Some descriptive characteristics and linear body measurements of Assaf sheep reared in Southern Sinai in Egypt

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Description of the morphological characteristics of sheep breeds is a very vital role in developing new breeding strategies in the developed country. In the current study on Assaf sheep, we tried to focus on descriptive some morphological characteristics and to investigate the relationship between body weight and morphological measurements. As well as to estimate the live weight from body measurements of Assaf sheep in the study area of El-Tor City, South Sinai Governorate of Egypt. Twelve body measurements of individuals (10 males and 10 females) namely; heart girth (HG), wither height (WH), chest depth (CD), paunch length (PL), paunch girth (PG), paunch height (PH), canon circumference (CC), head length (HEL), body condition score (BCS), body length (BL) and neck circumference (NC) were used to morphologically characterize the Assaf sheep in addition to live weight (LW). The influence of sex on the body measurements was analyzed and morphological harmony was determined through Pearson correlation. Standard morphology of the Assaf sheep was assessed with a live weight of 70.80 kg and 56.30 kg for males and females, respectively. The coefficient of variation in all traits ranged from 6.51% to 29.12%, this indicates homogeneity between traits under study. Some morphological characteristics such as HG and BCS usually considered important in the breed definition. The highest and strongly positive correlation (p<0.01) was recorded between LW and HG (0.98) for male and of BCS (0.91) for female sheep. Heart girth alone has explained the variation in live weight with an adjusted coefficient of determination of 0.98 and 0.82 for males and females, respectively. Live weight of sheep can be predicted from BCS, HEL, HG and NC with a coefficient of 0.84 for female and HG, HEL and PL with a coefficient of 0.98 for Assaf male sheep. From this data, it could be concluded that, the live weight can be predicted with high accuracy from somebody measurements which can be exploited by sheep producers for management, selection and genetic improvement of Assaf sheep and could be used successfully in new breeding programs in Egypt.

Keywords: Body measurement, correlation, regression, Assaf, sheep, Egypt.

INTRODUCTION

Considering the total economy of Egypt, livestock production of South Sinai governorate is not of big economic importance. However, within South Sinai, the traditional livestock subsector is of relatively high importance, especially to the Bedouin. Goats, camels and sheep are the main species of livestock. They provide milk, meat, wool, hair and hides, with occasional small amounts for sale or barter, and in the case of
camels, provide transportation for the herders and their families (Allam, 2004). A good description of indigenous sheep breeds on their own breed characteristics is required for conservation of their gene sources and the obtainment of their elite flocks of breeding aims (Riva et al., 2004 and Yilmaz et al., 2013). Growth and development are important for the production of meat animals and also body weight and body measurements are important parameters to describe growth and also it can describe completely an individual or a population (Salako, 2006). Assaf sheep is a composite breed of improved Awassi and East Frisian, with an original gene proportion of 3/8 East Frisian and 5/8 Improved Awassi. Assaf shows a higher prolificacy of 1.6 lambs per ewe and per lambing (LB/EL), but the breed was found to be less adapted to harsh conditions (Gootwine and Goot, 1996). The biometric measurements are used to assess several characteristics of animals. These measurements provide important evidence for the growth of the breed and the properties that change with feeding factors and environmental effects. Riva et al., (2004) reported that, body measurements are important data sources in terms of reflecting the breed standards and are also important to give information about the morphological structure and development ability of the animals. Body measurements differ according to the factors such as a breed, gender, yield type and age. The most common parameters used for body measurements of sheep are; head length, body length, wither height, rump height, body depth, heart girth, width at withers and cannon circumference. Gurcan (2000) indicated that, live weight estimates are done using body measurements by different statistical analysis. Live weight (LW) prediction is necessary for deciding suitable medicinal dose, feed amount and marketing for an animal (Birteeb and Ozoje, 2012 and Eydurcan et al., 2013). The prediction of body weight and its relationships to other morphological measurements produces appreciable knowledge for breeding investigation with regard to meat production per animal (Janssens and Vandepitte, 2004 and Yilmaz et al., 2013; Iqbal et al., 2013). Live body weight plays an important role in determining several characteristics of the farm animals especially the ones having economic importance. Nsoso et al., (2003) decided that, evaluation the live weight using body measurements is faster, practical, cheaper and easier in the rural districts where the sources are insufficient for the animal breeders. Thus, this investigation aimed to characterize Assaf sheep breed using morphological characteristics and has been used to determine the best-fitted regression model for prediction of live weight in arid and semi-arid regions such as South Sinai in an effort to develop a sheep breeding strategy in Egypt.

