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NON-GENETIC FACTORS AFFECTING LINEAR TYPE TRAITS IN SAHIWAL COWS

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ABSTRACT

The present study was designed to find out the magnitude of environmental factors affecting linear type traits in Sahiwal cattle. There were 790 observations for linear type traits on 310 lactating Sahiwal cows progeny of 53 sires. The linear model included fixed effects of herd, parity and stage of lactation at classification. The age of cow at classification was used as co-variable. The ASReml (Version 2.0) was the statistical package used (Gilmour *et al.* 2007). Herd, parity, stage of lactation and age at classification effects were significant for chest width, body depth, rear udder height, udder depth, rear udder width, thurl width, angularity and fore teat length (P<.001-.05). Herd, parity and stage of lactation effects were significant for stature, central ligament and dewlap surface area (P<.001-.05). Herd and stage of lactation effect was significant for rear legs set and rump width (P<.001-.05). Herd and parity of cows affected linear type scores significantly (P<.001-.01). Herd, parity and age at classification effects were significant for rear legs rear view (P<.01-.05).

Key words: Non-genetic factors, linear type traits, Sahiwal cows.

INTRODUCTION

In modern dairying, the cow is under extreme pressure for high milk production and for maintaining her body to withstand the environmental stress for longer period of time. Through out the productive life of dairy cattle, each individual is subjected to several selection decisions. Increased milk yield and decreased involuntary culling are important components of breeding objectives. A fairly large proportion of cows are culled from the herds each year for reasons other than production (Murril, 1974). To avoid such losses selection of cows for physical fitness is necessary (White *et al.* 1974; Burnside *et al.* 1984). There are many characters that have been incorporated in selection indices in developed countries. Type is emphasized to varying degree in different type production indexes in different countries. Type is the word used literally to describe an animal in terms of conformation. Dairymen and livestock breeders usually try to seek best type cows and willing to pay more for these beautiful and functional animals (Hyatt *et al.* 1949; White *et al.* 1974).

Cows of good type tend to survive longer in the herd than cows of poor type (Bowden, 1982). Selection for better type will increase strength, stamina, functionally and longevity of the animal for dairy production (Harris *et al.* 1992; Boettcher *et al.* 1993). Conformation traits have been used as indirect selection criteria for herd life (Vukasinovic *et al.* 2002). In nutshell type is important selection criteria to be considered for breeding livestock.

There are several challenges in linear type classification. Linear scores for different traits are dependent on several non-genetic factors. Parity and age of cow at classification and stage of lactation among physiological factors are considered important. Amongst others herd is considered most important source of variation in linear scores assignment.

The quantification of such environmental influences is necessary for more accurate evaluation for linear type traits. Herd has been reported to be significant source of variation in type traits (Thompson *et al.* 1981; Bowden, 1982; Lucas *et al.* 1984; Foster *et al.* 1988). Parity affects on linear type traits have also been documented (Thompson *et al.* 1981; Boldman and Famula, 1985; Hayes and Mao, 1987).

Variance of type due to stage of lactation was significant (Bowden, 1982). Similar conclusions have been reported by other workers (Thompson *et al.* 1983; Lucas *et al.* 1984; Boldman and Famula, 1985; Hayes and Mao, 1987; Foster *et al.* 1988). Age at classification has been reported important source of variation in type traits in most studies (Norman *et al.* 1983; Lucas *et al.* 1984; Hayes and Mao, 1987; Foster *et al.* 1988). Adjustments for age at classification and stage of lactation have been proposed for evaluation of cows for linear type traits (Hayes and Mao, 1987). Uribe *et al.* (2000) concluded that conformation traits are highly related to growth and aging and as such tend to change with age. The linear type traits in Sahiwal cows were adjusted for stage of lactation while studying the relationship of linear type traits with reproductive efficiency Shakeel and Abrar, 2013).

