



Full Length Article

Sex and Herd Related Variation in Body Weight and Type Traits Recorded on Dhanni Cattle in Punjab, Pakistan

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Abstract

The objectives of the study were to determine phenotypic variations in Dhanni cattle for quantitative and qualitative traits and to analyze the relationship between different body measurements and body weight in Dhanni cattle. Data were collected from Barani Livestock Production Research Institute (BLPRI) at Kherimurat, Attock and potential farmers who were raising Dhanni cattle in Potohar region. Ten (10) phenotypic parameters were measured on 125 adult animals (29 male and 96 female). Five qualitative and five quantitative traits were investigated. Qualitative traits were visually observed and expressed as a percentage. Descriptive analysis was done on quantitative variables. All Dhanni cattle had a predominately white coat color with pigmented body skin. Horns were present in all animals. However, there was variation in horn shape *i.e.*, curved (3) straight (56) and stumps (66). Analysis was performed in SAS On-Demand for Academics using PROC mixed model procedure. Overall means $\pm$ SD of Body Weight (BW), Body Length (BL), and Height at Withers (HW), Chest Girth (CG) and MC (Muzzle Circumference) were 312.07 ± 74.14 kg, 129.31 ± 10.99 cm, 130.37 ± 7.11 cm, 165.13 ± 11.14 cm and 42.84 ± 2.55 cm respectively. Both herd and sex had significant effect on BW, BL, CG, HW and MC ($P < 0.05$). Dhanni cattle raised at government farm had higher ($P < 0.05$) values for all traits. Female had lower BW, BL, HW, CG and MC ($P < 0.05$) as compared to their male herd mates. Dhanni cattle appear to have the potential for selection as beef cattle breed based on substantial within breed variation in live body weight (24% CV). A selection program may be devised to improve beef production potential of Dhanni cattle besides other traits.

Keywords: Dhanni cattle; Body weight; Type traits; Punjab Pakistan

Introduction

Livestock has an immense economic role in developing countries (Herrero *et al.* 2013). There are 15 different cattle breeds located across the country mainly raised for meat, milk, and draught purpose (Khan *et al.* 2008). Huge farm animal genetic diversity exists, which needs to be characterized (Fuentes *et al.* 2012).

The cattle breeds found in arid regions of Pakistan are mostly used for dual purposes *i.e.*, milk and draft purpose (Afzal and Naqvi 2004). The physical features of Dhanni cattle include small udder, fine skin, medium size, small and alert ears, compact body with a comparatively straight back, small head, stumpy horns, compact hump, small dewlap, tight sheath, and whip-like tail ending in a white switch (Joshi and Phillips 1953). Dhanni is suitable for draught

purposes because it is a strong animal having great alertness. Dhanni cattle is a breed well known for its running potential in famous bull races all over Punjab. However, due to increased mechanization in agricultural operations, Dhanni cattle can be potentially raised as beef cattle breed (Ahmad *et al.* 2013). Mature body weight of Dhanni cattle ranges between 350 and 400 kg for males and between 300 and 350 kg for females. It is observed that color pattern in Dhanni breed is known due to its ordinary body colors *i.e.*, Kala Burga (predominately black coat with white spot), Nuqra (white mottles with brown and black patches), Chitta Burga (predominately white coat with black spots), and Ratta Burga (greater part is red with white spotting on certain body parts) (Hussain 2012). Characterization of animals mainly depends upon the phenotype, genetics and historical background (FAO 2012). Breed characterization

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is the key step for conservation and genetic improvement of any livestock breeding program (Kierkegaard *et al.* 2020). Phenotypic characterization of animal genetic resources (AnGR) includes the identification of distinct breed population and description of their production and external characteristic within a given production environment. There are two types of characterization, “Primary characterization” and “advanced characterization”. The primary characterization defines the actions of field visits in a single day and the work done in advanced characterization must be validated by repeated visits (FAO 2012). Phenotypic characterization is the first step in any breeding program. However, our indigenous cattle breeds have not been characterized in their existing production environment particularly draught cattle breed such as Dhanni. Therefore, the current study was performed to fill this gap of information which is indeed vital for any selection/ breeding program. The objective of the current study was to investigate within breed phenotypic variations in Dhanni cattle for qualitative and quantitative traits and to find correlation among aforementioned traits.

