Iraqi Journal of Veterinary Sciences

www.vetmedmosul.com

Morphometric characterization of purebred Arabian horses for galop racing (Born and raised in Algeria)

A.R. Benia[1], S.M. Selles[1] and N. Benamor[2]

[1]Department of Biomedicine, Institute of Veterinary Sciences, [2]Department of Natural Sciences and Life, Faculty of Natural Sciences and Life, University of Tiaret, Tiaret, Algeria

Abstract

This study aims to determine the morphometric characteristics of Purebred-Arab horses born and bred in Algeria specialized in horse racing depending on age and sex. Measurement of the study was taken at the Kaid-Ahmed racecourse in Tiaret (Algeria). The average size at the withers of the subjects (n=95) was 152.15±05.07 cm, and the thoracic girth was 166.44±06.43 cm. Compared to the height at the withers, the rump size was slightly lower 151.61±04.79 cm, and the body length was almost identical 152.82±06.30 cm with an average weight of 395.83±40.51 kg that is considered minor. Our sample horses appear pretty thick relative to their size with an average circumference of the anterior and posterior guns of 18.30±01.70 cm and 19.68±0 1.79 cm respectively, and in extent arm lengths 30.90±02.66 cm and forearm 31.77±02.81 cm. The various calculated indices qualify our horses as compact horses, light, square and long. The reading of the dress color of our model presents the dominance of the Alazan at 51.57%, and the shape of the chamfer is mostly Camus at 56.84%, giving it a short head with a broad forehead and concave chamfer. Statistical analysis determined that males were more significant than females and adults compared to young.

Introduction

In Algeria, Equestrian Sport has undergone considerable development over the last few years, both in the number of existing horses and the number of owners and practitioners of horse riding. More than 312,000 horses live in the country, according to the latest censuses of the Ministry of Agriculture and Rural Development (1). The distribution of the equine population is spread over the different regions of Algeria, with three quarters in the highland region alone, like the wilaya of Tiaret. When categorizing through usage and size, we can distinguish five important breeds of horses in Algeria as Beard, Arab-Beard, Thoroughbred Arab, Thoroughbred English, and French Trotter (2), a sixth race is also currently under development. The Arabian

Thoroughbred is still a remarkable racehorse, endurance horse, and one of the oldest known pure breeds (3,4). It is a Horse of the rough civilization of the Middle-East desert distinguished by its flexibility, maneuverability, resistance, lightness, and above all, its beauty. In Algeria, the number of Arabian Thoroughbreds is estimated at 1,800 horses, of which 90% are from the national stud of Tiaret Jumenterie de Chaouchaoua (2). Today, this breed shines in several sports disciplines. For a horse to be accepted into the studbook, it must conform to specific phenotypic characteristics. Body conformation is used to distinguish, evaluate and compare breeds (5). The relationships among body dimensions also affect the beauty and performance of horses in different sports (6-8). According to Padilha *et al.* (9), it is a horse race that its small size could distinguish with

a tourniquet at 148 to 156 cm on average, usually of Alazani, bay, or grey dress. It also has a broad chest, a harmonious rump, a short tail, and attached high with very dry limbs.

The Arabian Thoroughbred bears to the head are signs that confirm its nobility. Other characteristics are the broad forehead, straight or concave profile, short ears, well-drawn and mobile large expressive and soft eyes, open and finely drawn nostrils, spread ganache with a lower short and small lip. A long neckline carries the very distinguished head instead of a thick one with silky hair. The morphometric measurements of horses are considered an excellent criterion for determining the characteristics and conformation of the body of a breed. In addition, they are essential for monitoring development during the growing period of youth and for determining suitability for breed standards during the post-growth period. Thoroughbred horses must conform to the breed's characteristics in various body measures. Numerous studies have been carried out involving morphometric measurements in different breeds of horses (9-13).

Knowing that little work has been done on the Arabian Thoroughbred horse born and raised in Algeria (from local strains and/or crosses with Arabian Thoroughbred stallions imported mainly from France), it remains little known to the general public. Veterinarians, zootechnicians, owners, and trainers of racehorses should have numerical data to characterize this horse better, especially since it is undergoing certain variations related to biotopes and humans. The dangers of drifting and altering this breed are numerous since they can come from divergent material or sporting interests. Today, this thoroughbred shines in several disciplines on a national scale (endurance, horse racing, model, and pace). This morphometric study of the Arab Thoroughbred born and raised in Algeria will be significant as it will allow us to bring elements defining in an updated and concrete way of this breed and better analyze its abilities. It can help us contribute to the morphological characterization of this leading player for horse racing so that professionals can match the required phenotype needed to estimate the morphometric indices from these measurements. Furthermore, the study will enable us to evaluate the biometric data and standards of functional classification.

