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The first morphological study of the Sloughi dog breed in Algeria

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Abstract

The present work aims to study morphometric profile, calculate body indices, and determine mathematical models that will be used for the estimation of adult live weights based on body measurements using multiple regression models in an endangered heritage breed, the Algerian Sloughi dog, raised in three different geographical regions of Algeria. The animal material of the study consisted of 105 Sloughi dogs, which included 30 individuals belonging to the eastern, 35 from the central, and 40 from the western regions of Algeria. Least squares means for height at withers and rump; head length and width; muzzle, ear, neck, body, tail lengths; muzzle, head, chest, waist, thigh, forearm, and wrist circumferences were used as body measurements. Least squares means for indices of massiveness, format, cephalic, body–tail, bone, muzzle–head, withers–rump, head–neck, ear–head length, and ear–head width were calculated using body measurements. Of the multiple regression models, the highest coefficients of determination (R^2) were obtained from the models formed from height at withers, height at withers and thigh circumference or height at withers, thigh circumference and chest circumference together (R^2 = 0.70, R^2 = 0.79 and R^2 = 0.86 respectively). This study concluded that live weight of Algerian Sloughi dog breed could be estimated with a high accuracy using body measurements and statistical methods.

Keywords: Algeria, body indices, morphometric analysis, Sloughi, dog weight
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Introduction

The Sloughi is a dog breed originating from North Africa, specifically the region encompassing Morocco, Algeria, Tunisia, and Libya. Developed for hunting purposes, this breed boasts a powerful and elegant appearance, with short, smooth hair; lop ears, and an athletic build. In addition to their striking aesthetic qualities, the Sloughi exhibits exceptional stamina, making them well suited for hunting a variety of prey, including hare, fox, jackal, gazelle, and big antelope species (www.akc.org). With a long-standing presence in North Africa, the Sloughi has been highly valued for its hunting prowess, endurance over long distances, and agility. In Algeria, the breed is regarded as a national heritage and is commonly found in the steppe areas of Wilayas, including Tebessa, Khenchela, Batna, Biskra, M'Sila, Djelfa, Tiaret, Laghouat (Nord), Saïda, and Tlemcen. However, the breed's pure-blood status

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is threatened by pollution and genetic erosion, according to a statement from a prominent breeder (El-Hassani, 2022). The lack of research about the Sloughi in Algeria is a contributor to the breed's uncertain future. Generally, when defining the various characteristics of animals, researchers and experts rely on well-documented academic studies. However, the absence of such works regarding the Sloughi in Algeria has made it difficult to establish a clear understanding of the breed's history, characteristics, and potential avenues for preserving its lineage.

Generally, to define various characteristics of animals we use body measurements; the most important characteristics used by researchers and during breed selection are live weight and several body measurements. In order to preserve and protect breeds, two important parameters are usually targeted, live weight and growth characteristics. A breed is defined as a group of individuals sharing some transmissible and distinctive traits, which means that each breed holds certain traits that set it apart from other breeds (González *et al.,* 2011). Another similar approach defines a breed as a group of individuals recognizable as being biologically different from others (Cavalli-Sforza, 2000). The methods used in the present study based on morphometric analysis are the same as those used in other dog breeds or other domestic species, such as sheep, goats, and camels (Traoré *et al.,* 2008; González *et al.,* 2011; Yilmaz *et al.,* 2012; Meghelli *et al.,* 2020; Urosevic *et al.,* 2020a; Djaout *et al.,* 2022).The aim of this work was to provide a morphometric profile and estimate body indices and live body weight of the Algerian Sloughi in order to provide a knowledge base for better breed identification and management of the genetic diversity of this important heritage and relevant biological resource. This study facilitates breeders to direct the selection of their dogs towards the desired activities without making crosses with other breeds.

Materials and Methods

The animal material of the study consisted of 105 Algerian Sloughis: 30 individuals from the eastern region, represented by Batna, Setif and M'sila; 40 individuals from the west, represented by Tlemcen, Sidi Bel Abbes, and Ain Temouchent; and 35 individuals from the central region, represented by the Wilaya of Laghouat (Figure 1). All of these animals were adults (> 36 months), purebred, fit, and well. All of these dogs used in the present study were neither in the reproductive period (concerning both males and females), in gestation, or lactating. In addition, all the individuals selected in this study were subjected to the same diet.