MATERIALS AND METHODS

2.1. Description of the study area

During the spring of 2015, sampling was carried out on a total of 20 Assaf sheep located in a special unit for producing improved sheep and goats and economically high quality rations under the authority of Agricultural Directorate in El-Tor city, South Sinai Governorate with National Research Centre. South Sinai is a part of Sinai Peninsula, Egypt and has an east-west extension of about 100 km. From north to south it is approximately 130 km. South Sinai Governorate covers an area of 30,000 km² (7,140 feddan) and is geographically isolated from the Egyptian mainland by the Suez Canal and the Gulf of Suez in the west, at 28°14′30″N and 33°37′20″E. from https://en.wikipedia.org/wiki/El_Tor,_Egypt, as shown in Figure (1). The climate of South Sinai is considered extremely arid from an agricultural standpoint in the central area and the southwest. The mean annual precipitation ranges from as low as 10 millimeters in the southwest to about 30 millimeters in the north. Temperatures are high in South Sinai. The average minimum and maximum temperatures recorded in the district range from 9.5 – 24.8°C to 20.9 – 33.3°C, respectively. Mean daily temperature varies from 16.1°C in January to 29.1°C in August, with an annual mean of 23.2°C. The highest temperature recorded was 42.6°C in May. The lowest was 2.6°C in January according to NOAA (2015).

2.2. Experimental procedure

2.2.1. Sampling procedure

Samples of 20 sheep (10 males and 10 females) were clinically healthy, aged 6–18 months, live body weight (38–86 kg). All sheep were housed as two groups in roofed pens at the special unit (10 animals in each group). All animals were kept under equal management condition and the ration was offered daily in two parts at 9 am and 4 pm. Fresh water and salts blocks were available continuously during the experimental period. All sheep were fed on concentrate feed mixture (CFM), consisted of (17% wheat bran, 15% cotton seed meal, 50%...
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yellow corn, 15% sunflower meal, 2% limestone and 1% salt) according to their live body weight (NRC, 1985), plus free available green Acacia and Atriplex or bean straw. Whereas *Acacia*

**Figure 1:** Map showing location of the study area in Southern Sinai in Egypt.

*Saligna* and *Atriplex halimus* were collected daily from the Experimental Farm in El-Tor city, South Sinai.

**2.2.2. Data collection**

**2.2.2.1. Assessment of morphological variables**

The variables measured included live weight recorded using a spring balance. The height measurement (cm) was done using a graduated measuring stick. The measurements were taken in the morning, with the animals standing on a flat surface with head held up and held by three field assistants. The length and circumference measurements (cm) were effected using a tape rule.

All measurements were carried out by the same person in order to avoid between individual variations. The following 11 linear body measurements namely, heart girth, wither height, body length, chest depth, head length, paunch length, paunch girth, paunch height, canon circumference, neck circumference and body condition score were recorded for all of the sampled animals.

The measurements were taken as below:

1. Heart girth (HG) was measured as a circumferential measure taken around the chest just behind the front legs and withers.
2. Wither height (WH) was measured as the distance from the surface of a platform to the wither.
3. Body length (BL) was the distance from the base of the ear to the base of the tail (where it joins the body).
4. Chest depth (CD) was measured as vertical distance from sternum to withers.
5. Head length (HEL) was the distance measured from nodule of the horn to the upper lip of the animal.
6. Paunch length (PL) is the distance between front and rear legs of the animal.
7. Paunch height (PH) was measured as the distance from the surface of a platform to the paunch of the animal, where, the paunch is defined as: The unde...downside between the legs.
8. Paunch girth (PG) was measured as the circumference of the paunch of the animal, where, the paunch is defined as: The unde...the part of the underside between the
9. Canon circumference (CC) was measured from the left mid metacarpus.
10. Neck circumference (NC) was measured as the circumference of the neck at the midpoint.