We worked on a sample of 95 horses from the main stables of the Kaid Ahmed racecourse in Tiaret (Horse Racing and Pari-Mutuel Society). This study will offer the different owners, stud farms, and pilot farms of equine species objective and relevant criteria to assess horses intended for horse racing from an early age.

Materials and methods

Ethics approval

The measurements were made with the agreement and under the supervision of the owners of the horses studied (private stud farms). For animal experimentation, no Algerian law applies to non-experimental measurement practices. An ethical review by the animal experimentation declaration committee was therefore not necessary. No additional animal discomfort was caused for data collection for the purposes of this study.

Study zone

The study was carried out during July and August 2020 in the suburbs of Tiaret, where; The Haras National Chaouchaoua (one of the oldest and largest pilot farms specializing in horse breeding in Africa) is located. The Kaid Ahmed Racecourse is one of the vital horse racing racetracks in the country. This area is of a Mediterranean climate is located at an altitude of 1,080 meters above sea level between latitude 35.3879 and longitude 1.32282, 35° 23′ 16″ North, and 1° 19′ 22″ East. Located on the high plateaus of the country, it extends on the Southern slope of the Telling Atlas at the place called Chaouchaoua 5 km away from the central city Tiaret. The farm covers an area of 922 hectares with 876 hectares of total agricultural area, including 74 hectares of functional agricultural area.

Study population

This work was carried out on 95 Arabian Thoroughbred horses born and bred in Algeria, 45 females and 50 males. They were all selected from crossbreeding between local strains and/or Arabian Thoroughbred stallions imported mainly from France with ages 3 to 10 (46 young people between the ages of 03 and 06 and 49 adults aged between 07 and 10 years). This population is also registered in the Algerian horse's studbook as horse racing horses. It belongs either to the Haras National Chaouchaoua de Tiaret or to the six largest private owners in the region of Tiaret, the official partners with the Horse Racing and Mutual Betting Society. These horses have at least one podium performance. They are all qualified and favorites in the 900m, 1000m, 1300m, 1400m, 1500m, 1600m, and 1700m horse races. For each horse, thanks to the data of the racing society, we have the information such as Name, Age, Sex, Breed, Dress, and Names of direct ascendants (father and mother). Each horse's chip number is checked on the day of measurements by a transponder.

Measurements

Table 1 lists the 24 measurements taken on horses inside each stable in a well-flattened, non-slippery horizontal plane. We worked on the left side profile of each horse (preferential side to approach the equines). We also used the instruments, i.e., a hippo-metric or toise cane, to measure height parameters and a metric tape for length and circumference parameters (towers).

Table 1: Description of the morphometric measures examined in the study

Abbreviation	Measures Part	Description
WH	Withers height in cm	The vertical distance from the highest point of the withers to the ground.
RH	Rump height in cm	The vertical distance between the highest point of the sacrum and the ground.
BL	Body length in cm	Distance between the point of the shoulder and the point of the buttock.
SIL	Scapula-iliac length in cm	Point of shoulder - point of the hip.
HL	Head length in cm	Measured on the midline between the top of the forelock (occipital region) and the tip of the nose.
NL	Neck length in cm	Measured from the cranial edge of the atlas wing to the top of the scapula.
SL	Shoulder length in cm	Measured between the top of the scapula and the caudal part of the large tubercle of the humerus.
AL	Arm length in cm	Measured between the caudal part of the large tubercle of the humerus and the lateral relief of the radial head.
FL	Forearm length in cm	Measured between the lateral relief of the radial head and the distal part of the radius.
CL	Cannon length in cm	Metacarpus IV head - distal end of the metacarpus at the fetlock.
IL	Ilium length in cm	Measured between the ventro-cranial iliac spine and the crest of the greater trochanter.
TL	Thigh-length in cm	Measured between the crest of the greater trochanter and the apex of the tibial tuberosity.
TP	Thoracic perimeter in cm	Circumference around the chest from behind the scapula at the end of expiration.
AK	Around the knee in cm	Pass through the accessory carpal bone (pisiform bone), the prominent bone behind the joint.
ACC	Anterior cannon circumference in cm	Perpendicularly in the middle of the axis of the cannon.
PCC	Posterior cannon circumference in cm	Perpendicularly in the middle of the axis of the cannon.
AFC	Anterior fetlock circumference in cm	At the level of its most voluminous part (carpal region).
PFC	Posterior fetlock circumference in cm	At the level of its most voluminous part.
APC	Anterior pastern circumference in cm	Go through the middle of the pastern fold.
PPC	Posterior pastern circumference in cm	Go through the middle of the pastern fold.
AHC	Anterior hoof circumference in cm	
PHC	Posterior hoof circumference in cm	
ULC	Upper leg circumference in cm	Perpendicular to the upper part of the tibia.
LLC	Lower leg circumference in cm	Perpendicular to the lower part of the tibia.