Materials and Methods

Study area

The study was performed at the Directorate of Barani Livestock Production Research Institute (BLPRI) Kherimurat, Attock and potential farmers who are raising Dhanni cattle in Potohar region. This station is situated in a semi-arid zone and the normal range of temperature recorded during summer season is 40–45°C. Average rain fall in Attock is 646 mm annually.

Sample size and traits

A total of 125 Dhanni cattle breed were studied out of which 96 were females and 29 were males. Data was recorded related to the qualitative traits mentioned as detailed in Table 1. Furthermore, the quantitative traits were measured as mentioned in Table 2. All animals under study were sampled from two herds. Barani Livestock Production Research Institute (BLPRI) Kherimurat (herd = 1) and animals taken from private potential farmers who are raising Dhanni cattle in Potohar region (herd = 2).

Phenotypic and morphometric characteristics

Dhanni cattle are very beautiful animals with a wide range of color patterns with black and white spots being predominant (Fig. 1). The ears of cattle are small and black in color which makes ear tattoos less visible. Moreover, ears of Dhanni cattle are usually alert and point backwards with short and stumpy horns and black hooves (Fig. 2). Dhanni cows, being poor milk producers, have small sized udder and teats with black spots (Fig. 3).

Data collection

A proforma was designed using guidelines of FAO Animal Genetics Resource Guide (FAO 2012) for the characterization of Dhanni cattle (Annexure-A). The Dhanni cattle were reared in field conditions where cattle were rarely stall fed. Feeding of Dhanni cattle mostly depends on grazing. Ten phenotypic (5 qualitative and 5 quantitative) parameters were measured on 125 adult animals. The qualitative traits were visually recorded. The quantitative traits other than the BW were measured with the help of measuring tape. Live weight data records on animals of institutional/government herd were retrieved from official live weight registers. Live weights of random animals were physically (weighing scale) measured to confirm their accuracy. Body measurements were taken in cm while body weight was taken in kg. Body measurement includes all the traits mentioned in Table 2.

Statistical analysis of data

The data were statistically analyzed in the SAS On-Demand for Academics (www.oda.sas.com) using PROC-MIXED procedure. Following statistical model was used for BW, BL, HW, CG, and MC;

$$Y_{ijk} = \mu + \text{Sex}_i + \text{Herd}_j + E_{ijk}$$

Where

Y_{ijk} = a measurement on k th animal in j th herd and of i th sex

μ = the overall population mean,

i = fixed effect of i th sex ($i=1$ for female and 2 for male),

j = fixed effect of j th herd ($j=1$ for Govt. and 2 for Private herd),

E_{ijk} = Random residual associated with measurement on k th animal in j th herd and of i th sex.

Correlations among all quantitative measurements were determined using PROC CORR procedure in SAS.

Results

Qualitative traits

The descriptive statistics (Frequency distribution of animal in each herd & Frequency distribution of animal in each sex) of the present study are presented in (Table 3, 4). Qualitative traits of Dhanni cattle are presented in Table 5. The body hair coat color of Dhanni cattle was (100%) white with black spots. Black spots have been seen on the back of the animal, face, udder, abdominal region and on the legs of some animals. Chitta Burga has a dominant white coat with black spots (Hussain 2012). Horns were present in all animals and most of the animals have stumps shaped (52.8%) straight shaped (44.8%), and curve shaped (2.4%) horns. Horns were shorts and stumpy mainly with black color but sometimes color of horn was white, pointed upward and downward reported by (Hussain 2012). The hooves of all animals were spotted grey color.