2.3. Data analysis
Live body weight and linear body measurement traits were subjected to multivariate analysis of variance using the General Linear Model (GLM) procedure of SPSS (2008) with sex as fixed effects. Means were separated using the two-tailed, two-sample t-test. Differences were considered to be significant at P<0.05.

The model used to analyze body measurements was: \( Y_{ik} = \mu + S_i + e_{ik} \), Where: \( Y_{ik} \) = the observation on body weight and other linear body measurements; \( \mu \) = Overall mean; \( S_i \) = fixed effect of sex (i = F, M) and \( e_{ik} \) = effect of random error. Live body weight was regressed on linear body measurements using stepwise multiple linear regression analysis. The coefficient of determination (R²) was used to assess the accuracy of prediction equations between live body weights and linear body measurements. Separate prediction equations were developed for male and female. The multiple linear regression equation for fitting standardized body weight and the factor scores equation are expressed below:

\[
Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \epsilon_i \] for male.

\[
Y_f = \beta_0 X_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \epsilon_f \] for female.

Where: \( Y_i \) = the dependent variable (body weight); \( \beta_0 \) = the intercept; \( X_1, X_2, X_3 \), and \( X_4 \) are the independent variables HG, HEL and PL for male and \( X_1, X_2, X_3 \), and \( X_4 \) are the independent variables BCS, HEL, HG and NC for female, respectively and \( \beta_1, \beta_2, \beta_3, \beta_4 \)...... and \( \beta \) are the regression coefficient of these variable. \( \epsilon_i \) = the residual error.

RESULTS AND DISCUSSION
Descriptive analysis of bodyweight and morphological traits
Descriptive statistics for all traits are shown in Table (1) and Figure (2).
This study showed that, there was a numerical mean difference between males and females in all morphometric measurements. However, these differences were not significant \((P < 0.05)\) indicating for HG, WH, CD, PL, PG, PH, BCS and NC. Males had higher \((P < 0.05)\) mean values for most measured morphological measurements than that of females. Male had higher LW, BL, CC, HEL and NC. Higher mean values for LW of males than that of females may be due to the aggressive behavior of males during feeding and male sex hormone, which has an anabolic effect. Our results seem in accordance with the previous reports of Legazet et al., (2011), who indicated that, the sexual dimorphism \((m/f)\) was 1.13 as expected, with males being 46% heavier than females in Assaf (Assaf.E) sheep. Bimerow et al., (2011) indicated that, males of Farta sheep were heavier than their female counterparts, also, he found that body weight has significantly \((P<0.001)\) increased from milk teeth to the fourth dentition group \((\geq3PPI)\). Previous studies indicated that, the higher body weight of male kids after weaning may be attributed to their birth weight; this is because they were born heavier than females (Abd-Allah et al., 2016). The effect of sex and dentition on body weight of sheep is well stated in the literature (Tibbo et al., 2004; Mengistie et al., 2010; Tesfaye et al., 2009 and Zewdu et al., 2009). It is important that, the coefficient of variation in all traits ranged from 6.51% to 29.12%, this indicates homogeneity between traits under study. The correlations coefficient between live weight and body measurement of the two sexes are shown in Table (2). It is clear that, the majority of correlation coefficients between measurements were high and significant \((P<0.01)\) in both males and females.

3.2. Bivariate correlations between body weight and measurements

The highest and strongly positive correlation \((p<0.01)\) was recorded between LW and HG \((0.98)\) for male and of BCS \((0.91)\) for female sheep. The results are supported by Topal and Macit (2004). Who decided that, the highest relationship was determined between HG and body weight in Morkaraman sheep. Afolayan et al., (2006) indicated that highest correlation coefficient \((0.94)\) was found between HG and LW in Yankasa sheep found in Nigeria. Since there are high correlation coefficients between LW and body measurements, either of these variables or combination could provide a good estimate for predicting live weight in Assaf sheep (Table, 2). In both males and females, HG showed the highest correlation with LW. Heart girth, as well as CD, was reported to have the highest correlation with body weight in lambs and kids by other authors (Nigmet et al., 1995; Shaker and Hammam, 2008; Abdel-Moneim, 2009 and Abdel-Mageed and Ghanem, 2013).