Estimated live weight

The most reliable method for determining a horse's weight is scale. Indeed, the scale could not be transported to every place where our measurements were taken because it is heavy. Moreover, measuring weight by this method has proved impossible for some horses that refuse to get on the scale. Live weight (LW) in kilograms (kg) was calculated from the thoracic perimeter (PT) and height at the withers (HW) according to the formulas proposed by the Institute of Agricultural Research of France (INRA) following the book by Martin-Rosset (14): Male: Live weight (LW) in kilogram = 4,3 Thoracic perimeter (TP) + 3 Withers height (WH) - 785. Female: Live weight (LW) in kilogram = 5,2 Thoracic perimeter (TP) + 2,6 Withers height (WH) - 855.

Indices

Six indices or body ratios were retained from withers height, length of the body, thoracic perimeter, circumference of the anterior barrel, height at the croup, and live weight (15-18): a) Bodybuilding Index: Thoracic perimeter (TP) / Withers height (WH). b) Profile Body Index: Withers height (WH) / Body length (BL). c) Body compactness index: Live weight (LW) / Withers height (WH). d) Relative body index: Body length (BL) / Thoracic perimeter (TP). e) Thoracic Typing Index: Anterior barrel circumference (ABC) / Thoracic perimeter (TP). f) Height Front Back: Withers height (WH) / Rump height (RH).

Qualitative characters

Two qualitative characteristics were appreciated with the naked eye as the colour of the dress (alzane, gray, bay, and other) is determined with the help of the new nomenclature of the dresses (19). The shape of the head (Camuse concave, Square rectilinear, Brusque, Rhinoceros). The qualitative parameters were collected in the form of percentages.

Statistical analysis

We calculated the average, standard deviation, confidence interval, and coefficient of variation for each parameter (20). The comparison between the groups was made using the software Rstudio version 3.6.1 for Windows. The difference was considered significant at the 5% risk of error (21).

Results

This first study in Algeria on the morphometric parameters of Thoroughbred-Arab (born and raised in Algeria) was carried out in the most critical horse racing field located in Tiaret (northwest of the country). Tables 2, 3 and 4 indicate average measurements and indices for the 95 horses studied (male and female). All the horses aged between 3 and 10 years old and divided into two age groups: young and adult. Two qualitative parameters are put together in the form of percentages in tables 5 and 6.

Table 2: Descriptive statistics of morphometric measurements and live weight calculated for Arabian Thoroughbred horses Born and Raised in Algeria.

Measure	m±σ	Min	Max	CV	CI
WH (cm)	152.15±05.07	143	161	3.33	1.0
RH (cm)	151.61±04.79	142	161	3.15	1
BL (cm)	152.82±06.30	140	166	4.12	1.3
SIL (cm)	105.57±02.07	100	111	1.96	0.4
HL (cm)	52.04±03.40	45	58	6.53	0.7
NL (cm)	67.75±02.15	61	73	3.17	0.4
SL (cm)	63.01±01.94	58	68	3.07	0.4
AL (cm)	30.90±02.66	27	40	8.60	0.5
FL (cm)	31.77±02.81	27	41	8.84	0.6
CL (cm)	18.78±01.85	15	22	9.85	0.4
LI (cm)	22.16±01.52	20	26	6.85	0.3
TL (cm)	41.74±01.82	38	46	4.36	0.4
TP (cm)	166.44±06.43	154	178	3.86	1.3
AK (cm)	27.03±02.04	23	31	7.54	0.4
ACC (cm)	18.30±01.70	15	22	9.28	0.3
PCC (cm)	19.68±01.79	17	23	9.09	0.4
AFC (cm)	24.34±01.99	20	29	8.17	0.4
PFC (cm)	25.21±02.40	19	30	9.52	0.5
APC (cm)	18.29±01.54	26	22	8.41	0.3
PPC (cm)	18.95±01.73	16	22	9.12	0.3
AHC (cm)	35.89±02.36	32	40	6.57	0.5
PHC (cm)	34.90±02.27	32	39	6.50	0.5
ULC (cm)	48.03±02.78	40	56	5.78	0.6
LLC (cm)	30.66±02.22	26	36	7.24	0.4
LW (Kg)	395.83±40.51	306	476	10.2	8.1

