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Estimation of direct and maternal genetic parameters for pre-weaning growth traits in Friesian calves

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Abstract

The objective of this study was to obtain direct heritability(h^2_a), maternal heritability (h^2_m), permanent environmental (pe^2) effect and estimated breeding values (EBVs)for pre-weaning body weight at birth (BW0/Kg), body weight at 30 days of age (BW30/Kg), body weight at 60 days of age (BW60/Kg), weaning weight (WW/Kg): body weight of calf at weaning and average daily gain (ADG/kg) of 1376 Friesian calves progeny of 33 sires and 284 dams during the period from the years 2009 to 2020, which bred at El-Karada Experimental station, Animal Production Research Institute (APRI), Agricultural Research Center (ARC), Dokki, Giza, Egypt. Pre-weaning growth traits are subject to the very clear influence of non-genetic factors included sex of calf, parity of dam, year and season of calving. The direct heritability h^2_a estimates for all growth traits under study were moderate. Estimates of h^2_a were 0.24 for BW0, 0.21 for both BW30 and BW60, 0.19 for WW and 0.23 for ADG. Estimates of h^2_m were 0.08 for BW0, 0.10 for BW30, 0.05 for BW60, 0.04 for WW, and 0.06 for ADG. The portion of pe^2 also was low, it was 0.049 for BW0, 0.064 for BW30, 0.041 for BW60, 0.044 for WW and 0.034 for ADG. Ranges of EBVs for Friesian calves were 4.585 kg for BW0, 6.821 kg for BW30, 9.075 kg for BW60, 9.459 kg for WW and 1.159 kg for ADG. The accuracy of minimum and maximum calves EBVs ranged from 56 to 79 %. Based on the results of the current study, improvement for these traits could be achieved through well-planned genetic improvement through selection for best animals according to their breeding values. Further investigation on the same traits using many data is required to reveal a more accurate and reliable genetic evaluation.

Keywords: Friesian calves, Pre-weaning growth traits, heritability, breeding value.

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1. Introduction

Beef is produced as a by-product of milk production by dairy breeds in Egypt, and the majority of the commodity comes from the original Friesian herds. Although some meat production traits have long been incorporated into dairy cattle breeding programs along with milk production traits, selection pressure on these traits has remained modest. In this respect, Friesian cows are among the most prestigious dairy cows in Egypt and can serve for multiple purposes that making the animal as dual purposes (Abdel-Glil and El-Banna, 2001). Continuing with the foregoing, growth traits are one of the intrinsic economic traits of livestock in different production systems and help in formulating management and selection decisions. However, birth weight is one of the first traits that can be easily measured and one parameter that is important for subsequent growth performance due to the fact that the heavier calves can grow faster and healthier compared to lighter calves (Sofienaz *et al*., 2014). The genetic makeup of a population can be studied by looking to the relative importance of heredity and environmental factors that influence the performance of an individual in that group (Goshu *et al*., 2014). Knowledge of the heritability and genetic correlates of traits is needed to estimate genetic assessments, predict response to selection, and help producers to select a breeding system that can be adopted for future improvement (Cassell, 2009). Moreover, genetic parameters are also needed to predict the breeding values that will be used in the classification and selection of beast animals for breeding. Thus, estimation of genetic parameters of productive traits and breeding values of Friesian herds present in Egypt is required for genetic improvement programs for these cows (Oudah and Zainab, 2010). The purpose of this study is to quantify genetic parameters related to direct and maternal influencing pre-weaning growth traits, as well as to identify the effects of non-genetic factors on such traits in Friesian calves born at one of government farms in Egypt.

2. Materials and methods

The current study contained, pre-weaning growth traits included, body weight at birth (BW0/Kg), body weight at 30 days of age (BW30/Kg), body weight at 60 days of age (BW60/Kg), weaning weight (WW/Kg), body weight of calf at weaning (90 days of age) and average daily gain (ADG/kg) of 1376 Friesian calves, the offspring of 33 sires and 284 dams during the period from the years 2009 to 2020, which bred at El-Karada Experimental station, located northwest of the Nile Delta in Kafr El-Sheikh governorate, The Animal Production Research Institute (APRI), Agricultural Research Center (ARC), Dokki, Giza, Egypt. While the current study relied upon body weight at birth and average daily gain calculated from the weight records of the farm to predict the weight of each calf at the age of 30 and 60 days, according to the following formula:

$$\text{Body weight at 30 days of age } (\text{BW30/Kg}) = (\text{ADG} \times 30) + \text{BW0}$$

$$\text{Body weight at 60 days of age } (\text{BW60/Kg}) = (\text{ADG} \times 60) + \text{BW0}$$