3.3. Prediction of body weight from body measurements

Based on the importance of the independent variables in predicting the live weight of Assaf sheep, five body measurements namely; BCS, HEL, HG, PL and NC were found to be more efficient. Thus, they were the variables entered to obtain the optimal regression models. It is necessary here to say that, LW of sheep can be predicted from BCS, HEL, HG and NC with a coefficient of 0.84 for female and HG, HEL and PL with a coefficient of 0.98 for Assaf male sheep.
The best-fitted regression models in each group were included in the Table (3).

**Table 2: Bivariate correlations among morphological traits of male (abovediagonal) and female (below diagonal) of Assaf sheep.**

<table>
<thead>
<tr>
<th>Trait</th>
<th>LW</th>
<th>HG</th>
<th>WH</th>
<th>BL</th>
<th>CD</th>
<th>PL</th>
<th>CC</th>
<th>HEL</th>
<th>PG</th>
<th>PH</th>
<th>NC</th>
<th>BCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LW</td>
<td>–</td>
<td>0.98**</td>
<td>0.98**</td>
<td>0.82**</td>
<td>0.75**</td>
<td>0.46</td>
<td>0.93**</td>
<td>0.65**</td>
<td>0.94**</td>
<td>0.46</td>
<td>0.96**</td>
<td>0.94**</td>
</tr>
<tr>
<td>HG</td>
<td>0.88**</td>
<td>–</td>
<td>0.96**</td>
<td>0.88**</td>
<td>0.67**</td>
<td>0.56</td>
<td>0.91**</td>
<td>0.55</td>
<td>0.97**</td>
<td>0.36</td>
<td>0.94**</td>
<td>0.91**</td>
</tr>
<tr>
<td>WH</td>
<td>0.76*</td>
<td>0.68*</td>
<td>–</td>
<td>0.77**</td>
<td>0.83**</td>
<td>0.40</td>
<td>0.88**</td>
<td>0.69*</td>
<td>0.89**</td>
<td>0.57</td>
<td>0.98**</td>
<td>0.92**</td>
</tr>
<tr>
<td>BL</td>
<td>0.75*</td>
<td>0.72*</td>
<td>0.29</td>
<td>–</td>
<td>0.33</td>
<td>0.82**</td>
<td>0.71*</td>
<td>0.21</td>
<td>0.95**</td>
<td>0.07</td>
<td>0.78**</td>
<td>0.74*</td>
</tr>
<tr>
<td>CD</td>
<td>0.50</td>
<td>0.57</td>
<td>0.44</td>
<td>0.32</td>
<td>–</td>
<td>0.07</td>
<td>0.63*</td>
<td>0.85**</td>
<td>0.51</td>
<td>0.80**</td>
<td>0.83**</td>
<td>0.75</td>
</tr>
<tr>
<td>PL</td>
<td>-0.43</td>
<td>-0.37</td>
<td>-0.00</td>
<td>-0.78**</td>
<td>0.20</td>
<td>–</td>
<td>0.34</td>
<td>0.08-</td>
<td>0.69*</td>
<td>-0.26</td>
<td>0.44</td>
<td>0.35</td>
</tr>
<tr>
<td>CC</td>
<td>0.76**</td>
<td>0.91**</td>
<td>0.60</td>
<td>0.54</td>
<td>0.30</td>
<td>-0.035</td>
<td>–</td>
<td>0.64*</td>
<td>0.88**</td>
<td>0.28</td>
<td>0.83**</td>
<td>0.89**</td>
</tr>
<tr>
<td>HEL</td>
<td>0.67*</td>
<td>0.44</td>
<td>0.72*</td>
<td>0.53</td>
<td>0.20</td>
<td>-0.32</td>
<td>-0.29</td>
<td>–</td>
<td>0.44</td>
<td>0.69*</td>
<td>0.71*</td>
<td>0.68*</td>
</tr>
<tr>
<td>PG</td>
<td>0.87**</td>
<td>0.97**</td>
<td>0.72</td>
<td>0.66*</td>
<td>0.72*</td>
<td>-0.21</td>
<td>0.82**</td>
<td>0.44</td>
<td>–</td>
<td>0.21</td>
<td>0.88**</td>
<td>0.86</td>
</tr>
<tr>
<td>PH</td>
<td>-0.40</td>
<td>-0.26</td>
<td>0.07</td>
<td>-0.32</td>
<td>0.22</td>
<td>0.50</td>
<td>-0.45</td>
<td>-0.03</td>
<td>-0.12</td>
<td>–</td>
<td>0.61</td>
<td>0.54</td>
</tr>
<tr>
<td>NC</td>
<td>-0.03</td>
<td>0.22</td>
<td>0.16</td>
<td>-0.12</td>
<td>0.09</td>
<td>0.27</td>
<td>0.32</td>
<td>-0.063</td>
<td>0.23</td>
<td>-0.21</td>
<td>–</td>
<td>0.92**</td>
</tr>
<tr>
<td>BCS</td>
<td>0.91**</td>
<td>0.79**</td>
<td>0.64</td>
<td>0.38</td>
<td>0.48</td>
<td>-0.24</td>
<td>0.68*</td>
<td>0.44</td>
<td>0.80**</td>
<td>-0.049</td>
<td>0.26</td>
<td>–</td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