m: Mean: σ: Standard deviation; Min: Minimum value; Max: Maximum value; Cv: Coefficient of variation; CI: Confidence interval; Kg: Kilogram: cm: centimeter

Table 3: Descriptive statistics for the different indices

Index	m±σ	Variance	CV	CI
Body Size Index (TP/WH)	1.09±0.03	0.00072	2.46	0.005
Profile Body Index (WH/BL)	0.99±0.02	0.00044	2.1	0.0041
Body Compactness Index (LW/WH)	2.6±0.20	0.03956	7.66	0.04
Relative Body Index (BL/TP)	0.91±0.03	0.00073	2.94	0.005
Thoracic Typing Index (ACC/TP)	0.11±0.01	$6.67e^{-05}$	7.43	0.002
Height Front Behind (WH/RH)	1±0.01	$7.86e^{-05}$	0.88	0.002

Table 4: Significant variations in the parameters studied according to the sex and age of the subjects

Measure	Males (n=50)	Females (n=45)	Meaning	Youngs (n=46)	Adults (n=49)	P value
WH (cm)	153.86±5.08	150.27±4.40	0.0004***	150.76±5.21	153.47±4.63	0.0087**
RH (cm)	153.08±4.63	149.98±4.49	0.0013**	150.28±4.94	152.86±4.35	0.0083**
BL (cm)	155.3±5.49	150.07±6.05	< 0.0001***	150.48±5.90	155.02±5.91	0.0003***
SIL (cm)	106.2±2.19	104.89±1.71	0.0017**	104.87±1.89	106.24±2.04	0.0010**
HL (cm)	52.24±3.56	51.82±3.25	0.5532	50.59±2.76	53.41±3.41	< 0.0001***
NL (cm)	68.28±2.42	67.18±1.66	0.0119*	67.09±1.93	68.39±2.18	0.0028**
SL (cm)	63.44±2.08	62.53±1.69	0.0227*	61.98±1.67	63.98±1.69	< 0.0001***
AL (cm)	31.64±3.02	30.09±1.94	0.0041**	29.57±1.38	32.16±2.97	< 0.0001***
FL (cm)	32.6±3.15	30.87±2.06	0.0023**	30.24±1.52	33.22±2.99	< 0.0001***
CL (cm)	19±1.71	18.56±1.98	0.2445	18.28±1.81	19.27±1.78	0.0089**
LI (cm)	22.52±1.54	21.78±1.43	0.0172*	21.65±1.00	22.84±1.64	< 0.0001***
TL (cm)	41.76±1.74	41.73±1.94	0.9438	40.74±1.48	42.69±1.61	< 0.0001***
TP (cm)	167.86±6.62	164.87±5.89	0.0227*	162.74±4.73	169.92±5.88	< 0.0001***
AK (cm)	27.54±2.06	26.47±1.90	0.0101*	26.46±1.95	27.57±2.01	0.0074**
ACC (cm)	18.6±1.60	17.98±1.78	0.0761	17.85±1.66	18.73±1.66	0.0107*
PCC (cm)	19.92±1.75	19.42±1.83	0.1783	19.09±1.59	20.24±1.81	0.0013**
AFC (cm)	24.68±2.06	23.98±1.88	0.0874	23.57±1.68	25.08±2.01	0.0001***
PFC (cm)	25.64±2.51	24.73±2.22	0.0663	24.35±2.08	26.02±2.43	0.0005***
APC (cm)	18.38±1.51	18.2±1.60	0.5746	17.76±1.45	18.8±1.49	0.0009***
PPC (cm)	19.24±1.61	18.64±1.84	0.0955	18.5±1.67	19.39±1.71	0.0120*
AHC (cm)	36.42±2.33	35.31±2.28	0.0216*	34.72±1.93	37±2.21	< 0.0001***
PHC (cm)	35.4±2.35	34.36±2.09	0.0249*	33.89±1.95	35.86±2.17	< 0.0001***
ULC (cm)	48.5±3.20	47.51±2.15	0.0839	47.35±1.95	48.67±3.28	0.0196*
LLC (cm)	30.96±2.27	30.33±2.15	0.1717	29.63±1.90	31.63±2.08	< 0.0001***
LW (Kg)	398.378±40.70	393±40.58	0.5212	374.94±33.52	415.44±36.75	< 0.0001***