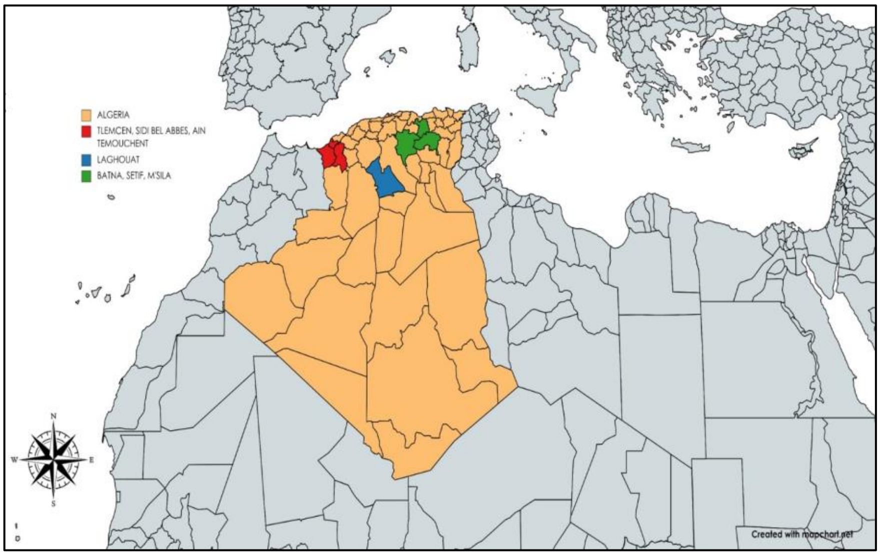

Figure 1. The location of Algeria and the sampling sites of Sloughi dogs

Sixteen body measurements represented by weight and ten calculated body indices were used in this study. Body measurements, including HW, HR, HL, HeW, ML, EL, NL, BL, and TL were taken using a measurement stick; all circumferences, including MC, HC, CC, WaistC, TC, FC, and WristC, were taken using a measuring tape; and live weights of dogs were measured using a digital scale (Figure 2). Figure 3 represents an example of the studied breed. The novelty of the work stems from all studied individuals that were measured directly on their owners' farms, taking into account the exact origin of these specimens and having information on at least three generations of their ancestors. Given the absence of a book of origins (studbook) in Algeria, we proceeded by eliminating any dogs of unknown origin. Body indices were calculated using mean values of the measurements in the formulas shown below using established methods used by local breeders and other studies on dogs (Drobnjak *et al.,* 2010; Drobnjak *et al.,* 2012) used by Oğrak *et al.* (2014).

- Index of Massiveness (IM) = $\frac{CC}{HW} * 100$
- Format Index (FI) = $\frac{BL}{HW} * 100$
- Cephalic Index (CI) = $\frac{HeW}{HL} * 100$
- Body-Tail Index (BTI) = $\frac{TL}{BL} * 100$
- Bone Index (BI) = $\frac{Wrist}{HW} * 100$
- Muzzle-Head Index (MHI) = $\frac{ML}{HL} * 100$
- Withers-Rump Index (WRI) = $\frac{HW}{HR} * 100$
- Head-Neck Index (HNI) = $\frac{HL}{NL} * 100$
- Ear-Head Length Index (EHLI) = $\frac{EL}{HL} * 100$
- Ear-Head Width Index (EHWI) = $\frac{EL}{HeW} * 100$

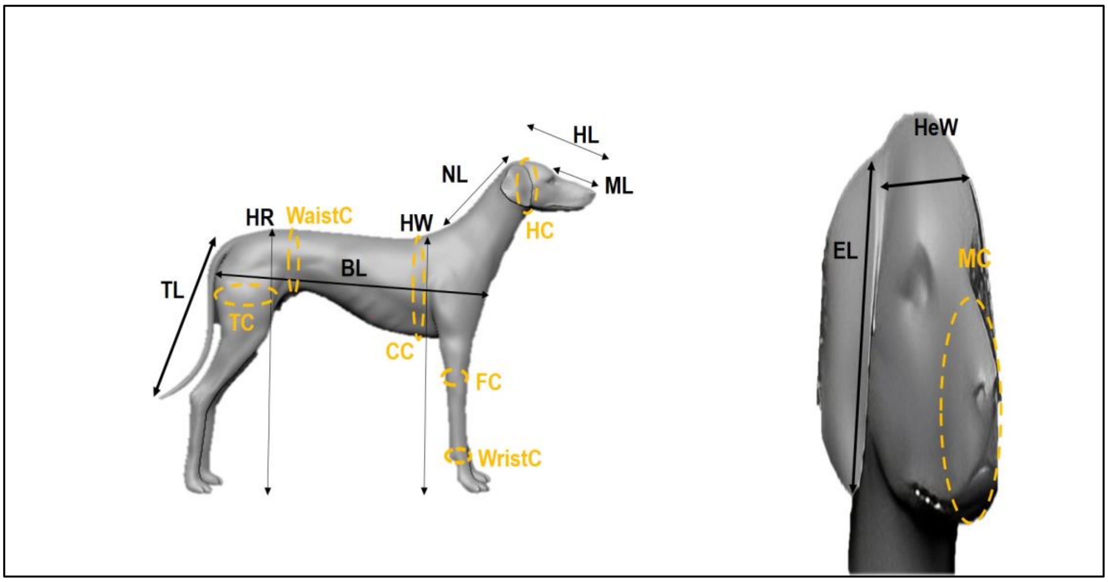

Figure 2. Overview of body measurements of the Sloughi dogs in this study

The UNIVARIATE procedure of the SAS (1999) statistical package program was used to check normality of the data. The result of the analysis showed that the data for all the measured characteristics were normally distributed. Afterwards, the GLM procedure of same software was used to make variance analyses and to obtain least squares means for the investigated characteristics. Duncan's multiple comparison test was used to test for differences between significant means. The phenotypic correlations between variables were also obtained using the PROC CORR procedures in SAS (1999).

