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Relation between pelvic and body measurements in bovine Girolanda females

Abstract

External and internal *in vivo* pelvic measurements were carried out in 110 Girolanda bovine females, using a tape measure, Hauptner pelvimeter and a Menissier-Vissac pelvimeter. Results were confronted with body biometric data and correlations were established between pelvic measurements and tocological conditions of each animal distributed into three groups (nuliparous, primiparous and multiparous) according to the occurrence and the number of parturitions. The variables corresponding to the general body measurements and to the external and internal measurements showed significant positive correlation ($p=0.0001$) when individually confronted with each other. There was a positive correlation between mean external and internal pelvic diameters. The pelvic external variables were positively correlated with body measurements, but most of them were below 0.5 ($p=0.0001$). The internal variables showed low correlations with height, length and thoracic perimeter and medium correlation with age and weight, except for the sacropubic with thoracic perimeter, coith which there was no significant correlation. It was concluded that pelvic measurements are correlated with body measurements and that they are influenced by the reproductive stage.

Key words: biometry, bovine, pelvimetry, reproduction

Relação entre medidas pélvicas e condições tocológicas de fêmeas bovinas da raça Girolanda

Resumo

Mensurações pélvicas externas e internas foram realizadas em 110 fêmeas bovinas da raça Girolanda mediante a utilização de trena padrão, pelvímeter Hauptner e pelvímeter Menissier-Vissac. Os resultados foram confrontados com os dados biométricos corpóreos e estabelecidas correlações entre as medidas pélvicas e as condições tocológicas de cada animal, segundo a distribuição em três grupos, cuja referência foi a ocorrência e o número de partos (nulíparas, primíparas e multíparas). Existiu correlação positiva média dos diâmetros pélvicos externos com os internos. As variáveis externas da pelvis tiveram correlação positiva com as medidas corpóreas, porém a maioria esteve abaixo de 0,5 ($p=0,0001$). As variáveis internas apresentaram baixas correlações com altura, comprimento e perímetro torácico; médias correlações com idade e peso, exceto sacropúbico com o perímetro torácico, entre as quais não houve correlação significativa. Concluiu-se que as medidas pélvicas estão correlacionadas com as medidas corpóreas e são influenciadas pelo estágio reprodutivo.

Palavra-chave: biometria, bovino, pelvimetria, reprodução

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INTRODUCTION

Brazil detainee of biggest bovine commercial herd of the world, which reveals the importance of studies related to different breeds derived from other continents, as well as the development of new breeds in the national territory, that perform an important role in the milk and beef agribusiness.

In this context, the Girolanda breed has expressed, throughout the years, its productive potential in different regions of Brazil, mainly in the Northeast Region. The Girolanda females, milk producers by excellence, possess perfect morphological and physiological characteristics for production in the tropics as capacity and support of udder, teat size, intrinsic factors to lactation, pigmentation, thermoregulatory capacity, grip and strong feet, feed conversion and reproductive efficiency.

As to the work already developed, establishing the morphological and physiological characteristics of different breeds (Bellow et al., 1971; Johnson et al., 1988; Donkengo et al., 1991; Weiher et al., 1992; Oliveira, 1993; Okuda et al., 1994; De Nuoro, 2000), little is known regarding the Girolanda breed, mainly as to the morphometric aspects of the anatomic structures that involve the reproductive system.

Problems referring to the reproductive scope in bovine are many and the distortions have had a great range on causing factors, such as heredity, nutrition, infections and traumas (Wolverton et al., 1991). Already Laster (1974) reported that the immediate cause of dystocia in bovine was the fetopelvic disproportion.

The knowledge of the relation of the probable cause factors of dystocia in bovine minimizes the losses with fetus and cow deaths as well as problems of fertility in bovine females. The greater or smaller easiness in parturition, the frequency of dystocic presentation of the concept, the variability relative to the number of caesarians and other obstetric implications represent motivation to the pelvimetric study and its relation to the different factors that may be intimately involved in this process.

The present work aimed to correlate the external and internal measurements in bovine females of the Girolanda breed with factors such as age, weight, thoracic perimeter, height and length.