Key: (P < 0.05)* Significant, (P < 0.01) ** Very significant, (P < 0.001) *** Highly significant.

Table 5: Coat colour results of Arabian thoroughbred horses

Coat Colour	Effective	Percentage (%)
Alezan	49	51.57
Bay	31	32.63
Gray	10	10.52
Roan	05	05.26

Table 6: Results of the shape of the chamfer of thoroughbred Arabian horses

Chamfer shape	Effective	Percentage (%)
Camus	54	56.84
Rhinoceros	30	31.58
Square	11	11.57
Buzzed	00	00

Discussion

The study is carried out on 95 horses, considered an acceptable number for statistical analysis. Horses were selected based on their outstanding performance in horse racing and not just through sampling, which evokes the representativeness of the study from a statistical point of view. Nevertheless, the results of our research constitute a database of the morphological parameters of The Arabian Thoroughbreds that future studies can use.

Chardes and Boudon (22) report that the Arabian Thoroughbred has no drastic standards, unlike many equine breeds. It has an average weight of 350 and 450 kg and size with withers of 148 to 156 cm. The weight of our model is 395.83±40.51 kg and 152.15±05.07 cm in height at the withers, which is considered to be small. Metayer *et al.* (23) cite that more and more horses are miniature than others. The larger their body surface, the more thermoregulation mechanisms are used during gallop races.

Its body count of compactness, estimated by the live weight ratio to height at the withers, is 2.6±0.20 kg/cm testifying a compact and light horse for its weight. Compared to other breeds, the size of the Thoroughbred-Arab is close to that of the beard (18) and lower than other saddle horse breeds present in Algeria, such as the Anglo-Arab 158-166 cm and the English thoroughbred 157-173 cm with an average of 165 cm (18,24). The dimensions of its well-arched neckline 67.75±02.15 cm indicate long, light, and thin compared to beard and Arabic-Barbe. Denoix (25) mentions that the neckline of the racehorse must be long

enough to play its role of balancing correctly, especially at a gallop, without overloading the front hand.

The chest circumference of our sample is 166.44±06.43 cm. The shoulder's moderately oblique and muscular length is 63.01±01.94 cm, indicating a deep open chest and a sizeable respiratory capacity. Loving (26) reports that for athletic horses, it is preferable that the shoulder be tilted (horizontal). This characteristic allows an energy saving despite the increase in the pace of strides which would contribute to very high performance through reducing the risk of developing a limp of the forebears. Several studies have shown that a long shoulder reduces the risk of fracture of the forelimbs in racehorses (27). A deep chest promotes good ventilation, and the Arabian thoroughbreds are reputed to have a deeper thorax, thus having better ventilation with a proportionally larger heart and lung (8). The average scapulo-iliac length of our study horses is 105.57±02.07 cm representing a relatively short back. This type of back is reputed to be solid, according to Van Weeren and Crevier-Dnoix (28). In addition, horses with longer backs have longer and less frequent strides, which increase the energy work to be provided following physical exertion (23). The Arabian thoroughbred has a shorter back because it would have only 17 dorsal vertebrae and five lumbar vertebrae compared to 18 and 6, respectively, for the other breeds (29).