Mathematical models used for analysis of variance is presented below:

Model used for weight and body measurement indices:

γ_ijkl=μ+a_i+b_j+e_ijkl (1)

Model used for body measurements:

γ_ijkl=μ+a_i+b_j+β_1 (X_i-X ̅) +e_ijkl (2) where *Yijkl* = observations for body measurements, weight, and index of massiveness (%); *μ* = overall mean of the trait; *ai* = fixed effect of gender (I = male and female); *bj* = fixed effect of region (j = east, west, and central); *β1* = coefficient of regression of live weight; $\bar{X}$ = mean weight; *Xi* = weight; *eijk* and *eijkl* = random errors with the assumption of N (0, σ^2).

Estimation equations of live weights with multiple linear regression analysis using body measurements according to region and region × sex groups were obtained by using stepwise multiple regression procedure in SAS (1999).

Figure 3. Example of Sloughis from the Wilaya of Laghouat (original photos)

Results and Discussion

Descriptive statistics belonging to the body measurements, weight, and body indices (Table 1) show that the highest coefficients of variation among the studied individuals were for both waist circumference and weight with 11.94% and 11.39%, respectively; the lowest was for the withers–rump index at 2.49%. It is also remarkable that some individuals had a height at the withers greater than 80 cm, which are considered as giant type Sloughis, but unfortunately, this type is becoming increasingly rare. They were chosen during this work to be part of a new program for the preservation of the breed, with the agreement and the participation of the breeders. Height at withers is one of the most important traits in the selection of dogs, especially in the Sloughi. Local breeders of the mountain regions consider tall Sloughis as the best, and this is due to their utility for hunting wild boars and golden African wolves without any difficulty. In addition, these breeders and owners have noticed that these so-called giant Sloughis adapt better to mountainous regions compared to other Sloughis originating from plains and desert regions, where height at withers is less important.

Table 1. Descriptive statistics of body measurements, body indices, and weight of Sloughi dogs

Variable	N	Mean ± SD	CV (%)	Minimum	Maximum
HW (cm)	105	70.53 ± 4.846	6.87	58.80	81.40
HR (cm)	105	69.37 ± 4.838	6.97	57.90	81.10
HL (cm)	105	24.77 ± 1.725	6.96	20.40	28.80
HeW (cm)	105	12.89 ± 0.858	6.65	10.70	14.80
ML (cm)	105	10.77 ± 1.047	9.72	8.10	14.20
EL (cm)	105	12.59 ± 1.311	10.41	9.80	15.90
NL (cm)	105	20.47 ± 1.907	9.32	16.20	24.30
BL (cm)	105	67.82 ± 4.629	6.83	56.80	76.40
TL (cm)	105	41.54 ± 3.669	8.83	34.30	51.70
MC (cm)	105	21.45 ± 1.641	7.65	17.20	25.70
HC (cm)	105	32.77 ± 2.469	7.54	26.10	38.70
CC (cm)	105	70.75 ± 5.138	7.26	55.10	80.50
WaistC (cm)	105	45.65 ± 5.449	11.94	35.30	59.10
TC (cm)	105	34.22 ± 2.986	8.73	23.90	41.10
FC (cm)	105	14.65 ± 1.208	8.25	11.80	17.60
WristC (cm)	105	10.69 ± 1.099	10.29	8.10	13.40
IM (%)	105	100.46 ± 5.91	5.88	83.41	114.53
FI (%)	105	96.28 ± 4.809	4.99	86.25	111.79
CI (%)	105	52.09 ± 2.113	4.06	47.86	57.39
BTI (%)	105	61.31 ± 4.416	7.20	49.09	76.16
BI (%)	105	15.16 ± 1.268	8.36	12.03	18.91
MHI (%)	105	43.55 ± 3.699	8.50	35.06	57.49
WRI (%)	105	101.70 ± 2.530	2.49	94.32	108.61
HNI (%)	105	121.73 ± 10.86	8.92	98.67	152.63
EHLI (%)	105	50.92 ± 4.913	9.65	39.56	64.79
EHWI (%)	105	97.90 ± 10.270	10.49	74.24	122.40
W (kg)	105	22.17 ± 2.525	11.39	17.00	30.00

HW: height at withers, HR: height at rump, HL: head length, HeW: head width, ML: muzzle length, EL: ear length, NL: neck length, BL: body length, TL: tail length, MC: muzzle circumference, HC: head circumference, CC: chest circumference, WaistC: waist circumference, TC: thigh circumference, FC: forearm circumference, WristC: wrist circumference, W:Weight, IM: Index of Massiveness, FI: Format Index, CI: Cephalic Index, BTI: Body–Tail Index, BI: Bone Index, MHI: Muzzle–Head Index, WRI: Wither–Rump Index, HNI: Head–Neck Index, EHLI: Ear–Head Length Index, EHWI: Ear–Head Width Index, N: number of samples, S.D.: standard deviation, CV: coefficient of variation

Least squares means and standard errors for body measurements and weights belonging to Sloughi dog breed are presented in Appendix Table 1. It is understood that for HW, HR, HL, HeW, MC, HC, FC and weight, male traits were larger (P <0.001). For WaistC and TC, males were larger (P <0.01). For NL and BL, males were larger (P <0.05). ML, EL, TL, CC, and WristC measurements were similar between sexes (P >0.05).