MATERIAL AND METHODS

Three groups of bovine females of the Girolanda breed were formed with 21 nuliparous, 20 primiparous and 69 multiparous. In the multiparous group, all females whose number of births was equal or greater than two were included. The animals had a level of blood 5/8 Dutch + 3/8 Gir, with no history of obstetric disturbances and in different stages of gestation (nuliparous, primiparous and multiparous).

The body measures were registered in individual protocols, considering the register number, age and weight. The measures of the thoracic perimeter obtained with the help of a metric tape, while for the height and length measurements a tape (Stanley-Hauptner) was used.

In relation to the external pelvic parameter measures, a circular pelvimeter (Hauptner), taking notes of the measures referring to its width, taken between the lateral extremes of the right and left thigh tuberosities (external biiliac), between the lateral extremes of the right and left ischiatic tuberosities (external biischiatic) and between the lateral extremes of the thigh and ischiatic tuberosities of each antimeres denominated as right and left ilioischiatic (external ilioischiatic).

Regarding the internal diameters, measured with a Menisier & Vissac (1971) pelvimeter, the variables registered were: distance between the internal parts of the bodies of the ilium immediately under the sacral bone (superior biiliac); distance between the ilium bodies close to the acetabulum (inferior biiliac) and the distance between the ventral prominence of the last lumbar vertebrae and the first sacral (promontory) and the skull extremity of the pubic symphysis (sacropubic).

Pearson correlation (r) analyses were carried out between pairs of variables aiming to determine the value of the correlation between the external measures; between the internal measures; between the internal and external measures; between age, weight, thoracic perimeter, height and length with the internal and external variables. The software utilized to obtain the statistical calculations was the SPSS (Statistical Package for the Social Sciences) version 11. The level of significance used in the decisions was of 5% (Altmann, 1991).

RESULTS AND DISCUSSION

Tables 1 to 5 contain Pearson correlation values between pairs of variables and the result of it had for the hypothesis that the population correlation is null.

The correlation values among the external measures varied from 0.58 to 0.64 and were equal to 1.00 between the measures of the ilioischiatic. In all the pairs there was a strong significant difference of the null value ($p < 0.0001$), according to the results presented on the Table 1.

Table 1. Correlation matrix of Pearson (r) and significance level between the external measures of the Girolanda female bovines

Tabela 1. Matriz de correlação de Pearson (r) e nível de significância entre as medidas externas de fêmeas bovinas da raça Girolanda

External Variables (cm)	External Variables (cm)			
	External Biiliac	External Biischiatic	Left Ilioischiatic	Right Ilioischiatic
External Biiliac	1.00	-	-	-
External Biischiatic	0.64 ($p < 0.0001$)	1.00	-	-
Left Ilioischiatic	0.58 ($p < 0.0001$)	0.61 ($p < 0.0001$)	1.00	-
Right Ilioischiatic	0.58 ($p < 0.0001$)	0.61 ($p < 0.0001$)	1.00 ($p < 0.0001$)	1.00

The morphological aspects of the pelvis related particularly to the metric facts are scarce in the bibliographic specific notes, especially for bovines of the Girolanda breed; therefore, the results of this research will contribute to the best

knowledge of its anatomy and, in parallel, will offer elements for eventual comparative studies.

This result goes along with the observation of Thomson & Wiltbank (1983), in which there was an increase of the pelvic measures on the multiparous when compared to the nuliparous and also related to the number of parturitions. Nevertheless, despite the high correlation between the weight and the pelvic area, only 30 to 37% of the pelvic variability can be attributed to its influence (by regression analysis); however, there are differences on the pelvic structures that are not dependent of the corporal development of the animal, opinion endorsed for it could avoid a possible fetus-pelvic disproportion, mainly when we refer to the nuliparous regarding the bulls, which will be able to contribute to the increase of the calf weight at birth.

The correlation between the internal measures are presented in Table 2, where it is possible to verify values of elevated correlation (over 0.72) and all three pairs with a significant difference of the null value ($p < 0.0001$).