Table 1: Overall Qualitative measures considered for the Dhanni breed characterization

Sr. No	Qualitative Variables	Symbol	Qualitative Variable Classes
1	Body Hair Coat Color	BHC	Black, dark red, Light Red, White, Grey
2	Body skin color	BSC	Pigmented, Not pigmented
3	Hoof Color	HC	Pigmented, Not pigmented
4	Horn presence	HP	Present, Absent
5	Horn Shape	HS	Lyre, straight, curve, loose, stumps, polled

Table 2: Quantitative measures considered for the Dhanni cattle breed characterization

Sr. No	Traits	Unit	Symbol	Definition
1	Body weight	kg	BW	live body weight
2	Body length	cm	BL	The horizontal distance from the pin bone to point of shoulder
3	Height at withers	cm	HW	The height from the bottom of the front foot to the highest of the shoulder point between the withers
4	Chest girth	cm	CG	The encircling the measuring tape behind the withers and the brisket area of the animals
5	Muzzle circumferences	cm	MC	Take little measurement little above the nostrils and around the point where the dewlap meets the chin

Table 3: Frequency distribution of animal in each herd

Herd	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	79	63.20	79	63.20
2	46	36.80	125	100.00

**Fig. 1:** A beautiful Dhanni cattle reared by govt farm**Fig. 2:** A beautiful Dhanni cattle showing black colored alert ears, short and stumpy horns and black hooves

Quantitative traits

Overall means $\pm$ SD of BW, BL, HW, CG and MC are described in Table 6. Overall mean $\pm$ SD for BW kg, BL cm, HW cm, CG cm, and MC cm were 312.07 ± 74.14 kg, 129.31 ± 10.99 cm, 130.37 ± 7.11 cm, 165.13 ± 11.14 cm and 42.84 ± 2.55 cm, respectively. The means of male

animals were significantly higher than female Dhanni cattle shown in Table 6.

Effect of sex

The least square mean $\pm$ standard error of different body measurements of two different sex (male and female)

Table 4: Frequency distribution of animal in each sex

Sex	Frequency	Percent	Cumulative frequency	Cumulative percent
1	96	76.80	96	76.80
2	29	23.20	125	100.00

Table 5: Frequency (%) of each level for the qualitative traits recorded in Dhanni cattle breed

Sr .No	No. of Samples	Traits/ Variables	Color/presence/shape	Frequency	Percent (%)
1	125	Body Hair Coat Color	a. black	0	0
			b. dark red	0	0
			c. light red	0	0
			c. white	125	100%
			e. grey	0	0
2	125	Body skin color	a. Pigmented	125	100%
			b. not-pigmented		
3	125	Hoof Color	a. Pigmented	125	100%
			b. not-pigmented		
4	125	Horn presence	a. Yes	125	100%
			b.no	0	
5	125	Horn Shape	a. Lyre shape	0	0
			b. straight shape	56	44.8%
			c. curve	3	2.4%
			d. loose	0	0
			e. stumps	66	52.8
			f. polled	0	0

Table 6: Overall Means $\pm$ SD of various body measurement and body weight in Dhanni cattle

S. No	Traits	Unit	N	Mean $\pm$ SD	Minimum	Maximum	CV%
1	BW	kg	125	312.07 $\pm$ 74.14	195.00	577.00	24%
2	BL	cm	125	129.31 $\pm$ 10.99	102.00	162.00	9%
3	HW	cm	125	130.37 $\pm$ 7.11	114.00	157.00	6%
4	CG	cm	125	165.13 $\pm$ 11.14	128.00	203.00	7%
5	MC	cm	125	42.84 $\pm$ 2.55	28.00	49.00	6%

** BW = body weight, BL = Body length, HW = Height at withers, CG = Chest girth, MC = Muzzle circumferences

Table 7: Effect of sex on various body measurements and body weight in Dhanni Cattle

Sr. No	Traits (unit)	Sex		Overall <i>P</i> value
		Female(N = 96)	Male(N = 29)	
1	BW (kg)	294.25 $\pm$ 4.89	425.69 $\pm$ 8.55	<.0001
2	BL (cm)	125.98 $\pm$ 0.93	138.65 $\pm$ 1.62	<.0001
3	HW (cm)	128.66 $\pm$ 0.54	139.68 $\pm$ 0.94	<.0001
4	CG (cm)	161.93 $\pm$ 0.79	180.39 $\pm$ 1.39	<.0001
5	MC (cm)	42.15 $\pm$ 0.26	44.9278 $\pm$ 0.46	<.0001