2.1 Feeding and management

The herds were kept under a regular system of feeding and management adopted by the Research Center, Ministry of Agriculture. Calves were produced mainly by artificial insemination. After calving, birth weight, sex and pedigree were recorded. Calves were allowed to suck out the colostrum, which was milked by machines from their dams for the first 4 days. Colostrum was offered 3 times daily totaling 10% of the calf's body weight. From the fifth day of age, calves were fed on natural whole milk and then after the daily milk, starter, and hay were offered. At the beginning of the last two weeks of the suckling period, the frequency of daily meals was stepwise reduced to twice daily for 10 days and lastly once before 5 days of weaning period. Minerals blocks were available freely throughout the experimental periods. Also, water was available all time except one hour before every time of feeding of milk. The starter (18 % protein) was formulated as follows: Maize (54%), soybean (25%), wheat bran (15%), limestone (2%), ordinary salt (1%) and molasses (3%).

2.2 Data analysis

Statistical analysis using the general linear model (GLM) procedure (SAS, 2003), was used to determine the fixed effects contained in the statical model using the following linear model:

$$\text{Yijklm} = \mu + \text{Si} + \text{Pj} + \text{Yk} + \text{SX} + \text{SEl} + \text{eijkXlm}$$

Where: Yijklm = either BW0, BW30, BW60, WW and ADG , μ= overall mean for each trait, Si= the random effect of ith sire, Pj= the fixed effect of jth parity j, (j=1, 2…, 7), Yk= the fixed effect of kth year of calving k, (k=2009…., 2020), SX= the fixed effect of xth sex of calf x, (x= 1, 2) were 1=male, 2= female SEl=the fixed effect of lth season of calving l, (l=1, 2… 4), were 1=autumn, 2= winter, 3= spring and 4= summer, and eijkxlm = random residual assumed to be independent and normally distributed with mean zero and variance σ^2e.

2.3 Genetic parameters

2.3.1 Heritability

Heritability for all studied traits was computed using a single-trait animal model (STAM) by using the MTDFREML program of Boldman *et al.* (1995) obtained by REML method of the VARCOMP procedure (SAS, 2003). The following model was used to estimate genetic parameters within the population:

$$\text{Model}: \text{Y} = \text{Xh} + \text{Z}_{1\text{a}} + \text{Z}_{2\text{pe}} + \text{Z}_{3\text{m}} + \text{e with Cov (a, m)} = 0$$

$$\text{and .... var}\begin{pmatrix} a \\ m \\ p_e \\ e \end{pmatrix} = \begin{pmatrix} A\sigma_a^2 & 0 & 0 & 0 \\ 0 & A{\sigma^2}_m & 0 & 0 \\ 0 & 0 & I_{d\sigma_{pe}^2} & 0 \\ 0 & 0 & 0 & I_{n\sigma_e^2} \end{pmatrix}$$

Where, Y= a vector of observations (traits studied), b= a vector of a fixed effect specific to sex, year, season, and parity. a= a vector of random direct additive genetic effects. pe=a vector of random maternal permanent environmental effects. m= a vector of random maternal effects. X, Z_1, Z_2 and Z_3= incidence matrix relating individual records to b, a, pe and m, respectively, e=

a vector of random residual effects with mean equals zero and variance σ^2_a, A=is the numerator relationship matrix, σ^2_a=is the variance due to direct additive genetic, σ^2_m= is the variance due to maternal genetic, σ^2_{pe}= is the maternal permanent environmental variance; σ^2_e= is a random residual effect associated with each observation. I_d and I_n are identity matrices of order equal to the number of dams and animals, respectively.

2.3.2 Estimated breeding values (EBVs)

Best linear unbiased prediction (BLUP) for evaluating breeding values (EBV) was calculated by a back solution using the MTDFREML program for all animals in the pedigree file.