**Table 3: Regression equations developed to estimate weight from linear body measurements of Assaf sheep.**

<table>
<thead>
<tr>
<th>Group</th>
<th>Model</th>
<th>R</th>
<th>R²</th>
<th>Adj. R²</th>
<th>SE</th>
<th>R² Change</th>
<th>F Change</th>
<th>Sig. F Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>1</td>
<td>0.989a</td>
<td>0.978</td>
<td>0.976</td>
<td>1.853</td>
<td>0.978</td>
<td>364.03</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.979b</td>
<td>0.994</td>
<td>0.993</td>
<td>1.010</td>
<td>0.016</td>
<td>19.906</td>
<td>.003</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.999c</td>
<td>0.997</td>
<td>0.996</td>
<td>0.739</td>
<td>0.003</td>
<td>7.082</td>
<td>.037</td>
</tr>
<tr>
<td></td>
<td>Model summary</td>
<td></td>
<td>Regression equations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. Predictors: (Constant), HG</td>
<td></td>
<td>LW=81.036+1.441* HG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. Predictors: (Constant), HG, HEL</td>
<td></td>
<td>LW=120.798+1.319* HG+2.577* HEL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c. Predictors: (Constant), HG, HEL, PL</td>
<td></td>
<td>LW=109.912+1.423* HG+1.787* HEL-0.118* PL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1</td>
<td>0.914a</td>
<td>0.836</td>
<td>0.815</td>
<td>7.132</td>
<td>0.836</td>
<td>40.670</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.963b</td>
<td>0.928</td>
<td>0.907</td>
<td>5.046</td>
<td>0.092</td>
<td>8.979</td>
<td>.020</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.988c</td>
<td>0.976</td>
<td>0.965</td>
<td>3.118</td>
<td>0.048</td>
<td>12.336</td>
<td>.013</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>0.998d</td>
<td>0.995</td>
<td>0.992</td>
<td>1.500</td>
<td>0.019</td>
<td>20.896</td>
<td>.006</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>0.999e</td>
<td>0.995</td>
<td>0.993</td>
<td>1.370</td>
<td>0.000</td>
<td>.001</td>
<td>.973</td>
</tr>
<tr>
<td></td>
<td>Model summary</td>
<td></td>
<td>Prediction equations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. Predictors: (Constant), BCS</td>
<td></td>
<td>LW=3.500+16.5* BCS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. Predictors: (Constant), BCS, HEL</td>
<td></td>
<td>LW=55.111+13.815* BCS+3.519* HEL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c. Predictors: (Constant), BCS, HEL, HG</td>
<td></td>
<td>LW=125.895+8.964<em>BCS+3.063</em> HEL+.941* HG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>d. Predictors: (Constant), BCS, HEL, HG, NC</td>
<td></td>
<td>LW=55.288+11.488<em>BCS+.026 <em>HEL+1.166</em> HG-1.125</em> NC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>e. Predictors: (Constant), BCS, HG, NC</td>
<td></td>
<td>LW=54.745+11.507 BCS+1.168 HG-1.132 NC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Dependent Variable: LW