**BW = body weight, BL = Body length, HW = Height at withers, CG = Chest girth, MC = Muzzle circumferences

**Fig. 3:** Dhanni cow with small udder and teats

described in Table 7. There were (female = 96) and (male = 29) in this study. The mean $\pm$ SE of BW, BL, HW, CG and MC of male were 425.69 $\pm$ 8.55, 138.65 $\pm$ 1.62, 139.68 $\pm$ 0.94, 180.39 $\pm$ 1.3925 and 44.9278 $\pm$ 0.46, respectively. The mean $\pm$ SE of BW, BL, HW, CG and MC of female were

294.25 $\pm$ 4.89, 125.98 $\pm$ 0.9312, 128.66 $\pm$ 0.5416, 161.93 $\pm$ 0.7968 and 42.15 $\pm$ 0.2636, respectively. The effect of sex on BW and body measurements was highly significant however the male Dhanni cattle weight was heavier (130 kg) than female.

Table 8: Effect of herd on various body measurements and body weight in Dhanni Cattle

Sr. No	Traits (unit)	Herd		
		Herd1 (N = 79)	Herd2 (N = 46)	Overall P value
1	BW (kg)	401.05 ± 7.54	318.88 ± 6.33	<.0001
2	BL (cm)	141.56 ± 1.43	123.07 ± 1.20	<.0001
3	HW (cm)	139.15 ± 0.83	129.19 ± 0.70	<.0001
4	CG (cm)	179.60 ± 1.22	162.73 ± 1.03	<.0001
5	MC (cm)	44.62 ± 0.40	42.46 ± 0.34	<.0001

**BW = body weight, BL = Body length, HW = Height at wither, CG = Chest girth, MC = Muzzle circumferences

Table 9: Correlation of body weight with morphometric measurements of Dhanni Cattle

Pearson Correlation Coefficients N = 125 Prob > r under H0: Rho = 0					
	BW	BL	HW	CG	MC
BW					
BL	0.61747 <.0001				
HW	0.71561 <.0001	0.63124 <.0001			
CG	0.85636 <.0001	0.66745 <.0001	0.77254 <.0001		
MC	0.43391 <.0001	0.44562 <.0001	0.47828 <.0001	0.54316 <.0001	

**=significant $P < 0.001$, BL = Body length, HW = height at Withers, CG = Chest Girth, MC = Muzzle circumference

Effect of herd

The least square mean ± standard error of different body measurements of two herds (Herd 1 and Herd 2) are presented in Table 8. The mean ± SE of BW, BL, HW, CG, and MC of herd 1 were 401.05 ± 7.54, 141.56 ± 1.43, 139.15 ± 0.83, 179.60 ± 1.22 and 44.62 ± 0.40, respectively. The mean ± SE of BW, BL, HW, CG and MC of herd 2 were 318.88 ± 6.33, 123.07 ± 1.20, 129.19 ± 0.70, 162.73 ± 1.03 and 42.46 ± 0.34, respectively. The quantitative traits of Herd 1 (BLPRI) are significantly higher ($P \leq .0001$) than Herd 2 (Private Farm).

Estimation of correlation of body weight with morphometric measurements

Correlation of BW was determined with Morphometric measurements including BL, HW, CG and MC. Significantly strong correlation of BW was found with CG (0.85636) and HW (0.71561) whereas, moderate correlation was found with BL (0.61747) and MC (0.43391). A significant moderate correlation of BL was found with HW (0.63124), CG (0.66745) and MC (0.44562). Significantly strong correlation of HW was found with CG (0.77254), however, moderate correlation with MC (0.47828). A significant moderate correlation of CG was found with MC (0.54316). Values for correlation coefficients and level of significance (P values) are given in Table 9.

Discussion

To discriminate between and within cattle breeds various morphometric measurements have been identified as the most appropriate variable (Mwacharo *et al.* 2006; Yakubu *et al.* 2010). This result was in accordance with (Desalegn *et al.* 2012) who reported that males Arrado cattle have better body measurements than females.