3. Results and discussion

3.1 Means

Means, standard deviation (SD), coefficients of variation (CV %), minimum and maximum for pre-weaning growth traits (BW0, BW30, BW60, WW and ADG) of Friesian calves are presented in Table (1). Actual means of pre-weaning growth traits are within the ranges, reported in Egyptian studies, especially under the conditions of government farms (Faid-Allah, 2014; Oudah and Zainab, 2010; Sanad and Gharib, 2017; 2018) for BW0, BW30, BW60, WW and ADG. Nevertheless, these means were relatively lower than that reported by other Egyptian studies, whether for the same genotype (Friesian) or Holstein cattle Atil *et al*. (2005) and El-Arain *et al*. (2014) for BW0, BW30, BW60 and WW reported. on contrast, these means were relatively higher than that reported by other Egyptian studies whether, for Friesian and Holstein cattle under a commercial system (El-Arain *et al*., 2014; Sanad and Gharib, 2017) ranged from 0.556 to 0.656 kg for ADG, and (Faid-Allah, 2014; Ghonelm *et al*., 2008; Sanad and Gharib, 2018) ranged from 74.4 to 82.47 kg for WW. In this respect, the differences in means are possibly due to one or more of the following reasons such as: different climatic conditions, management practice, genetic and phenotypic differences (El-Arain *et al*., 2014; Hossain *et al*., 2018; Ibrahim *et al*., 2019).

Table (1): Means, standard deviations (SD) and coefficients of variation (CV %), minimum, maximum for pre-weaning growth traits of Friesian calves.

Traits[1] (kg)	Mean	SD	CV%	Minimum	Maximum
BW0	28.068	3.25	11.58	18.60	40.00
BW30	39.685	5.79	14.59	22.5	55.28
BW60	50.597	8.78	17.36	21.97	79.59
WW	92.108	11.17	12.13	68.75	134.0
ADG	0.7116	0.115	16.22	0.48	1.11

[1] BW0=body weight at birth, BW30=body weight at 30 days of age, BW60=body weight at 60 days of age, WW= body weight of calf at weaning (90 days of age) and ADG= average daily gain.

3.2 Coefficients of variation

As shown in Table (1) estimates of CV% for all studied growth traits were considered moderate and almost equal ranges from 11.582 to 17.363%. These estimates are within the ranges reported by Oudah and Zainab (2010), Faid-Allah (2014) and Sanad and Gharib (2017). In this regard, the estimates of CV% may reflect a reasonable variation of growth traits among individuals, which enhanced the possibility of utilizing such variation to improve the body weight productivity of calves through phenotypic selection.

3.3 Non-genetic effects on growth traits

Least-squares mean (LSM) and standard errors (SE) for fixed effects of (sex of calf, parity of dam, year and season of calving) of calving affecting BW0, BW30, BW60, WW and ADG are presented in table (2).

3.3.1 Season of calving

In the current study, the season of calving had a highly significant effect on BW0, BW30, WW and ADG ($P \leqslant 0.001$) and significant effects on BW60 ($P \leqslant 0.05$). These results agreed with that mentioned by Faid-Allah (2014), Ferdous *et al*. (2019), Elkaschab *et al*. (2020) and Sanad and Gharib (2018). The least-squares means presented in Table (2) showed that winter calves had the highest body weight traits followed by autumn calves. Moreover, the results indicated that the performance of BW0, BW30 and BW60 was lowest through summer where spring was lowest for WW and ADG. In this respect, Abdel-Glil and El-Banna (2001) and Sanad and Gharib (2018) reported that Holstein calves born in winter were higher than that born in summer ($P \leqslant 0.05$) for body weight traits compared to other seasons. It seems likely that the improved conditions of dams in the winter season of calving refer to the confounding effects of the moderate climate and availability of green forages under Egyptian conditions.

3.3.2 Sex of calf

The effect of sex on calves body weight was significant ($P \leqslant 0.01$) and male calves had higher BW0, BW30, BW60, WW and ADG than females (Table, 2). Sagar *et al*. (2017), Hossain *et al*. (2018), Ibrahim *et al*. (2019), Khan et al., (2019), Mohammad and Hoque (2020) and Almasri *et al*. (2020) reported similar findings. This result might be due to longer gestation periods and higher androgen hormone intensity of fontal serum as reported by Uzmay *et al*. (2010).

3.3.3 Year of calving

In the current study, the year of calving had a highly significant effect on BW0, BW30, BW60, WW and ADG ($P \leqslant 0.001$). The same trend was observed by Putra *et al*. (2018), Khan *et al*. (2019), Ibrahim *et al*. (2019) and Almasri *et al*. (2020) on different genotypes of calves.