According to the results of this study, the highest correlation was determined between LW and HG in male group. These findings are in harmony with that of Nigm et al., (1995) who found that HG was the best single predictor and accounted alone for 77% of the variation in body weight of Merino males. Heart girth was not the best variable to estimate LW for female sheep. It was the BCS, HEL and HG, that was used to estimate weight for female sheep. In the male group, HG alone explained 97.8% of the variation in the body weight of sheep. The result is generally in agreement with literature of Taye et al., (2010) who reported that, HG is the best predictor of weight. Nevertheless, HG parameter is the easiest way to use for LW prediction in field.
The findings of the present study are in close agreement with the findings of Thiruvenkadan (2005) who decided that HG can be used best for prediction of LW in Kanni Adukids. The regression output including the best fitted function and adjusted coefficient of determination (adjusted R² values) explained in Table (3). Adjusted R² for best-predicted equation was 99.6%, where the equation contains the following measurements (HG, HEL and PL) in male group followed by (BCS, HG and NC) in females with adjusted coefficient of determination (99.3%). What we can estimate at this study can be explained in these equations. The regression equation for the male group was established as: LW = 81.036 + 1.441 * HG; adjusted R² = 98%. When HG and HEL were considered together, we noticed the adjusted R² increased to 99.3% and the equation is changed into; LW = -120.798 + 1.319 * HG + 2.577 * HEL; adjusted R² = 99.3%. When PL was included in the equation, adjusted R² increased to 99.6% and the equation is changed into; LW = -109.912 + 1.423 * HG + 1.787 * HEL - 0.118 * PL; adjusted R² = 99.6%. For the female group the regression equation is established as: LW = 3.500 + 16.7 * BCS; adjusted R² = 82%. When HEL was included in the equation, the adjusted coefficient of determination increased to 90.7% and the equation is changed into; LW = 55.111 + 13.815 * BCS + 3.519 * HEL; adjusted R² = 90.7%. When HEL and HG were considered together, adjusted R² increased to 96.5% and the equation is changed into; LW = 125.895 + 8.964 * BCS + 3.063 * HEL + 0.941 * HG; adjusted R² = 96.5%. When four different body measurements are used, the adjusted R² increased to 99.2% and the equation is established as: LW = 55.288 + 11.488 * BCS + 0.026 * HEL + 1.166 * HG - 1.125 * NC; adjusted R² = 99.2%. When BCS, HG and NC were considered together, Adjusted R² changed slightly to 99.3% and the equation is changed into; LW = 54.745 + 11.507 * BCS + 1.168 * HG - 1.132 * NC and adjusted R² = 99.3%.

CONCLUSION
To our knowledge, this may be the first study to characterize Assaf sheep breed using morphological characteristics in Egypt. Assaf Sheep is one of the sheep breeds that can be used to improve the local breeds of sheep genetically by the crossing in Egypt, especially as it is an attractive morphological strain of great potential for milk and fattening compared with other local breeds in Egypt. As compared to other local breeds in Egypt, Assaf sheep is better in most of the morphological characteristics. The range of values in different traits considered in the population indicates its potential response to crossing. The positive and significant correlation of weight with linear body measurements indicate that linear body measurements can be used as a marker to estimate weight using regression equations. Different models can be used for different purposes. For marketing and by farmers and breeding purposes, since there is a need to be more precise, use of models involving a number of variables is encouraged.

CONFLICT OF INTEREST
All authors declared that this study was performed without any conflict of interest.

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AUTHOR CONTRIBUTIONS
SA performed the farm experiments and wrote the manuscript. MMS reviewed the manuscript. MIM designed and reviewed the manuscript. HHA and AAA participated in performed the farm experiments and collected & analyzed data.

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