In another study Sambe *et al.* (2019) weight record from adult group of cattle (7 years or above) were analyzed. In this study, average body weight of was 577.5 ± 81.32 kg and 393.81 ± 51.69 kg for adult males and females, respectively. Average height at wither, heart girth and body length were 121.56 ± 5.53 cm, 171.39 ± 11.23 cm and 127.15 ± 11.29 cm, respectively. All these results support the present study.

Uddin *et al.* (2014) reported the average body weight, body length, height at wither, of Achai cattle 203.81 ± 6.17 kg, 110.27 ± 1.66 cm, 99.73 ± 1.26 cm respectively, which is comparable with the present study. Adinata *et al.* (2016) identified the relationship of body measurements in Jabres cattle. In addition, describe the average mean of describe the mean of BW (260.868) kg, BL (109.732) cm, HW (115.572) cm, and HG (147.169) cm on adult cows.

Bilal *et al.* (2016) conducted a study that shows that male (73.94 ± 1.81) Dhanni cattle weight was heavier than female (71.77 ± 1.97). In a study on Friesian cattle, it was found that sex has no significant effect on birth weight; however, male weight was higher than female. This difference in male and female weight may be because of high androgen levels in male fetus that also influence the birth weight in male calves (Bakir *et al.* 2004). Male had heavier BW than female and it might be because of the effect of testosterone in males. Due to higher level endogenous testosterone effect the growth and carcass cutability is increased in beef cattle (Gortsema *et al.* 1974). The production system of samples animals could be described as predominant grazing/pasture fed with

confinement in the evening. In this context, it has been extensively reviewed that feedlot fed cattle had a growth rate of twice as that of pasture fed cattle. Therefore, it may presume Dhanni may have greater potential for growth, if raised under feedlot system. Furthermore, Ahmad *et al.* (2013) had reported even higher increase in body weight (884.7 ± 75 g/day) in six Dhanni calves fed through feedlot fattening from 12 to 16 months of age as compared to Lohani and crossbred calves and argued that the better performance of Dhanni calves in rain fed area could be due to their comparatively better acclimatization to the area. This difference between farms might be due to the environment of farm, better feeding and management practices (Bakir *et al.* 2004).

Body measurements include BL, HG, and WH, correlation value (r) of 0.983, it was shown that body weight and heart girth had highly significant positive correlation ($P < 0.00$) (Siddiqui *et al.* 2015). Body weight has been reported to have a strong correlation with heart girth in cattle (Abdelhadi and Babiker 2012) and (Valdez and Bagui 2007). In another study, the relationship between BW, HG, BL and HW results indicate that there exists a high correlation ($r \geq 0.90$) of BW with BL, HW and CG. Highest correlation ($r = 0.96$) found with HG (Francis *et al.* 2002). These results support the present study.

Conclusion

The present study concluded that animals in the Herd-1 (Barani Livestock Production Research Institute (BLPRI) at Kherimurat) had higher BW and body measurements as compared to animals reared at private herds. The body weight of Dhanni cattle could be improved by using the body measurements (BL, HG, CG and MC) as selection criteria. Documenting and selecting Dhanni with better phenotypic characteristics and morph-metric measurements can help in improving the breed traits. *In vivo* conservation program has been initiated by Department of Livestock and Dairy Development Punjab at BLPRI, but the capacity and scope still need to be improved. The result of the present study on BW and body measurements indicates that Dhanni cattle can be used for multipurpose *i.e.*, meat production, draught, cart racing and ploughing. A selection program may be devised to improve beef production potential of Dhanni cattle besides other traits.

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Author Contributions

Andelib Qayyum planned and executed the study, analyzed data and wrote manuscript. Hafiz Muhammad Waheed and Muhammad Fiaz hepled in designing the study, Ghulam Bilal assisted in data analysis and manuscript write up. Jalal Akbar Baig, Fazle Ahad, Hafiz Muhammad Bilal Akhtar, Saqib Ahmad Siddiqui and Muhammad Aslam facilitated data collection from the field. All authors read and approved the manuscript.

Conflicts of Interest

Authors declare there is no conflict of interest.

Data Availability

Data is available on request subject to approval from Livetsock and Dairy Developmemt Department, Lahore, Punjab.

Ethics Approval

Approval is not needed owing to nature of study *i.e.*, field data recording.

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