The least-squares means indicated that there is an inconsistent trend from one year to another (Table 2). In this regard, the calves in 2017 had the highest values of BW0, BW30, and BW60 in general compared to the other years, while the higher WW and ADG were recorded in 2016. Variations from year to other was attributed by different investigators to annual changes in atmospheric conditions such as humidity and temperature variation, the quantity and quality of available feeds, differential management strategies presented each year, disease patterns, and the interaction of some or all of the preceding non-genetic factors.

Table (2): Least square means (LSM) and standard error (SE) of the factors affecting body weight traits in Friesian calves.

Item	No.	BW0	BW30	BW60	WW	ADG
Season						
Autumn	483	28.359±0.201	40.156±0.343	50.715±0.513	93.226±0.557	0.720±0.005
Winter	437	28.356±0.208	40.210±0.355	50.506±0.531	93.307±0.577	0.721±0.006
Spring	402	28.031±0.209	39.526±0.357	50.259±0.534	90.089±0.580	0.689±0.006
Summer	367	26.909±0.210	38.354±0.359	49.245±0.537	90.541±0.584	0.707±0.006
Sig.		***	***	*	***	***
Sex						
Male	831	28.357±0.175	40.874±0.300	54.123±0.449	92.817±0.488	0.716±0.005
Female	858	27.471± 0.171	38.248±0.291	46.239±0.436	90.764±0.474	0.703±0.005
Sig.		***	***	***	***	**
Year						
2009	159	27.173±0.312	38.297±0.533	50.807±0.797	82.739±0.867	0.617±0.009
2010	152	26.790±0.320	37.282±0.546	50.035±0.817	79.819±0.888	0.589±0.009
2011	145	27.167±0.322	37.977±0.551	49.556±0.824	85.063± 0.895	0.643±0.009
2012	144	27.404±0.323	38.190±0.551	49.987±0.824	89.215±0.896	0.686±0.009
2013	141	27.106±0.317	37.771±0.541	47.567±0.810	89.481± 0.880	0.693±0.009
2014	140	28.805±0.324	40.896±0.553	50.487±0.827	95.762±0.899	0.743±0.009
2015	138	28.622±0.316	40.883±0.539	51.120±0.806	100.821±0.877	0.802±0.009
2016	138	29.334±0.303	42.054±0.518	51.846±0.775	105.434±0.843	0.845±0.008
2017	133	30.039±0.300	43.287±0.513	53.636±0.768	97.279±0.834	0.746±0.008
2018	121	26.842±0.333	38.123±0.569	48.854±0.851	95.018±0.925	0.757±0.009
2019	105	27.778±0.462	39.712±0.789	48.534±1.180	92.665±1.282	0.721±0.013
2020	92	27.626±0.362	39.665±0.619	50.861±0.925	87.053±1.00	0.660±0.010
2021	81	28.192±0.375	40.160±0.641	49.065±0.959	92.932±1.042	0.719±0.011
Sig.		***	***	***	***	***
Parity						
1	285	26.403±0.242	36.437±0.413	48.119±0.618	91.063±0.672	0.701±0.006
2	271	27.305±0.233	37.651±0.398	48.936±0.596	90.385±0.648	0.717±0.007
3	255	27.850±0.243	39.197±0.414	50.142±0.620	92.520±0.674	0.718±0.007
4	242	28.403±0.253	40.259±0.432	50.235±0.66	92.988±0.719	0.718±0.007
5	221	28.643±0.265	41.450±0.452	51.830±0.676	93.691±0.702	0.725±0.007
6	216	28.421±0.259	41.161±0.637	51.581±0.953	92.962±0.735	0.714±0.007
7	199	28.371±0.373	40.773±0.442	50.424±0.64	88.928±1.036	0.672±0.010
Sig.		***	***	***	***	***

*=P≤0.05, **=P≤0.01, *** = significant at P≤ 0.001.