Indeed, our study horses appear pretty thick relative to their sizes, with fairly loaded limbs in mass (circumferences of joints and cannons) and in extent (arm and forearm lengths). According to the horse's encyclopedia (30), the dimensions of the guns would be as follows (i) 18 cm for a size of 157 cm or less, (ii) 19 cm for a height larger than 157 cm, and (iii) 20 cm for heavy horses. However, our study horses have a cannon perimeter of 18.30±01.70 cm for the forelimbs; 19.68±01.79 cm for the hindquarters) and a knee circumned 27.03±02.04 cm for a height of 152.15±05.07 cm, this proves the strength and thickness of its limbs. According to Atger *et al.* (31), the quality of the horse is at the top up to the knee, and the hock underneath it is longevity. Loving (26) and Metayer *et al.* (23) say that The Arabian Thoroughbreds are ground-ready with short limbs and a short forearm, promoting shaving gestures and thus contributing to energy saving. They also have a long femur and a closed hock that facilitates propulsion and horizontal movements. These horses are reputed to have strong limbs due to their high bone density and wide joints, which is a good asset in endurance and racing (29,32), knowing that draft horses would have a bone density 20% higher (33). According to studies by Atger *et al.* (31) and Galletier (29), the sport horse should preferably have suitable aplomb, and its feet must be strong.

The results of this research (relatively homogeneous around the averages) reveal a horse weighing 395.83 - 405.1 kg that is considered light compared to other heavy breeds 600 to 1000 kg (24). The size at the withers is 152.15±05.07

cm, and the body length is 152.82±06.30 cm, giving a body profile index to assess the proportion of the horse that is around 1 more precisely 0.99±0.02 and making it a square horse, length is approximately equal to its size. It is said to be short if the index is less than 1, Medio line if it is equal to 1, and long for an index greater than 1 (34). Our model with a relative body index (BL/TP) of 0.91 is one of the so-called long-haired horses (racehorses). An index of 0.90 or higher characterizes them. At the same time, those with an index of 0.85 or less are called breviligne (draft horses). On the other hand, those whose index is between 0.85 and 0.90 are said to be Medio-Line. Jordana *et al.* (35) and Guedioura *et al.* (18) report that the long-pitched appearance favors gathering and translating an aptitude for running and training. The body length impacts the length of the kidney, and the more critical it is, the more well-dressed the animal is. The height checks the horizontality of the top at the withers that must be equal to that of the rump, with the ratio (Height Front Behind) for our model is equal to 1±0.01. This type of characteristic meets the standard of the horse adapted to the following race (36,37) that is now approved by the national studs. The typist-thoracic index is 0.11±0.01 expresses the relationship between the mass of a horse and the limbs intended to support it. It must not be less than 0.108 for blood horses which relates a skeleton thickness consistent with weight on return to the results described by Carroll and Huntington (38).

Regarding the body size index (TP / WH), our population's average is 1.09±0.03. Marcenac *et al.* (24) indicate that the horses are compact above 0.90 of these indices. We can thus deduce that our horses studied are among the horses with good tendencies.

The dress colors of the Arabian horses vary almost to infinity. According to Galletier (29), their usual dresses are bai, grey, alezan, and occasionally black, and they are reputed to have thinner skin with prominent blood vessels. All this contributes to the promotion of caloric transfers outwards during exercise leading to decreases in cooling time. The dress color reading of our model shows the dominance of the Alezane at 51.57%, while Bai and grey come in second and third with a percentage of 32.63% and 10.52%, respectively. According to Table 6, the shape of the chamfering is mostly camus at 56.84% out of 95 horses studied. Rhinoceros at 31.58% and square at 11.57% give it a short head with a broad forehead with a concave handlebar (very beautiful camuse head with a noble profile). Ketata (39) describes that the Arabian Thoroughbred has a dry and typical head with a somewhat concave profile, well-opened nostrils, and is characterized by its prominent veins.

Of the 25 parameters studied, 12 parameters express significant variations by sex. We found that males were more significant than females. The effect of sex on height is well known since it is related to the hormonal effect of youth growth that can be used for selection. Size is a genetic trait

with high heritability (34). Males generally perform better than females, resulting from a different morphology, physiology, and hormonal system (40,41).

It shows that the males in our study are taller with tourniquets and rumps, longer (total and scapulo-iliac lengths), with more elongated bony rays (shoulder and cannon), and thicker limbs. These males have the head, shoulders, arms and forearms, thighs and long guns; knees, forelimbs, and wider legs. These results are also reported by the study conducted in Tunisia by Chabchoub (37). Some precautions are to be taken for weight. We cannot conclude when there is a sex difference, given that weights have been estimated (36). The statistical analysis of our study shows that adult horses are taller, longer, and heavier than young ones, with significant or highly significant differences for all variables studied. Doligez and Baudouin (42) report that once growth is complete in 3.5 years for blood horses on average, five years for draught horses, the skeletal system is constantly overhauled, and it is far from complete. The bone reserves calcium and phosphorus dynamically through osteosynthesis and osteolysis, with metabolism governed by two hormones: parathormone and calcitonin and vitamin D. The authors cite that fat mass is more important than muscle mass, and growth ends around the age of 06 when a phase of muscle development follows during which the horse expands.