Conformation recording is not in vogue for dairy animals in Pakistan. However there is an increasing interest at farmer's level to broaden the breeding objectives and to include more traits of economic importance, especially the conformation traits (Khan, 2007). The present study was designed to find out the magnitude of environmental factors affecting linear type traits of Sahiwal cattle in Pakistan.

MATERIALS AND METHODS

Site of Experimentation: The study was started at Livestock Experiment Station Bahadurnagar (LESB) District Okara, Livestock Experiment Station Jahangirabad, (LESJ) District Khanewal and Livestock Experiment Station Khizerabad (LESK) District Sargodha in the Punjab Province of Pakistan. These livestock experiment stations represent the major recorded population of Sahiwal cattle in Pakistan.

Feeding and Management Practices: At all the three farms, animals were regularly grazed at seasonally available fodders. During the course of study berseem (*Trifolium alexandrium*) from November to April and sorghum (*Andropogan sorghum*) and Sadabahar (*Sudan-sorghum hybrid*), Mott grass (Pennisetum purpureum) and maize (*Zea mays*) from May to October were major fodder fed to animals. In the evening chaffed fodder was offered at stall. The lactating cows were fed concentrates at the rate of one kilogram for every three kilogram of milk produced. Concentrate ration was offered generally @ of 1% of body weight to advance pregnant cows at Bahadurnagar and Jahangirabad. This practice was not observed at Khizerabad during the course of study. Provision of lumps of common salt in feeding trough was a common practice at all three farms. Cows were milked twice daily with an interval of 12 hours at all the three farms. Calves were weaned soon after birth at Livestock Experiment Stations Bahadurnagar, District Okara, and at Livestock Experiment Station, Jahangirabad, District Khanewal. Calves were fed milk @ of 10% of their body weight. Calves at Livestock Experiment Station, Khizerabad were not separated from their dams and allowed to suckle their milk allowance directly from their dams. In case the calf died, cow was shifted on concentrates as a stimulus for milk let down.

Data Collection: Freshly calved cows from parity first to fifth were selected for assignment of linear score for type traits in the light of guidelines given by the International committee on animal recording (ICAR, 2002). For the sake of linear scoring, lactation period was divided into three stages (15 to 45 days, 90 to 120 days and 165 to 195 days after calving). Each cow was assigned linear score thrice provided she remained in milk. Cows within 15 days after calving were not entitled for scoring just to avoid influence of edematous swelling. Dewlap of each cow was visually scored into three categories (dewlap with light skin folds, intermediate skin folds and heavy skin folds).

Statistical Analysis: The ASReml (Version 2.0) was the statistical package used (Gilmour *et al.* (2007). The linear model included fixed effects of herd, parity and stage of lactation at classification. The age of cow at classification was used as co-variable.

There were 790 observations on 310 cows for linear type traits. These cows were the progeny of 53 sires. The cows were grouped for analysis into first and second and later parity cows. Different combinations of fixed effects and interactions were fitted in the model. The interaction effect of parity by stage of lactation was non-significant in the initial analysis and hence was dropped from the final model. The fixed effects were the herd, parity and stages of lactation. The linear and quadratic effects of age at classification were fitted as co-variable. The quadratic effect of age at classification of cow and interaction effect of parity by stage was non significant.

The model assumed the following statistical expression

$$Y_{ijkl} = \mu + H_i + P_j + T_k + b_1(a_{ijkl}) + b_2 (a_{ijkl})^2 + e_{ijkl}$$

Where

μ = overall mean
H_i = effect of i^{th} herd (1-3)
P_j = effect of j^{th} parity (1-2)
T_k = effect of k^{th} stage of lactation (1-3)
a_{ijkl} = age of cow at classification
b_1 and b_2 = the linear and quadratic regression coefficients of trait on age at classification
e_{ijkl} = random error

RESULTS

Data structure is presented in Table 1. Out of the 790 observations, 331 pertained to LESB, 210 to LESJ and 249 to LESK. Almost one third (259) of the observations belonged to first parity cows while two third (531) observations were distributed among second and later parity cows. There were 310, 262 and 218 observations on cows in first, second and third stage of lactation.