Table 2. Correlation matrix of Pearson (r) and level of significance between the internal measures of Girolanda bovine females

Tabela 2. Matriz de correlação de Pearson (r) e nível de significância entre as medidas internas de fêmeas bovinas da raça Girolanda

Internal Variables (cm)	Internal Variables (cm)		
	Superior Biiliac	Inferior Biiliac	Sacropubic
Superior Biiliac	1.00	-	-
Inferior Biiliac	0.87 ($p < 0.0001$)	1.00	-
Sacropubic	0.82 ($p < 0.0001$)	0.72 ($p < 0.0001$)	1.00

In the present study high values of correlation were verified between the internal measures of the pelvis (over 0.72), findings that comply with Weiher et al. (1992), into working with Dutch calves and cows detected medium to high coefficient between the internal measures.

In this experiment, an increase of the pelvic width and of the sacropubic diameter was observed regarding the occurrence of births (Barreto et al., 2004), complying with Okuda et al. (1994) that observed greater pelvic width related to the occurrence of birth in the cows of the Guzerá breed.

Table 3 shows that the values of the correlation between the internal and external variables were of 0.27 to 0.49, however with a significant difference of the null value.

The external and internal measures observed in the Girolanda cows in this study are in accordance with De Vuono (2000), who observed similar values using the same methodology and measured points.

A low correlation of the thoracic perimeter with the transversal diameters and without significance with the sacropubic diameter were observed, complying with the findings of Thomson & Wiltbank (1983), that also found a low correlation between the thoracic perimeter and the transversal measure of the pelvis (0.28). In the measures performed in nuliparous female bovine, with the exception of the sacropubic

Table 3. Correlation matrix of Pearson (r) and level of significance between the internal and external diameters of Girolanda bovine females

Tabela 3. Matriz de correlação de Pearson (r) e nível de significância entre os diâmetros externos e internos de fêmeas bovinas da raça Girolanda

External Variables (cm)	Internal Variables (cm)		
	Superior Biiliac	Inferior Biiliac	Sacropubic
External Biiliac	0.46 ($p < 0.0001$)	0.40 ($p < 0.0001$)	0.36 ($p < 0.0001$)
External Biischiatric	0.44 ($p < 0.0001$)	0.45 ($p < 0.0001$)	0.27 ($p < 0.0042$)
Left Iliioischiatric	0.49 ($p < 0.0001$)	0.39 ($p < 0.0001$)	0.41 ($p < 0.0001$)
Right Iliioischiatric	0.49 ($p < 0.0001$)	0.39 ($p < 0.0001$)	0.41 ($p < 0.0001$)

diameter (0.54), agree also with the results of Okuda (1992). However, there is a disagreement with De Vuono (2000), who obtained correlations positive and high (values of 0.66, 0.69 and 0.64 to nuliparous, primiparous and multiparous, respectively) in measures done in Jersey cows.

Table 4 shows that the external variables present low correlation with height, length and thoracic perimeter (maximum value of 0.47) and reasonably elevated with weight (values of at least 0.60) and age (values of at least 0.55). However, all correlations were significantly different from zero.

Table 4. Correlation matrix of Pearson (r) and level of significance between the external diameters with age, weight, thoracic perimeter, height and length variable of Girolanda bovine females

Tabela 4. Matriz de correlação de Pearson (r) e nível de significância entre os diâmetros externos com as variáveis idade, peso, perímetro torácico, altura e comprimento de fêmeas bovinas da raça Girolanda

External Variables (cm)	Variables				
	Age (days)	Weight (kg)	Thoracic Perimeter (cm)	Height (cm)	Length (cm)
Biiliac	0.55 ($p < 0.0001$)	0.66 ($p < 0.0054$)	0.42 ($p < 0.0001$)	0.47 ($p < 0.0001$)	0.26 ($p < 0.0001$)
Biischiatric	0.59 ($p < 0.0001$)	0.60 ($p < 0.0001$)	0.36 ($p < 0.0001$)	0.42 ($p < 0.0001$)	0.36 ($p < 0.0001$)
Left Iliioischiatric	0.63 ($p < 0.0001$)	0.63 ($p < 0.0178$)	0.42 ($p < 0.0001$)	0.41 ($p < 0.0001$)	0.23 ($p < 0.0001$)
Right Iliioischiatric	0.63 ($p < 0.0001$)	0.63 ($p < 0.0178$)	0.42 ($p < 0.0001$)	0.41 ($p < 0.0001$)	0.23 ($p < 0.0001$)

High and positive correlation was observed between the external and internal pelvic measures and medium positive correlation of the weight with the same measures. Positive correlations were also verified by Dahaliwal et al. (1981) and Oliveira (1993), they pointed out in their studies the observation of high correlation mainly between weight and internal and external pelvimetry, when studied pelvimetry measures in the same specie.