3.3.4 Effect of parity

Parity had a highly significant effect on all studied traits (P≤0.001). Similar result was observed by El-Arain *et al*. (2014), Sanad and Gharib (2018) and Ibrahim *et al*. (2019). In the current study, the least-squares mean for BW0, BW30, BW60, WW and ADG increases with advanced parity until they reach the fifth one then followed by a gradual decrease. Moreover, the body weights of calves in the first parity were the least when compared with other parities (Table 2). Similar results were reported by Abdel-Glil and El-Banna (2001) and Ibrahim *et al*. (2019) who indicated a gradual increase in average BW0 and WW in both male and female calves from the first to the fourth parity, followed by a decrease in that weight thereafter. Also, Sanad and Gharib (2018) reported that BW0 and WW of calves in the first parity were the least when compared with other parities and both traits increased with the advancement of parity and reached their maximum at the 5th parity, then decreased thereafter. Many pervious authors attributed this variation to the good maternal environment provided by mature cows to the newly developing fetus and competition for nutrients between fontal development and maternal growth, which is higher in the early parities of the dam.

3.4 Genetic aspects

3.4.1 Heritability estimates for growth traits

Estimation of variance components, as well as direct heritability (h^2_a), maternal heritability (h^2_m), and maternal permanent environment effect (pe^2) for the considered traits, are presented in Table (3). Direct heritability (h^2_a) estimates for all growth traits under study were moderate. Estimates of h^2_a were found to be 0.24 for BW0, 0.21 for both BW30 and BW60, 0.19 for WW and 0.23 for ADG. Similar ranges for (Friesian and Friesian Holstein) calves' body weight were observed by Ghonelm *et al*. (2008), Abera *et al*. (2011), EL-Arain *et al*. (2014), Faid-Allah (2014) and Sanad and Gharib (2017).The magnitude of direct genetic variances and associated heritability currently obtained were generally high for BW0, BW30, BW60, WW and ADG which implied that generally there is sufficient genetic variation to implement genetic improvement through well-planned selection. However, h^2_a estimates of the current study were lower than the high estimates reported by Ghonelm *et al*. (2008) for BW60, El-Arain *et al*. (2014) for BW30. Also, the estimates were lower than the Holstein Friesian estimates reported by Abera *et al*. (2011) for BW0, WW, and ADG, respectively. Conversely, the estimates were higher than those reported by Oudah and Zainab, (2010), Zeleke *et al*. (2016), Sahin *et al*. (2017) and Almasri *et al*. (2020) for BW0. Moreover, the estimates in the current study were higher than those reported by Atil *et al*. (2005), Oudah and Zainab (2010) and Almasri *et al*. (2020) for WW. Concerning ADG, Almasri *et al*. (2020) working on Holstein Friesian reported low estimates compared to the current study. In general, the differences between the results of this study and the results of previous research may be due to the differences in the methods of statistical analysis, the number of records used, different management and ways of care. Concerning maternal heritability (h^2_m), estimates of h^2_m were lower, which were 0.08 for BW0, 0.10 for BW30, 0.05 for BW60, 0.04 for WW, and 0.06 for ADG. Similar results were obtained by Atil *et al*. (2005), Sanad and Gharib (2017), Sahin *et al*. (2017) and Ibrahim *et al*. (2019) for BW0 and WW. These results indicated that this component has little influence on the phenotypic variance. In the current study, h^2_m, estimates were somewhat higher after birth (BW0 and BW30 and then decreased with the increase in the age of calf until weaning, and the decrease was about half of its value at BW0 and BW30.

Table (3): Estimates of variance components, direct (h^2_a± SE), maternal (h^2_m±SE) and the error variance (e^2± SE), and maternal permanent variances (pe^2± SE) of growth traits.

Traits Item	BW0	BW30	BW60	WW	ADG
Variance components					
σ^2_a	1.50	1.30	2.60	2.60	0.60
σ^2_m	0.50	0.60	0.60	0.60	0.15
σ^2_{pe}	0.30	0.40	0.50	0.60	0.09
σ^2_e	3.84	3.96	8.40	9.84	1.80
σ^2_p	6.14	6.26	12.10	13.64	2.64
Genetic parameters					
h^2_a	0.24±0.053	0.21±0.030	0.21±0.026	0.19±0.024	0.23±0.010
h^2_m	0.08±0.043	0.10±0.025	0.05±0.012	0.04±0.018	0.06±0.008
pe^2	0.04±0.068	0.06±0.041	0.04±0.039	0.04±0.045	0.03±0.18
e^2	0.63±0.034	0.63±0.044	0.69±0.043	0.72±0.048	0.68±0.020

σ^2_a = additive direct genetic variance; σ^2_m=additive maternal genetic variance; σ^2_{pe}= permanent environmental maternal variance; σ^2_p=phenotypic variance-sum of variance and covariance components; σ^2_e=error variance; h^2_a= direct heritability; h^2_m= maternal heritability; e^2 = error and $pe^{2\,=}$ permanent environmental effect.