Herd Effect: The means along with standard deviations and level of significance of linear type traits for the three herds are presented in Table 2. Herd effects were significant for stature, chest width, body depth, rear legs set, foot angle, rear udder height, central ligament, udder depth, rear udder width, thurl width, dewlap width, and dewlap visual score ($P<0.001$). Angularity, rump angle, fore teat length and dewlap surface area were also different across herds ($P<0.01$). Herd effects also reached statistical significance for rump width and rear legs rear view ($P<.05$) but herd was not a significant source of

variation for fore udder attachment, teat placement rear view and naval length.

Table 1 Distribution of observations on linear type traits

Effect	Level	Number of Observations
Herd	Bahadurnagar	331
	Jahangirabad	210
	Khizerabad	249
Parity	First parity	259
	Second and later parities	531
Stages of lactation	1 (15-45 days)	310
	2 (90-120 days)	262
	3 (165-195 days)	218

Table 2 Means and standard deviations for linear type traits scored on a scale of 1-9 at three herds†

Traits	Level of significance	Farm		
		Bahadurnagar	Jahangirabad	Khizerabad
1 Stature	***	4.8±1.90a	6.2±1.98b	4.7±1.80a
2 Chest Width	***	4.4±1.53a	5.4±1.24b	3.5±1.11c
3 Body Depth	***	4.2±1.83a	6.0±1.65b	4.7±1.82c
4 Angularity	**	4.9±1.67a	4.8±1.81a	5.5±1.90b
5 Rump Angle	**	5.1±1.55a	4.9±1.51b	5.5±1.57c
6 Rump Width	*	4.4±1.40a	4.7±1.55b	5.0±1.41c
7 Rear Legs Set	***	4.6±1.54a	4.7±1.74a	5.6±1.73b
8 Rear Legs Rear View	*	4.6±1.95a	4.3±1.63b	4.0±1.56c
9 Foot Angle	***	5.8±1.68a	4.4±2.02b	5.5±1.75c
10 Fore Udder Attachment	NS	4.5±1.66	4.4±1.75	4.6±1.93
11 Rear Udder Height	***	5.1±1.95a	3.7±1.90b	6.2±1.78c
12 Central Ligament	***	3.4±1.51a	4.6±1.50b	3.6±1.38c
13 Udder Depth	***	4.9±1.56a	4.1±1.49b	5.5±1.70c
14 Teat Placement Rear View	NS	5.0±1.47	5.0±1.42	4.9±1.29
15 Fore Teat Length	**	4.0±1.89a	4.5±1.95b	3.7±1.56c
16 Rear Udder Width	***	3.5±1.72a	4.2±1.87b	3.02±1.45c
17 Thurl Width	***	4.6±1.23a	5.9±1.37b	4.6±1.09a
18 Naval Length	NS	4.7±1.36	4.6±1.54	4.7±1.43
19 Dewlap Width	***	4.7±1.23	4.5±1.43	4.1±1.15
20 Dewlap Surface Area	**	4.4±1.7	4.8±1.65	4. ±1.71
21 Dewlap Visual Score	***	2.3±0.75	2.2±0.67	1.9±0.74

† ***, **, *, NS = significant at P<0.001, significant at P<0.01, significant at P<.05 and non significant respectively. Means bearing same letters are not different and vice versa

The cows at (LESJ) were taller at spine, wider at chest with deeper body possessing deeper udders than cows at (LESB) and (LESK). The cows at Livestock Experiment Station, Khizerabad (LESK) were more angular with straighter rump possessing high rear udder attachment as compared to cows at other two farms. However, cows at (LESB) were narrower at their rump width as compared to those at (LESK) and (LESJ). Foot angle of cows was steeper at (LESB) and (LESK) as compared to those at (LESJ). Cows possessed straighter legs from side view at (LESK) than at other two farms. Fore teats were longer at (LESJ) than at other two farms. Cows at (LESJ) were significantly wider at their rear udder attachment position followed by (LESB) and (LESK). The cows at (LESB) and (LESK) were not significantly different from each other at thurl width position. The cows at (LESJ) were wider at thurl position as compared to cows at the other two farms.