Results obtained in this study showed that in the Algerian Sloughi, sexual dimorphism was evident in 11 measurements out of 16, without forgetting weight, where males were heavier than females. This phenomenon is common in dogs, according to the several dog breed standards of the AKC (American Kennel Club), where sexual dimorphism is evident in all dog breeds. In the Italian pointing dog (*Bracco italiano*), males are larger than females in HW, CC, BL, HR, and HL (Cecchi *et al.,* 2015). For HW, HR, BL, CC, and HL in the Tarsus Çatalburun breed of Turkish hunting dog, males were larger (Oğrak *et al.*, 2014).

In Turkey, two studies on the Turkish Tazi have shown that there is a larger gain for males in HW, HR, CC, HL, HeW, and BL (Urosevic *et al*., 2020a), and for HW, HR, CC, BL, and weight (Yilmaz & Ertuğrul, 2011). The third study was on the Akbash Turkish Shepherd, which shows sexual dimorphism and HW, HL, and back height in males are larger (Urosevic *et al*., 2020b). A study carried out in Brazil in the Labrador had also shown that the males have two larger measurements than females, HW and BL (Thuller *et al.,* 2015). In the present study and the other citations mentioned above, HW, HR, CC, BL, HL, and HeW showed greater importance in morphometric differentiation between sexes. For live weight, males were always heavier than females. There was a difference in HW, HR, and FC (P <0.001) in western Sloughis with higher withers than central and eastern Sloughis; central

Sloughis had greater HR and FC than the other regions (Appendix Table 1). Regional differences were apparent for NL, TL, CC, and WaistC (*P* <0.01), where western Sloughis had larger NL, TL, and CC than the two other regions; eastern Sloughis had a larger WaistC. ML, TC and WristC (*P* <0.05) were larger in central Sloughis than western and eastern dogs. HL, HeW, EL, BL, MC, HC, and weight were similar among regions (*P* >0.05).

The above differences could be due to the different environmental factors, such as climate, soil texture, and the shape of the land. Breeders report a difference between the Sloughi sub-populations and this is certainly related to the environment where they evolved, especially the use of Sloughi in hunting. The taller dogs are generally used against large game such as wild boar, the African golden wolf, or the jackal and the smaller dogs are used for hunting small game, such as the hare. In other words, Sloughis are selected according to criteria that meet the needs of breeders and users of this breed. In Turkish Tazi, when the study was carried out on three sub-populations of dogs belonging to three different regions of Turkey (southeast, central and eastern), the southeastern sub-population had a longer body length than the two other sub-populations (Yilmaz & Ertuğrul, 2011). This phenomenon is probably evident in other dog breeds.

Regressions between weight and all body measurements were statistically significant: between weight and HW, HR, EL, BL, TL, CC, TC, and FC (*P* <0.001); weight and HL, HeW, NL, MC, WristC, (*P* <0.01); and weight and ML, HC, and WaistC (*P* <0.05). Least squares means and standard errors for body indices are presented in Appendix Table 2. The results reported in Appendix Table 2 indicated differences between the sexes for IM (*P* <0.01), with females larger. Females had a larger FI (*P* <0.05) and female body length was similar to height at withers, such that females were more blockish than males. For all the remaining indices, differences were not apparent.

Body indices were influenced by the environment too. There were differences in IM and CI between dogs belonging to the three regions (*P* <0.001), where eastern Sloughis had larger indices, indicating that eastern dogs had a less athletic body and their head width represented more than 50% of their head length in comparison to the two other regions (53.32% vs. 51.86% and 51.31%, respectively) (Appendix Table 2). For BTI, WRI, and HNI, the differences were significant (*P* <0.05); western dogs' tail length represented 62.75% of their body length (62.75% versus 60.62% and 60.15% for central and eastern dogs, respectively). HW and HR were approximately equal in the central population compared to the western and the eastern populations, respectively, where HW was larger than HR (100.88% versus 101.81% and 102.43%, respectively). In the eastern population, HL represented 125.14% of NL, such that HL was 25.14% larger than NL; in the western population, HL was 18.38% larger than NL; and in the central population, HL was 22.54% larger than NL. FI, MHI, EHI, and EHWI were similar (*P* >0.05). In the Tarsus Çatalburun breed of Turkish hunting dog, females had larger indices than males for Index of Format (FI), index of massiveness (IM), and index of bone (BI). The reason could be due to the shorter height of shoulder in females (Oğrak *et al.,* 2014).

Phenotypic correlation coefficients between weight and body characteristics are presented in Appendix Table 3. A general evaluation shows that there were strongly positive phenotypic correlations between weight and body measurements in the study. Analysis of correlation coefficients between weight and body measurements according to region showed that the highest coefficients were obtained in the western region. It was also found that correlation coefficients between weight and all body measurements were strongest in western Sloughis for HW, HR, HL, HeW, NL, BL, TL, HC, CC, TC, and FC (*P* <0.001); EL, MC, and WristC (*P* <0.01); and ML and WaistC (*P* <0.05). Correlation coefficients between weight and HC and WaistC were not significant (*P* >0.05) in central Sloughis, and between weight and NL in eastern Sloughis.

