| **y** | 244 | 1.0000 | | 1.0000 | |

Significance of F-value: *** – $P< 0.001$; ** – $P< 0.01$; * – $P< 0.05$; N.S. – $P> 0.05$.

The ANOVA of the two models of the dispersion analysis are presented in Table 3. The results from the all-calvings model show that the index related to rump length at 18 months is a significant source of variance of the qualitative trait incidence of prolapse ($P< 0.01$). The combined effects with season of calving and period are even more pronounced ($P< 0.001$). At first calving in particular the effect of $I_{RL}$ is also significant at $P< 0.01$, and the interactions with season and period – respectively at $P< 0.01$ and $P< 0.05$. The all-factors co-effect (x) is not significant in both models.

**Table 4.** Effect of $I_{RL}$ on incidence of prolapse in all calvings and first calving.

| Classes | $\Sigma n_x$ | $\Sigma m_x$ | $p_i$ | Percent of $\Sigma\Sigma n_x$ | Percent of $\Sigma\Sigma m_x$ |
|---|---|---|---|---|---|
| All calvings | | | | | |
| 1. <34 | 81 | 7 | 0.086 | 2.86 | 18.9 |
| 2. 34-40 | 87 | 10 | 0.115 | 4.08 | 27.0 |
| 3. >40 | 77 | 20 | 0.260 | 8.16 | 54.1 |
| Mean / Σ | 245 | 37 | 0.151 | 15.10 | 100.0 |
| $F_d$ | | | 3-[1, 2]*** | | |
| First calving | | | | | |
| 1. <34 | 81 | 2 | 0.025 | 0.82 | 10.5 |
| 2. 34-40 | 87 | 4 | 0.046 | 1.63 | 21.1 |
| 3. >40 | 77 | 13 | 0.169 | 5.31 | 68.4 |
| Mean / Σ | 245 | 19 | 0.078 | 7.76 | 100.0 |
| **$F_d$** | | | 3-[1, 2]*** | | |

$\Sigma n_x$ – total number of animals in the class

$\Sigma m_x$ – number of animals with registered prolapse out of the respective $\Sigma n_x$

$F_d$ – significance of differences among classes within gradations: *** – $P< 0.001$

The gradation resulted from the all-calvings model is expressed in $p_i$-values in Table 4. It indicates that the incidence of prolapse in the buffaloes with proportionally longest rump ($I_{RL}$) at the age of 18 months (26%) is remarkably highest ($P< 0.001$). Compared to the registered pathological cases in the animals with low and moderate $I_{RL}$, their number is 2 to 3 times greater and constitutes 8 percent of all studied buffaloes and 54 percent of all animals with prolapse. Of all prolapsed buffaloes ($\Sigma\Sigma m_x$= 37) a half suffered this disorder at first calving ($\Sigma\Sigma m_x$= 19), where the effect of the index is even more pronounced (Table 4, first-calving model). Of all cases of prolapse at first parity 68% had proportionately longest rump at pre-breeding age ($P< 0.001$). It is also noteworthy that in the prolapsed buffaloes with high rump-length index ($\Sigma m_x$= 20) 65% had that obstetrical problem at first calving ($\Sigma m_x$= 13).

**Discussion**

The established influence of rump length at pre-breeding age on the incidence of prolapse in the studied buffaloes should not be considered by itself but – in view of the negligible differences in rump width – attributed to rump proportionality and its variation between affected and normally calving animals. Practical experience in cattle husbandry indicates that rump width should be bigger than length to ensure optimal breeding. Such proportion is observed also in the Italian buffalo heifers (Terzano *et al.*, 2007), unlike the established measures in the Bulgarian Murrah breed in the present study. This is to accommodate the discrepancy about the particular effect of rump length on incidence of prolapse between our results and the report of Zicarelli (2000) associating high incidence of this reproductive pathology with short pelvis. To contribute to field practice, as an outcome of this study, it can be suggested the difference between the two rump dimentions to be as small as possible, which also applies to the Italian breed.

The observed analogy between the effects of rump length and rump index implies that the differences in the incidence of prolapse are not due to variation in the general body growth of the heifers but to variation in rump-related proportions. From standpoint of incidence of genital prolapse, rump length is preferably to be less than 40% of body length, just as field practice in bovine cows shows. In view of the uniformity in body-balance index and rump width observed in the studied buffaloes, shorter rump should be associated with lesser heart girth, i.e. lower risk of prolapse expected in the heifers of more slender body constitution.

Unlike some reports elsewhere (Patidar *et al.*, 2010; Rabbani *et al.*, 2010), herein and in a previous study (Ilieva and Peeva, 2008) was observed that in the Bulgarian Murrah breed this obstetrical problem is more serious at first parity, constituting a half of all buffaloes with prolapse. The present study also found very high culling rate of 32 out of 37 prolapsed animals (see Material and methods) and it should be borne in mind that even if surviving, buffaloes fail to timely rebreed due to disturbed genital involution and ovarian malfunction (Jadon *et al.*, 2005; El-Wishy, 2007) and subsequently prolong their calving intervals, which penalizes profitability to a large extent (Peeva, 2000).

The etiology of genital prolapse in buffaloes is rather complex and while the studies treating the causes in direct relation to the condition of the animals during the gestation, the peripartum and the calving itself are numerous (Campanile *et al.*, 1997; Pandey *et al.*, 2007; Akhtar *et al.*, 2008), the attempts to make association with earlier skeletal development are scarce (Zicarelli, 2000). The present study demonstrates the influence of rump shape, suggesting that the issue of proper development of bone system is primarily the basis of the prophylactics of this obstetrical problem, though this is only part of the entire clinical picture of this pathology. On the other hand, considering body measurements, indices and proportions is not to be applied independently and generalized about the whole bubaline species but about a particular herd from a particular breed, and especially in the particular management conditions. Except by sire selection and mineral feeding at all growth ages, which affect skeletal development, incidence of prolapse can be limited by applying proper raising systems with extensive pasturing (Mishra *et al.*, 1998; Zicarelli, 2000), in the same time contributing to animal welfare and product quality. In dairy buffalo farms, where growth-stimulating natural suckling and delayed weaning are not feasible, such conditions lead to slower development of the skeletal system (Terzano *et al.*, 2007), and hence require delayed breeding since low live weight at calving is also associated with high incidence of prolapse (Medina and Landicho, 2001). Along with the essential qualification that age at first calving has highest weight in the construction of the economic index (Peeva, 2000), these are aspects to form farmers' attitude towards genital prolapse and the general issues concerning profitability.

**Conclusion**

The present study found that the buffaloes with registered utero-vaginal prolapse had significantly greater absolute and relative rump length at 18 months, compared to the normally calved (P< 0.01), rump width being practically identical; the cases of prolapse at first parity are associated with even more disproportional rump. The effect of the rump-length index was established to be significant at P< 0.01, the buffaloes with proportionally longest rump having 2 to 3 times significantly higher incidence of prolapse (26.0%), compared to the animals with low and moderate index (P< 0.001). Of all 37 prolapsed buffaloes 19 have suffered this obstetrical pathology at first calving, 13 of them having been with the highest value of the index at 18 months.

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