Martin-Rosset (14) and Paragon *et al.* (43) point out that racehorses are bred in such a way as to reach an adult weight as soon as possible, knowing that early training may delay their growth. Therefore, the dietary scheme should provide for the needs on both levels: growth and intensive sports training. The weight of young racehorse's changes from 200 kg at weaning to 420-450 kg at 07 years old.

Conclusion

This study provided a better understanding of the morphometric characteristics of the Pure Arab Blood Born and Raised in Algeria from a representative sample of 95 heads specialized in horse racing (Hippodrome Kaid Ahmed de Tiaret). This study constitutes a reliable physiological and scientific database for a reasoned selection of horses in this field. The sample studied is close to the standard of the Pure Arab blood horse in general, and it has morphological characteristics with as main characteristics a small size, a compact body, square, and slightly slender. Our model can perform in speed races at different distances, being given that it has specific characteristics of the fast-paced saddle horse, namely the forehead, chest, broad limbs, extended shoulder, back, and short guns. In addition to its broad limbs, this horse has thick joints benefiting from a safe foot. This characteristic is considered an excellent initiation horse to endurance. Our statistical data were significantly superior in males compared to females and adults compared to young.

For this reason, it is recommended that future work separate the results from these categories to obtain more homogeneous and representative data of the model. The elements of this work have direct applications for owners, trainers, and veterinarians in horse racing. The morphometric parameters could be critical components of the racehorse's performance, and they can easily be used for selecting the best horses both in training and for reproduction.

Acknowledgments

Conflict of interest

The authors declare no conflict of interest.

References

1. MARD. Ministry of Agriculture and Rural Development. The Information Systems, Statistics and Foresight Department. 2019. [available at]
2. NODECB. National Office for the Development of Equine and Camel Breeding. 2018. [available at]
3. Lassere JM. Beard (The horse). Berber encyclopedia. 1991;1348-1360. DOI: 10.4000/encyclopedieberbere.1292
4. Taylor RE, Field TG. Scientific Farm Animal Production. 10th ed. England: Pearson Education Limited; 2014. [available at]
5. Lawrence LA. Horse Conformation Analysis. USA: Cooperative Extension; 2001. 10 p. [available at]
6. Evans JW. Horses: A guide to selection, care, and enjoyment. New York USA. 2001;16(3):879. [available at]
7. Parker R. Equine Science. NY: Thomson Delmar Learning; 2002. 188-206 p. [available at]
8. Sadek MH, Al-Aboud AZ, Ashmawy AA. Factor analysis of body measurements in Arabian horses. J Anim breed Genet. 2006;123(6):369-377. DOI: 10.1111/j.1439-0388.2006.00618.x
9. Padilha FGF, Andrade AM, Fonseca ABM, Godoi FN, Almeida FQ, Ferreira AMR. Morphometric measurements and animal-performance indices in a study of racial forms of Brazilian Sport Horses undergoing training for eventing. Revista Brasileira de Zootecnia. 2017;46(1):25-32. DOI: 10.1590/S1806-92902017000100005
10. Anderson TM, McIlwraith CW. Longitudinal development of equine conformation from weanling to age 3 years in the thoroughbred. Equine Vet J. 2004;36(7):563-570. DOI :10.2746/0425164044864507
11. Staniar WB, Kronfeld DS, Hoffman RM, Wilson JA, Harris PA. Weight prediction from linear measures of growing Thoroughbreds. Equine Vet J. 2004;36(2):149-154. DOI: 10.2746/0425164044868585
12. Gucuyener HO, Akcapınar H. Some phenotypic and genetic parameters of Purebred Turkish Arabian horses raised in different stud farms. J Lalahan Livestock Inst. 2011;51(2):55-70. [available at]
13. Yılmaz O and Ertugrul M. Some morphological traits of Thoroughbred horses in Turkey. Agro Life Sci J. 2012;1:157-164. [available at]
14. Martin-Rosset W. Horse feeding, techniques and practices. Nat Inst Agricul Res. 1990;232. [available at]
15. Chabchoub A, Landolsi FY. Study of the morphological parameters of Tunisian Barb horses. Rev Med Vet. 2004;155(1):31-37. [Available at]
16. Nicks B, Delfontaine B, Canart B, Vanderbruggen J, Vandenheede M. Morphological characteristics of Belgian Draft mares. Ann Med Vet. 2006;150(4):247-251. [Available at]