In the present work, the prediction equations were specific to the studied breed; in German shepherds, Labrador retrievers, and Belgian Malinois, the results obtained were similar concerning the correlations between weight and body measurements (Dirlik, 2008). In Nigerian native dogs, the results were also similar (Emehelu *et al.,* 2012). In their studies, the correlations between live weight and chest circumference were the highest. In Zağar dogs, live weight could be adequately predicted from body length, chest width, chest circumference, hind cannon bone circumference, and ear interval; in Zerdava dogs, live weight could be predicted from wither height, chest width, chest circumference, and head length; and in Çatalburun dogs, live weight could be predicted from wither height, body length, and chest circumference (Özkul *et al.,* 2021). In Philippine native dogs, the correlation and regression analyses indicated that all body measurements had positive linear relationships with body weight regardless of sex, but the single best determinant of body weight for both sexes was thoracic girth, with a coefficient of determination (R^2) of 0.468 (Valdez and Valencia, 2004). A study by the Gemlik Military Veterinary School indicated that ear length was the strongest predictor of live weight in German shepherd dogs (Elmaz *et al.,* 2006). The use of the classification and regression tree method (CART) and multivariate adaptive regression splines (MARS) explained 68% and 91% of the variation in live weight of Turkish Tazi dogs with morphometric measures (Çelik & Yilmaz, 2018). Separate models were developed for each region for the estimation of weight from body measurements and coefficients of determination (R^2) (Table 2).

Table 2. Weight estimation models of Algerian Sloughi dogs for three different regions according to stepwise regression analysis

Region	Models	$\hat{\beta}_i$			R^2	*P*-value
		$\hat{\beta}_0$	$\hat{\beta}_1$	$\hat{\beta}_2$		
East	$\hat{\gamma}_1 = \hat{\beta}_0 + \hat{\beta}_1 x_1$	0.74	0.32		0.46	0.000
West	$\hat{\gamma}_1 = \hat{\beta}_0 + \hat{\beta}_1 x_2$	-15.40	0.53		0.72	0.000
Central	$\hat{\gamma}_1 = \hat{\beta}_0 + \hat{\beta}_1 x_2$	-9.361	0.44		0.73	0.000
	$\hat{\gamma}_1 = \hat{\beta}_0 + \hat{\beta}_1 x_2 + \hat{\beta}_2 x_3$	-4.28	0.52	-0.80	0.76	0.000

x_1 = Height at rump (HR), x_2 = Height at withers (HW), x_3 = Head width (HeW), $\hat{\beta}_0$ = Constant, β_i = Regression coefficient, R^2 = Adjusted estimation power

Analysis of R^2 values indicated that the highest value was obtained from the second model of the central group (R^2 = 0.76); the lowest value was obtained from the model of the eastern group (R^2 = 0.46). HR with HeW could be used in the regression model. Separate models were developed for each region and sex for the estimation of weight from body measurements and coefficients of determination (R^2) are presented in Table 3.

Table 3. Weight estimation models of Algerian Sloughi dogs for three different regions and sexes according to stepwise regression analysis

Region	Sex	Models	$\hat{\beta}_i$				R^2	*P*-value
			$\hat{\beta}_0$	$\hat{\beta}_1$	$\hat{\beta}_2$	$\hat{\beta}_3$		
East	Male	$\hat{\gamma}_1 = \hat{\beta}_0 + \hat{\beta}_1 x_1$	-1.86	0.36			0.37	0.003
	Female	$\hat{\gamma}_1 = \hat{\beta}_0 + \hat{\beta}_1 x_3$	9.07	0.95			0.65	0.003
West	Male	$\hat{\gamma}_1 = \hat{\beta}_0 + \hat{\beta}_1 x_2$	-26.62	0.69			0.70	0.000
	Female	$\hat{\gamma}_1 = \hat{\beta}_0 + \hat{\beta}_1 x_4$	4.73	0.24			0.48	0.000
Central	Male	$\hat{\gamma}_1 = \hat{\beta}_0 + \hat{\beta}_1 x_2$	-18.78	0.57			0.70	0.000
		$\hat{\gamma}_1 = \hat{\beta}_0 + \hat{\beta}_1 x_2 + \hat{\beta}_2 x_5$	-19.84	0.42	0.35		0.79	0.000
		$\hat{\gamma}_1 = \hat{\beta}_0 + \hat{\beta}_1 x_2 + \hat{\beta}_2 x_5 + \hat{\beta}_3 x_6$	-21.03	0.52	0.56	-0.20	0.86	0.000
	Female	$\hat{\gamma}_1 = \hat{\beta}_0 + \hat{\beta}_1 x_2$	-8.71	0.44			0.65	0.000

x_1 = Height at rump (HR), x_2 = Height at withers (HW), x_3 = Head width (HeW), x_4 = Body length (BL), x_5 = Thigh circumference (TC), x_6 = Chest circumference (CC), $\hat{\beta}_0$ = Constant, β_i = Regression coefficient, R^2 = Adjusted estimation power

Analysis of R^2 values showed that the highest value was obtained from the third model in males from the central region and the lowest value was obtained from the model in males from the eastern region (R^2 = 086 versus R^2 = 0.37; Table 3). For the females, the highest R^2 was obtained in both the eastern and central females (R^2 = 0.65; Table 3). It was indicated that HW with TC and CC could be used in regression model for Sloughi males. HR or HeW could be used in regression models for females. The use of multiple regression models in other mammals, such as Karya sheep, showed that the highest coefficients of determination (R^2) were obtained from the models including body length or body length and chest girth together (R^2 = 0.79, R^2 = 0.87), such that live weight of Karya sheep could be estimated with a high accuracy (Yilmaz *et al.,* 2013). In dromedaries, live weight models with chest girth measurements had R^2 values of 0.74–0.99; chest girth was the most important measurement that could be used for estimate live weight (Meghelli *et al.,* 2020).