It is convenient yet to mention that the positive correlation between the external and internal measures was also observed by Murray et al. (2002), resulting from observations made in cows of the Belgian blue breed, where emphasized that the greater width and height of the pelvis contributed to

a parturition without difficulties; however, the weight of the fetus at birth is worth reminding.

Analyzing the results of the sampling of this study (Barreto et al., 2004), it is observed that the absolute values of the external and internal pelvic diameters showed tendency of significant increase, mainly when the nuliparous were compared to the multiparous, as these metric alterations relative to the corporal measures would be inducing to the significant increase of the absolute values. It is not strange, since the multiparous animals tend to be older and bigger under the corporal point of view, although it has been observed, regarding the external measures, that there was a low correlation with the height, length and thoracic perimeter, with maximum value of 0.47 and reasonably high of weight with value of at least 0.60. It was observed by Barreto et al. (2004) that pelvic measurements are influenced by the reproductive stage, and that they are larger in the pluriparous females.

Table 5 shows that the internal variables presented low correlations with the thoracic perimeter, height and length (maximum value of 0.36) and were reasonably elevated with the weight (values of at least 0.52) and age (values of at least 0.50); however, except for the thoracic perimeter and the sacropubic, all correlations were significantly different from zero.

Table 5. Correlation matrix of Pearson (r) and level of significance between the internal diameters with age, weight, thoracic perimeter, height and length, variables of Girolanda bovine females

Tabela 5. Matriz de correlação de Pearson (r) e nível de significância entre os diâmetros internos com as variáveis idade, peso, perímetro torácico, altura e comprimento, de fêmeas bovinas da raça Girolanda

Internal Variables (cm)	Variables				
	Age (days)	Weight (kg)	Thoracic Perimeter (cm)	Height (cm)	Length (cm)
Superior	0.60	0.60	0.31	0.30	0.22
Billiac	(p<0.0001)	(p<0.0001)	(p<0.0012)	(p<0.0018)	(p<0.0193)
Inferior	0.51	0.54	0.36	0.23	0.22
Billiac	(p<0.0001)	(p<0.0001)	(p<0.0001)	(p<0.0140)	(p<0.0210)
Sacropubic	0.50	0.52	0.16	0.30	0.17
	(p<0.0001)	(p<0.0001)	(p<0.0873)	(p<0.0014)	(p<0.0834)

A considerable increase of the measures between the nuliparous and multiparous groups was observed (Barreto et al., 2004), and, according to the information obtained, the multiparous females did not have difficulties of parturition, ratifying the observations of Morrison et al. (1986) and Johnson et al. (1988), where carried out for the evaluation of the pelvic measures relating to the difficulty of parturition, concluded that females with a greater pelvic area would benefit the replacement of others in the group and that the most significant variable was the weight of the calf at birth, indicating that a selection process should include the follow-up of the pelvic measure to diminish the difficulty of parturition.

Regarding the variable weight, when correlated to the external and internal measures, an elevated correlation with values superior to 0.63 and 0.52, respectively, were obtained, agreeable results with the conclusions of Bellows et al. (1971),

Ward (1971) and Laster (1974), in whose studies researched the correlation of the pelvic opening with dystocic births and concluded that the variable weight is the most significant on the pelvic opening and width of the hip.

This observation ratifies the opinion of Toniollo & Vicente (1993), based on the previous classification proposed by Benesch (1965), which takes in account the shape of the cranial contour of the pelvic area, where it was included the ruminants in a general way in the category of dolichopellics, or with oval contour and flattened laterally, being the real conjugated diameter bigger than the biliac.

CONCLUSIONS

Except from the thoracic perimeter, the external pelvic measures are good indicators of pelvimetry and pelvility in Girolanda females, as these are well correlated with the internal pelvic measures. The corporal weight can be utilized as an indicator of pelvility of Girolanda females for presenting an elevated positive relation with the internal measures.

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