Smaller but significant differences were observed for rear legs rear view across herds. Rear legs were straighter when viewed from rear for cows at (LESB) followed by (LESJ) and (LESK). Cows at (LESJ) possessed stronger central ligament as compared to cows at other two farms.

Parity Effect: The means alongwith standard deviations and level of significance of linear type traits for different parities are presented in Table 3. Parity effects were significant (P<0.001) for stature, chest width, body depth, rear udder height, udder depth, fore teat length, rear udder width and thurl width. Cows in later parities received higher score for stature, chest width, body depth, angularity, thurl width, rear legs rear view, central ligament, fore teat length and rear udder width. A decrease in linear score was observed for rear udder height and udder depth. Parity also affected rear legs rear view and dewlap visual score (P<0.01). Angularity, central ligament and dewlap surface area were affected by parity of cows (P<.05). Parity was not a significant source of variation for rump angle, rump width, rear legs set, foot angle, fore udder attachment, teat placement rear view, naval length and dewlap width (P<.05).

Table 3 Means and standard deviations for linear type traits scored on a scale of 1-9 in different parities

		Parity	
Traits	**Level of significance†**	**First**	**Later**
1 Stature	***	4.7±1.96	5.4±1.98
2 Chest Width	***	4.1±1.45	4.5±1.55
3 Body Depth	***	4.0±1.77	5.2±1.85
4 Angularity	*	4.7±1.96	5.3±1.70
5 Rump Angle	NS	5.2±1.38	5.2±1.65
6 Rump Width	NS	4.5±1.30	4.8±1.53
7 Rear Leg Set	NS	4.9±1.82	5.0±1.66
8 Rear Leg Rear View	**	3.9±1.52	4.5±1.85
9 Foot Angle	NS	5.4±1.82	5.3±1.92
10 Fore Udder Attachment	NS	4.7±1.77	4.4±1.77
11 Rear Udder Height	***	5.4±2.17	4.9±2.06
12 Central Ligament	*	3.6±1.61	3.9±1.50
13 Udder Depth	***	5.3±1.56	4.7±1.68
14 Teat Placement Rear view	NS	5.0±1.50	4.9±1.35
15 Teat Length (Fore)	***	3.1±1.49	4.4±1.83
16 Rear Udder Width	***	3.0±1.56	3.8±1.78
17 Thurl Width	***	4.5±1.40	5.1±1.29
18 Naval Length	NS	4.6±1.49	4.7±1.40
19 Dewlap Width	NS	4.4±1.38	4.5±1.25
20 Dewlap Surface Area	*	4.3±1.68	4.5±1.73
21 Dewlap Visual Score	**	2.1±0.78	2.2±0.71

† ***, **, *, NS = significant at P<0.001, significant at P<0.01, significant at P<.05 and non significant respectively

Stage of Lactation Effect: The means alongwith standard deviations of linear type traits for different stages of lactation are presented in Table 4. Stage of lactation was significant (P<0.001) source of variation for stature, body depth, angularity, rump width and dewlap surface area amongst body traits. Amongst feet and legs traits, rear legs set was affected significantly (P<0.001) by stage of lactation. Rear udder height, udder depth, fore teat length and rear udder width were amongst udder traits significantly influenced by stage of lactation (P<0.001). Stage of lactation effect was significant for chest width, central ligament, and thurl width (P<0.05). Traits including rump angle, rear legs rear view, foot angle, fore udder attachment, teat placement rear view, naval length, dewlap width and dewlap visual score were not affected by stage of lactation (P<0.05).