It is remarkable that even the simplest calculations using morphometric measurements led to promising results in terms of accuracy in the prediction of live weight of Algerian Sloughi, especially HW, HR, CC, BL, TC, and HeW.

Conclusion

The models constructed with regression analysis used in this study facilitated the use of the most important body measurements that were likely to change between breeds, sexes, or geographical regions in the estimation of body weight. Results of the present study showed that there were statistically significant differences between sexes in the studied population of 105 individuals for the majority of body measurements, some body indices, and between the three different sub-populations for six of ten body indices and ten of sixteen body measurements. The western individuals were the tallest with good proportions between head measurements. Indices confirmed the statements of breeders, who use several historical methods to evaluate morphological profile, which is closely related to hunting potential. For the format index, central Sloughis had the best proportion; breeders use this parameter to evaluate the aesthetic of the Sloughi, which means that the proportion between wither and rump height should be equal to 100%. In Algeria, there is an important genetic potential and morphological diversity within the Sloughi population that are beneficial in a program of genetic improvement and the creation of a breed standard in order to preserve this endangered heritage breed. This type of study allows breeders to direct the selection of their dogs and direct each animal towards the most appropriate activity.

Compliance with ethical standards

All activities were performed according to Algerian laws and regulations. No ethical conflicts exist in the realization of this work.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Author contribution

HHY and GSBS developed and conceptualized the study; AM, BMEA, and WH provided field trips with HHY. Statistical analyses were made by OY and HHY. Writing, review, and editing were done by HA, MI, and HHY. All authors have read and agreed to the published version of the manuscript.

Data availability

Data will be made available on reasonable request.

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Appendix Table 1 Least squares means and standard errors for body measurements and weight of the Sloughi dog breed

Variable	Sex			Region				Reg (Linear)	
	Males N=62	Females N=43	*P*-value	East N=30	West N=40	Central N=35	*P*-value	Weight	Overall N=105
HW (cm)	71.59 ± 0.370	68.68 ± 0.461	***	68.34 ± 0.500	71.09 ± 0.431	70.97 ± 0.453	***	1.170 ± 0.123	70.13 ± 0.270
HR (cm)	70.35 ± 0.391	67.61 ± 0.487	***	66.74 ± 0.529	69.84 ± 0.455	70.35 ± 0.479	***	1.119 ± 0.130	68.98 ± 0.285
HL (cm)	25.32 ± 0.195	23.95 ± 0.243	***	24.33 ± 0.263	24.60 ± 0.227	24.98 ± 0.238	ns	0.199 ± 0.065	24.63 ± 0.142
HeW (cm)	13.21 ± 0.093	12.46 ± 0.116	***	12.97 ± 0.126	12.73 ± 0.109	12.80 ± 0.115	ns	0.094 ± 0.031	12.84 ± 0.068
ML (cm)	10.91 ± 0.130	10.51 ± 0.162	ns	10.33 ± 0.176	10.92 ± 0.152	10.88 ± 0.159	*	0.114 ± 0.043	10.71 ± 0.095
EL (cm)	12.67 ± 0.163	12.44 ± 0.203	ns	12.37 ± 0.221	12.72 ± 0.190	12.57 ± 0.200	ns	0.208 ± 0.054	12.55 ± 0.119
NL (cm)	20.73 ± 0.224	19.94 ± 0.279	*	19.62 ± 0.303	20.88 ± 0.26	20.50 ± 0.274	**	0.255 ± 0.075	20.34 ± 0.163
BL (cm)	68.63 ± 0.513	66.50 ± 0.640	*	66.53 ± 0.695	67.84 ± 0.598	68.32 ± 0.629	ns	0.833 ± 0.171	67.56 ± 0.374
TL (cm)	41.81 ± 0.400	40.85 ± 0.498	ns	40.05 ± 0.541	42.60 ± 0.466	41.33 ± 0.490	**	0.689 ± 0.133	41.33 ± 0.291
MC (cm)	21.97 ± 0.185	20.71 ± 0.231	***	21.37 ± 0.251	21.31 ± 0.216	21.35 ± 0.227	***	0.196 ± 0.062	21.34 ± 0.135
HC (cm)	33.65 ± 0.276	31.47 ± 0.344	***	32.66 ± 0.374	32.84 ± 0.322	32.18 ± 0.338	***	0.209 ± 0.092	32.56 ± 0.201
CC (cm)	71.31 ± 0.547	69.79 ± 0.682	ns	70.82 ± 0.740	72.23 ± 0.638	68.59 ± 0.671	ns	0.922 ± 0.182	70.55 ± 0.399
WaistC (cm)	46.90 ± 0.633	43.97 ± 0.789	**	47.19 ± 0.857	46.14 ± 0.738	42.97 ± 0.776	**	0.453 ± 0.211	45.44 ± 0.461
TC (cm)	34.98 ± 0.335	33.09 ± 0.418	**	33.37 ± 0.453	33.67 ± 0.390	35.06 ± 0.411	**	0.426 ± 0.112	34.03 ± 0.244
FC (cm)	15.11 ± 0.120	13.99 ± 0.149	***	14.33 ± 0.162	14.24 ± 0.139	15.07 ± 0.147	***	0.159 ± 0.0400	14.55 ± 0.087
WristC (cm)	10.80 ± 0.133	10.46 ± 0.165	ns	10.24 ± 0.179	10.81 ± 0.155	10.83 ± 0.163	ns	0.159 ± 0.0440	10.63 ± 0.097
Weight (kg)	23.28 ± 0.277	20.53 ± 0.334	***	21.67 ± 0.401	22.04 ± 0.348	22.00 ± 0.365	***	--	21.90 ± 0.216