In this respect, Atil *et al*. (2005) suggested that maternal effects only from conception to calving. In terms of maternal permanent environment effect (pe^2), the portion that represents the effect of pe^2 also was little, it was 0.049 for BW0, 0.064 for BW30, 0.041 for BW60, 0.044 for WW and 0.034 for ADG (Table 3). These results were within the range recorded by some studies on Friesian calves (Atil *et al*., 2005; Sanad and Gharib, 2017; 2018). In parallel with the results of the current study, Keoletile and Mulugeta, (2022), working on the Tswana cattle, reported that the pe^2 effect explains approximately 3 to 8% of the variance on growth traits. It could said that minor values of pe^2 effects indicate that pe^2 effects do not seem to have any significant effect on offspring and will only be effective during the prenatal period, such effects would include: dam health, dam feeding status, age of dam, transfer of immunity from the dam to offspring, intrauterine environment and capacity, and the postnatal effect of colostrum consumption by the calf at the first 24 hours after birth. In general, the lower estimates of both h^2_m and pe^2 in the current study or previous studies with the same ranges show that improvement in these traits can be achieved more efficiently if the selection is based on the animal's direct genetic potential. Estimates of the error variance (σ^2e) were moderate to high for growth traits. The ratio to phenotypic variance ranged from 63% to 72% (Table 3). Demeke *et al*. (2003) attributed the large residual variance to unknown high environmental influences, causing severe environmental stress affecting the magnitude of genetic variance for different traits. In general, growth traits continue to follow the pattern noted in most studies and are most impacted by both genetic factors and non-genetic factors such as weather or technical processes, which vary substantially among herds, even within the same herd in calves.

3.4.2 Breeding value estimates

The efficiency of a genetic improvement program is dependent on the animal selection using precise and accurate estimates of performance parameters for the prediction of breeding values (Demeke *et al*., 2004). Complete animal recording, including pedigree and performance data, is recommended for all breeds to allow for accurate estimates of breeding values (Abin *et al*., 2016). A large range of breeding values indicated wide genetic variance, and this allows for improving the studied traits through selection according to the animal superiority value (Abo-Elenin, 2018). Range and accuracy of calves, sire and dam breeding values for BW0, BW30, BW60, WW and ADG are presented in Table (4).

3.4.2.1 Calves breeding values

The present results showed that the ranges of estimated breeding values (EBVs) for Friesian calves were 4.585 kg for BW0, 6.821 kg for BW30, 9.075 kg for BW60, 9.459 kg for WW and 1.159 kg for ADG (Table 4).

Table (4): Range of estimated breeding values (EBVs) for all pedigrees and their percentage of accuracy (%).

Item	BW0	BW30	BW60	WW	ADG
Calves EBVs					
Range[1] (kg)	4.585	6.821	9.075	9.459	1159.2
Accuracy[2] %	75-79	70-72	60-65	56-72	59-74
Sire EBVs					
Range (kg)	2.709	4.65	6.086	5.973	787
Accuracy%	58-71	68-85	79-91	50-53	52-56
Dam EBVs					
Range (kg)	4.4	6.639	8.015	10.507	1088.2
Accuracy%	75-76	71-73	77-81	56-73	56-76

[1]Calculated by subtracting the upper and lower values of estimated breeding values (EBVs), [2]Accuracy values attached to the maximum and minimum values.

In this study, these values are approximately equal to that of Pabna milking cattle and 5.749 for Friesian cross with the same breed, as mentioned by Hossen *et al*. (2012). Moreover, Said *et al*. (2020) working on Bali cattle, found highest relative EBVs of calves on Lombok and Sumbawa islands. Under Egyptian conditions, Atil *et al*. (2005) and Sanad and Gharib (2017) found that estimates of calves breeding values ranged from 9.21 to 10.1 kg for WW. Moreover, this range was mostly higher than Brown Swiss calves in Turkey and in Frisian calves for BW obtained by Zulkadir *et al*. (1995). Furthermore, Ibrahim et al. (2019) recorded low EBVs compared to the current study for WW. Also, Sanad and Gharib (2017) recorded low EBVs. Conversely, it was less than the range reported by Atil *et al*. (2005); Sanad and Gharib (2017 and 2018). In addition, Abera (2017) found similar breeding values for animals born in different years. The accuracy of minimum and maximum calves EBVs for studied traits ranged from 56 to 79 % (Table 4). Accordingly, moderate to high accuracy indicated that genetic improvement can be achieved through the body weights of calves. Moreover, the higher range of calves breeding values compared with that of sire or dam EBVs), indicates that the selection for BW for calves will lead to an increase in WW for the next generation in this study. In this respect, Sanad and Gharib (2017) stated that the accuracy of calves EBVs for BW0, WW and ADG. Moreover, Atil *et al*. (2005) mentioned the accuracy of EBVs for BW0 and from 22 to 65 % for WW. The difference between the current study and, the other studies may be due to the different herds, environmental conditions, analytical methods and data used.