There was a decrease in linear score in second stage of lactation followed by an increase in third stage for stature, central ligament and thurl width. There was a consistent decrease in linear score from first to later stages of lactation for chest width, rear udder height, rear udder width and fore teat length. A slight non significant increase in linear score for rear legs set in second stage and a significant decrease was observed in third stage of lactation. The linear score increased with advancement in stage of lactation for body depth, angularity, rump width and udder depth. The cows possessed deeper body with wider rump, shallow udder and narrower rear udder width in later stages of lactation. The cows received higher

Table 4 Means and standard deviations for linear type traits scored on a scale of 1-9 at three stages of lactation†

.	Level of significance	Lactation stages		
		15-45 days	90-120 days	165-195 days
1 Stature	***	5.3±2.04a	5.0±1.95bc	5.1±1.98c
2 Chest Width	*	4.5±1.69a	4.3±1.42bc	4.3±1.39c
3 Body Depth	***	4.6±2.00a	4.9±1.82b	5.1±1.87c
4 Angularity	***	4.6±1.75a	5.3±1.80bc	5.5±1.73c
5 Rump Angle	NS	5.1±1.63	5.2±1.55	5.3±1.46
6 Rump Width	***	4.5±1.54a	4.7±1.40b	4.9±1.41c
7 Rear Legs Set	***	5.0±1.86a	5.1±1.67a	4.7±1.52b
8 Rear Legs Rear View	NS	4.4±1.94	4.3±1.64	4.3±1.68
9 Foot Angle	NS	5.3±1.99	5.4±1.84	5.3±1.82
10 Fore Udder Attachment	NS	4.5±1.83	4.6±1.79	4.5±1.66
11 Rear Udder Height	***	5.5±2.21a	4.8±1.99bc	4.7±2.01c
12 Central Ligament	*	3.9±1.56a	3.7±1.57ab	3.8±1.50a
13 Udder Depth	***	4.6±1.72a	5.0±1.69b	5.1±1.54c
14 Teat Placement Rear View	NS	4.9±1.52	5.0±1.39	5.0±1.25
15 Teat Length (Fore)	***	4.1±1.90a	3.9±1.82bc	3.9±1.76c
16 Rear Udder Width	***	4.3±1.95a	3.2±1.48b	2.8±1.24c
17 Thurl Width	*	5.0±1.43a	4.9±1.34bc	4.9±1.30c
18 Naval Length	NS	4.7±1.42	4.6±1.45	4.7±1.42
19 Dewlap Width	NS	4.4±1.37	4.5±1.25	4.6±1.24
20 Dewlap Surface Area	***	4.3±1.68	4.3±1.66	4.7±1.79
21 Dewlap Visual Score	NS	2.1±0.74	2.2±0.74	2.2±0.74

† ***, *, NS = significant at P<0.001, significant at P<0.05 and non significant respectively
Means bearing same letters were not different from each other.

score during first stage of lactation that was significantly different from second and third stage for stature, chest width, rear udder height, central ligament, fore teat length and thurl width. The cows became more angular in later stages of lactation although difference between second and third stage was non-significant. Linear score for rear legs set was low in third stage of lactation indicating that legs were straighter in third stage of lactation as compared to first and second stage.

Age at Classification Effect: Age at classification effect was not apparent for all the traits (Table 5). The quadratic effect of age of cow at classification was non significant for all traits except dewlap width (P<.05). Age of cow at classification affected chest width, body depth, and rump width (P<0.001). Angularity, rear udder height, rear udder width, udder depth fore teat length and thurl width were also affected by age of cow at classification (P<0.01). These effects reached statistical significance (P<0.05) for rear legs rear view and fore udder attachment.

The linear scores were higher with advancement in age of cow at classification for chest width, body depth, angularity, rump width, rear legs rear view, rear udder width, fore teat length and thurl width. A decline was observed in linear score for udder depth, rear udder height and fore udder attachment with advancement in age of cows at classification.