HW: height at withers, HR: height at rump, HL: head length, HeW: head width, ML: muzzle length, EL: ear length, NL: neck length, BL: body length, TL: tail length, MC: muzzle circumference, HC: head circumference, CC: chest circumference, WaistC: waist circumference, TC: thigh circumference, FC: forearm circumference, WristC: wrist circumference, ns: non-significant $P > 0.05$, *$P < 0.05$, ** $P < 0.01$, ***$P < 0.001$

Appendix Table 2 Least squares means and standard errors for body indices of the Sloughi dog breed

Body index	Sex			Region			
	Males N=62	Females N=43	*P*-value	East N=30	West N=40	Central N=35	*P*-value
IM (%)	99.32 ± 0.665	102.35 ± 0.801	**	103.87 ± 0.961	101.78 ± 0.833	96.86 ± 0.876	***
FI (%)	95.53 ± 0.602	97.60 ± 0.726	*	97.62 ± 0.871	95.54 ± 0.755	96.54 ± 0.794	ns
CI (%)	52.18 ± 0.254	52.14 ± 0.306	ns	53.32 ± 0.367	51.86 ± 0.318	51.31 ± 0.335	***
BTI (%)	61.26 ± 0.555	61.09 ± 0.669	ns	60.15 ± 0.802	62.75 ± 0.696	60.62 ± 0.731	*
BI (%)	15.07 ± 0.164	15.27 ± 0.197	ns	15.00 ± 0.237	15.21 ± 0.205	15.29 ± 0.216	ns
MHI (%)	43.25 ± 0.47	43.75 ± 0.566	ns	42.47 ± 0.679	44.43 ± 0.589	43.59 ± 0.619	ns
WRI (%)	101.85 ± 0.318	101.56 ± 0.384	ns	102.43 ± 0.460	101.81 ± 0.399	100.88 ± 0.420	*
HNI (%)	122.21 ± 1.367	121.82 ± 1.647	ns	125.14 ± 1.976	118.38 ± 1.714	122.54 ± 1.802	*
EHLI (%)	50.51 ± 0.634	51.38 ± 0.764	ns	50.74 ± 0.917	51.70 ± 0.795	50.41 ± 0.836	ns
EHWI (%)	96.97 ± 1.310	98.71 ± 1.579	ns	95.29 ± 1.895	99.88 ± 1.643	98.35 ± 1.727	ns

IM: Index of Massiveness, FI: Format Index, CI: Cephalic Index, BTI: Body–Tail Index, BI: Bone Index, MHI: Muzzle–Head Index, WRI: Withers–Rump Index, HNI: Head–Neck Index, EHLI: Ear–Head Length Index, EHWI: Ear–Head Width Index, ns: non-significant $P > 0.05$, *$P < 0.05$, ** $P < 0.01$, ***$P < 0.001$

Appendix Table 3 Phenotypic correlation coefficients between weight and body measurements according to region in Slough dogs in Algeria