3.4.2.2 Sire breeding values

The ranges of sire breeding values were 2.709 kg for BW0, kg 4.65 for BW30, 6.086 kg for BW60, 5.973 kg for WW and 0.787 kg for ADG (Table 4). Similar to these results about sire EBVs obtained by Atil *et al*. (2005) and Ibrahim *et al*. (2019) for WW. The range of sire EBVs in the present study is higher than the ranges obtained by Zulkadir *et al*. (1995) for BW0 of Brown Swiss calves. Moreover, the ranges of sire EBVs for ADG were mostly higher than estimated breeding values reported by Sanad and Gharib (2017). Contrary, sire EBVs were less than, the range of 5.61 to 6.39 for BW0 and the range for WW, as reported by Atil *et al*. (2005), Sanad and Gharib (2017and 2018) and Ibrahim *et al*. (2019). Concerning sire EBVs accuracy of minimum and maximum for BW0, BW30, BW60, WW and ADG that ranged from 53 to 91% (Table 4). Similarly, Sanad and Gharib (2017) and Atil *et al*. (2005) noted that the accuracy of sire breeding values for BW0, WW and ADG. Moreover, Ibrahim *et al*. (2019) stated similar accuracy of sire for BW0 WW in H-Frisian. These results indicated that the vital role of the sire effect on BW0, BW30, BW60, WW and ADG which might be due to large number of daughters per sire.

3.4.2.3 Dam breeding values

The present results showed that the range of the dam's EBVs was 4.4 kg for BW0, 6.639 kg for BW30, 8.015 kg for BW60, 10.507 kg for WW and 1.088 kg for ADG. In this regard, these values are approximately equal to that is in Friesian cattle (Sanad and Gharib, 2018). The range of dam's EBVs in the present study was higher than the ranges obtained by Sanad and Gharib (2017) for ADG and Ibrahim *et al*. (2019) for BW0 and WW. The current estimates of dam's EBVs for BW0 within the range that reported by Atil *et al*. (2005), Sanad and Gharib (2017) under Egypt conditions. The accuracy of minimum and maximum dam's EBVs for studied traits ranged from 56 to 77% (Table 4). In this regard, Atil *et al*. (2005) and Sanad and Gharib, (2017) reported same accuracy of minimum and maximum dam breeding values for BW0, WW and ADG. Moreover, Ibrahim *et al*. (2019) reported similar accuracy of EBVs for dams for BW0 and for WW. The same authors added the importance of the dam since it gave a higher range of breeding values for body weight. Thus, selection for a dam to the next generation would lead to higher genetic improvement in the herd. From another point of view, it is also necessary to give attention to the accuracy of breeding values (EBVs) from calves, sires, and dams for BW0 and WW. If there is a problem with vitality because of low BW0, a selection can be made toward a high breeding value to increase vitality in a herd or population (Ibrahim *et al*., 2019; Zulkadir *et al*., 1995).

4. Conclusion

The present results showed that pre-weaning growth traits are very clear influenced on non-genetic factors included in the study, which require further studies and a clearer understanding of those factors and their effects on those traits. Inclusion of the predicted weight traits within the followed administrative framework as an input into the selection programs, especially early ones, or in the selection indices. The moderate Heritability found in this study suggested that improvement for these traits could be achieved through well-planned genetic improvement through selection for superior animals according to their breeding values. To avoid result bias and the effect of insufficient data or pedigree structure, that may result in outcomes such as reduced stratification of maternal genetic influences and permanent maternal environmental effects, further studies on the same traits using many data is required to reveal a more accurate and reliable genetic assessment of such genetic effects.

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