Table 5 Linear (b_1) and quadratic (b_2) regression coefficients for age of cow at classification†

Traits	α	b_1	b_2
1 Stature	2.80	0.0429NS	-0.0002NS
2 Chest Width	2.75	0.0318***	-0.0001NS
3 Body Depth	1.67	0.0297***	-0.0000NS
4 Angularity	2.54	0.0367**	-0.0001NS
5 Rump Angle	6.77	-0.0460NS	0.0003NS
6 Rump Width	2.74	0.0278***	-0.0000NS
7 Rear Legs Set	3.25	0.0414NS	-0.0003NS
8 Rear Legs Rear View	4.08	0.0001*	0.0001NS
9 Foot Angle	6.41	-0.0105NS	0.0000NS
10 Fore Udder Attachment	4.62	0.0057*	-0.0001NS
11 Rear Udder Height	6.80	-0.0120**	-0.0000NS
12 Central Ligament	2.68	0.0115NS	-0.0000NS
13 Udder Depth	5.87	-0.0056**	-0.0002NS
14 Teat Placement Rear view	5.04	0.00065NS	-0.0000NS
15 Fore Teat Length	1.00	0.0491**	-0.0001NS
16 Rear Udder Width	2.84	0.0163**	-0.0000NS
17 Thurl Width	3.20	0.0220**	-0.0001NS
18 Naval Length	4.23	0.0080NS	0.0000NS
19 Dewlap Width	2.82	0.0481NS	-0.0003*
20 Dewlap Surface Area	3.12	0.0250NS	-0.0001NS
21 Dewlap Visual Score	1.75	0.0108NS	-0.0001NS

† * = significant at P<0.05, ** = significant at P<0.01, = significant at P<.001 and NS = non significant, respectively

DISCUSSION

The herd differences in type traits were indication of feeding, management and housing differences at three farms. Climatic conditions at the three farms were not very different. The housing facilities were better for lactating cows at Livestock Experiment Station, Jahangirabad followed by Livestock Experiment Station, Bahadurnagar and Livestock Experiment Station, Khizerabad. Green fodder availability during the course of study was also better at Livestock Experiment Station, Jahangirabad followed by Livestock Experiment Station, Bahadurnagar and Livestock Experiment Station, Khizerabad. If this was the situation in previous years, growth associated conformation traits might have been affected by it causing differences among cows at three farms. Differences in feed and fodder availability could also affect udder development and hence udder associated linear type traits.

Several studies in the literature pointed out herd differences in linear type traits. Large herd effects reported for stature and rear udder width of Ayrshire, and for most of traits for Jerseys and for udder depth of Shorthorn cows were in consensus with the present findings (Norman *et al.* 1983). Variation due to herd for all linear type traits of Nili-Ravi are in consensus to current study (Javed *et al*. 2013). Similar findings in Piemontese cows in Italy has been reported (Mantovani *et al*. 2010). Herd-year variation in type or score card traits have also been reported (Moreno *et al.* 1979; Lawstuen *et al.* 1987; Foster *et al.* 1988). Herd differences for all linear type traits with a few exceptions as for this study were reported for Valdostana cattle (Mazza *et al*. 2013).

Significant parity effects for chest and body and udder depth in present study were in consensus to those reported by Vij *et al* (1990) while non-significant effect of parity on rump width was not in agreement. Significant parity effects on stature and chest width were in agreement to findings by Schaeffer *et al.* (1985) for Holsteins. Findings of present study for significant effects of parity on stature, chest width, body depth, angularity, rear udder height, central ligament, udder depth and rear udder width were in consensus to Thompson *et al.* (1981). Significant parity effects for stature, body depth and angularity, little effects for feet and legs traits and higher rear udder width and lower udder depth score in later parities was in agreement to findings of Hayes and Mao (1987). Current study findings were in partial agreement to Boldman and Famula (1985) for effects of parity on linear type traits.