Trait	Region	HW	HR	HL	HeW	ML	EL	NL	BL	TL	MC	HC	CC	WaistC	TC	FC	WristC
	East	0.928***															
HR	West	0.984***															
	Central	0.902***															
	East	0.585**	0.719***														
HL	West	0.611***	0.620***														
	Central	0.570***	0.550**														
	East	0.588**	0.705***	0.897***													
HeW	West	0.572***	0.574***	0.807***													
	Central	0.606***	0.551**	0.880***													
	East	0.558**	0.620***	0.597***	0.553**												
ML	West	0.539***	0.551***	0.518**	0.487**												
	Central	0.459**	0.522**	0.510**	0.513**												
	East	0.657***	0.650***	0.417*	0.364*	0.429*											
EL	West	0.433**	0.462**	0.590***	0.450**	0.290^{ns}											
	Central	0.416*	0.502**	0.283^{ns}	0.178^{ns}	0.425*											
	East	0.443*	0.466**	0.433*	0.327^{ns}	0.431*	0.313^{ns}										
NL	West	0.583***	0.593***	0.480**	0.468**	0.324*	0.417**										
	Central	0.567***	0.515**	0.481**	0.380*	0.274^{ns}	0.402*										
	East	0.766***	0.708***	0.580**	0.534**	0.575**	0.575**	0.581**									
BL	West	0.720***	0.710***	0.498**	0.390*	0.543***	0.419**	0.590***									
	Central	0.739***	0.619***	0.556**	0.481**	0.413*	0.382*	0.57***									
	East	0.817***	0.812***	0.611***	0.588**	0.559**	0.786***	0.495**	0.695***								
TL	West	0.668***	0.643***	0.417**	0.229^{ns}	0.354*	0.559***	0.427**	0.723***								
	Central	0.550**	0.612***	0.218^{ns}	0.242^{ns}	0.458**	0.525**	0.319^{ns}	0.271^{ns}								
	East	0.462*	0.610***	0.616***	0.619***	0.297^{ns}	0.328^{ns}	0.292^{ns}	0.267^{ns}	0.421*							
MC	West	0.559***	0.544***	0.582***	0.578***	0.419**	0.153^{ns}	0.350*	0.238^{ns}	0.219^{ns}							
	Central	0.675***	0.651***	0.566***	0.447**	0.556**	0.345*	0.557**	0.673***	0.467**							
	East	0.589**	0.709***	0.712***	0.731***	0.540**	0.305^{ns}	0.543**	0.496**	0.500**	0.636***						
HC	West	0.653***	0.646***	0.769***	0.591***	0.444**	0.384*	0.475**	0.576***	0.401*	0.517**						
	Central	0.458**	0.454**	0.841***	0.706***	0.412*	0.258^{ns}	0.399*	0.439**	0.295^{ns}	0.682***						
	East	0.771***	0.781***	0.638***	0.564**	0.462*	0.611***	0.566**	0.831***	0.674***	0.391*	0.530*					
CC	West	0.696***	0.716***	0.726***	0.479**	0.539***	0.543***	0.516**	0.552***	0.615***	0.492**	0.653***					
	Central	0.641***	0.586***	0.517**	0.491**	0.261^{ns}	0.454**	0.475**	0.587***	0.529**	0.604***	0.604***					
	East	0.682***	0.748***	0.757***	0.676***	0.469**	0.491**	0.549**	0.742***	0.573**	0.480**	0.691***	0.880***				
WaistC	West	0.347*	0.339*	0.610***	0.346*	0.167^{ns}	0.443**	0.319*	0.166^{ns}	0.358*	0.468**	0.646***	0.620***				
	Central	0.303^{ns}	0.291^{ns}	0.354*	0.292^{ns}	0.025^{ns}	0.269^{ns}	0.176^{ns}	0.344*	0.307^{ns}	0.307^{ns}	0.410*	0.712***				
	East	0.640***	0.688***	0.576**	0.600***	0.341^{ns}	0.324^{ns}	0.488**	0.484***	0.509***	0.584**	0.756***	0.529**	0.641***			
TC	West	0.698***	0.695***	0.604***	0.506**	0.312^{ns}	0.437**	0.534***	0.426**	0.473**	0.505**	0.626***	0.773***	0.577***			
	Central	0.476**	0.347*	0.285^{ns}	0.217^{ns}	0.023^{ns}	0.291^{ns}	0.150^{ns}	0.395*	0.350*	0.330^{ns}	0.356*	0.711***	0.596***			
	East	0.806***	0.850***	0.681***	0.634***	0.513**	0.633***	0.538**	0.742***	0.770***	0.525**	0.787***	0.756***	0.820***	0.781***		
FC	West	0.648***	0.668***	0.643***	0.523**	0.288^{ns}	0.567***	0.613***	0.623***	0.598***	0.409**	0.611***	0.709***	0.532***	0.676***		
	Central	0.662***	0.667***	0.543**	0.528**	0.403**	0.491**	0.506**	0.599***	0.363*	0.677***	0.535**	0.661***	0.391*	0.435**		
	East	0.650***	0.676***	0.720***	0.646***	0.472**	0.708***	0.581**	0.747***	0.675***	0.521**	0.636***	0.724***	0.699***	0.608***	0.786***	
WristC	West	0.572***	0.534***	0.316*	0.283^{ns}	0.362*	0.184^{ns}	0.279^{ns}	0.504**	0.542***	0.185^{ns}	0.420**	0.453**	0.146^{ns}	0.445**	0.396*	
	Central	0.526**	0.512**	0.475**	0.417*	0.369*	0.642***	0.359*	0.393*	0.532**	0.538**	0.558***	0.742***	0.369*	0.575***	0.566***	
	East	0.579**	0.692***	0.516**	0.614***	0.502**	0.411*	0.299^{ns}	0.450*	0.566**	0.422*	0.588**	0.505**	0.583**	0.465*	0.596**	0.443*
W	West	0.855***	0.849***	0.610***	0.582***	0.375*	0.509**	0.570***	0.607***	0.635***	0.508**	0.547***	0.686***	0.361*	0.614***	0.634***	0.465**
	Central	0.859***	0.735***	0.374*	0.373*	0.347*	0.420*	0.482**	0.654***	0.504**	0.555**	0.263^{ns}	0.536**	0.261^{ns}	0.510**	0.530**	0.457**

HW: height at withers, HR: height at rump, HL: head length, HeW: head width, ML: muzzle length, EL: ear length, NL: neck length, BL: body length, TL: tail length, MC: muzzle circumference, HC: head circumference, CC: chest circumference, WaistC: waist circumference, TC: thigh circumference, FC: forearm circumference, WristC: wrist circumference, W: Weight, ns: non-significant $P > 0.05$, *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$