The change in linear score for chest width in present findings with advancement in stage of lactation was in consensus to findings of Boldman and Famula (1985) where body strength (chest width) was reported to change with changing stage of lactation. Significant stage of lactation effects for stature, chest width, body depth, angularity, rump width, rear legs set, rear udder height, rear udder width, central ligament and udder depth were in agreement to findings of Lawstuen *et al.* (1987). Increase in udder depth score in later stages of lactation was in consensus to findings by Smith *et al.* (1985). Significant stage of lactation effect on angularity and udder depth were same as reported for US Holsteins (Lucas *et al.* 1984). Significant stage of lactation effects for most of traits in present findings were in agreement to the findings of previous studies (Thompson *et al.* 1981; Funk *et al.* 1991; Foster *et al.* 1988). In a most recent study stage of lactation (days in milk) affected all 22 linear type traits with a few exceptions in Valdostana cattle (Mazza *et al*. 2013). Significant effect of stage of lactation on stature, rump width, rear udder height and udder depth in present study were in agreement to findings of Dahiya (2005a) for Sahiwal cattle. Stage of lactation effect on stature, chest width, central ligament and udder depth were in agreement to findings by Dahiya (2005) for Hariana cows. Significant stage of lactation effect on udder depth was in agreement to Vij *et al.* (1990). Drop in score for stature after first stage and then increase in current finding were similar to Hayes and Mao (1987). As for this study, stage of lactation was important source of variation for type traits (Norman *et al.* 1979; Klassen *et al.* 1992; Kumar *et al.* 2000).

Non-significant effect of age at classification on stature indicated that Sahiwal cows were mature enough as regards height at spine at the time of calving even at lower ages. Decrease in linear score for udder depth with age looked logical due to more milk and development of udder with age. Increase in linear score for fore teat length could be joint result of age and practice of hand milking. Highly significant effect of age at classification on growth and size associated traits including chest width, body depth, angularity, rump width and thurl width can be justified. This could be due to actual biological development of the cows. Growth associated traits change considerably as animal advances in age (Vij *et al.* 1990; Hayes and Mao, 1987). Boldman and Famula (1985) were of the opinion that rear udder height, udder depth and rear udder width change with advancement in age as a result of udder development. Significant effects of age at classification on chest width, body depth, rump width, rear udder width and udder depth in present study were similar to Lawstuen *et al.* (1987). Increase in linear score means with age for chest width, body depth, angularity, rump width, rear udder width were in consensus to Lawstuen *et al.* (1987). Significant effect of age at classification on chest width, angularity, rump width, fore udder attachment, rear udder height, rear udder width and udder depth in present study and negative regression coefficient of age of cow for udder depth were in agreement to Lucas *et al.* (1984). Significant effect of age at classification on rear legs rear view in present study was contrary yet; such effects for

udder depth and chest width were in agreement to (Thompson *et al.* 1983). Significant age at classification effects for chest width, body depth, angularity, thurl width, fore udder attachment, rear udder height, rear udder width and udder depth in the present study was in agreement to findings of Funk *et al.* (1991). Significant age at classification effect on chest width, angularity, rump width, fore udder attachment, rear udder width, rear udder height, and udder depth found in present study were in agreement to findings of Dahiya (2005a) for Indian Sahiwal cows. Findings of current study are substantiated by the study of Dahiya (2005) conducted on Hariana cows. Significant effect of age of animal on some linear type traits in Sahiwal cattle were in agreement to present study (Ashutash *et al*. 2014).

Conclusions: The results pertaining to present study indicated that herd, parity, stages of lactation and age of cow at classification were important sources of variation for most of linear type traits. Herd differences were likely reflection of management differences. So, for genetic evaluations herd should be modeled to obtain unbiased results. For evaluation of Sahiwal cows, use of linear type traits scores obtained during first lactation will be better option to avoid parity effect biases. It will be preferable to select future bull calves from dams having linear type traits information recorded during first parity. However, for studying durability of cow for linear type traits, information on later parity cows will be required. While making comparison among different parity cows, age of cow effects should also be considered. Similarly stage of lactation effects should be kept in mind while selecting cows. Adjustment for environmental factors will be needed for evaluation of cows and bulls on comparative basis.

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