17. Boudjenane I, Touati I, Machmoum M. Body measurements of Arabe Barbe horses in Morocco. Rev Med Vet. 2008;159(3):144-149. [Available at]
18. Guedioura S, Cabaraux JF, Moumene A, Tahraoui A, Nicks B. Morphometric evaluation of barb breed horses and products in Algeria. Ann Med Vet. 2011;155(1):14-22. [Available at]
19. Robert C. Horse report. NY: National Veterinary School of Alfort; 2011. 26. [available at]
20. Schartz D. Statistical methods for the use of doctors and biologists. 4th ed. France: Flammarion Medecine-sciences; 1993. 336 p. [available at]
21. Lamotte L. Initiation to statistical methods in biology. 2nd ed. Paris: Masson; 1971. 144 p. [available at]
22. Chardes A, Boudon X. Arabic (Technical sheets blood horses). France: National Stud Library; 2007. [available at]
23. Metayer N, Biau S, Cochet JL, Barrey E. Study of locomotor and morphological factors of endurance horse performance. Hal Inra. 2003;104:22-44. [Available at]
24. Marcenac LN, Aublet H, Dutheville P. Horse Encyclopedia. 4th ed. Maloine: Veterinary Academic of France; 1981. 123-124 p. [available at]
25. Denoix JM. Exterior and physical examination of the horse, Optional teaching of equine locomotor pathology. Pathol Teach Unit. 2002;249. [available at]
26. Loving NS. Going the distance, all about the endurance horse. Actes Sud. 2004;350. [available at]
27. Anderson TM, Mcilwraith CW, Douay P. The role of conformation in musculoskeletal problems in the racing thoroughbred. Equine Vet J. 2004;36(7):571-575. DOI: 10.2746/0425164044864462
28. Van Weeren PR, Crevier-Denoix N. Equine conformation: Clues to performance and soundness?. Equine Vet J. 2006;38(7):591-596. DOI: 10.2746/042516406x159007
29. Galletier A. The Arabian thoroughbred, Evreux. NY: Editions Atlas; 2011. 125 p. [available at]
30. Goodier J. The horse encyclopaedia. Ref Rev. 2017;31(5):27-28. DOI: 10.1108/RR-03-2017-0057
31. Atger F, Luchez R, Chazel S. Training of model and allures endurance. Judges Saint Pierre du Lorouer. 2011;12:33. [available at]
32. Ancelet E. Equestrian endurance raids. Paris: Crepin-Leblond; 2003. 294 p. [available at]
33. Marks D. Conformation and soundness. NY: AAEP proceedings; 2000. 39-46 p. [available at]
34. Benhamadi M, Mezouar K, Benyarou M, Bouandas A, Gaouar S, bechir S. Morphometric characterization of the equine barbe breed in northwest of Algeria. Genet Biod J. 2017;1(2):48-65. [available at]
35. Jordana J, Pares PM, Sanchez A. Analysis of genetic relationships in horse breeds. J Equine Vet Sci. 1995;15(7):320-328. DOI: 10.1016/S0737-0806(06)81738-7
36. Tamzali Y. The situation of the barb horse in Algeria. Lausanne: World Barb Horse Organization; 1989. 107-115 p. [available at]
37. Rahal K, Guedioura A. Oumouna M. Morphometric parameters of the horse barb from Chaouchaoua, Algeria. Rev Med Vet. 2009;160(12):586-589. [Available at]
38. Carroll CL, Huntington PJ. Body condition scoring and weight estimation of horses. Equine Vet J. 1988;20(1):41-45. DOI: 10.1111/j.2042-3306.1988.tb01451.x
39. Ketata A. Contribution to the study of national stud farms in the breeding of Arabian thoroughbreds in Tunisia [master's thesis]. Tunisia: Veterinary Medicine, Sidi-Thabet, Tunisia; 1980. 84 p.
40. Entin P. Do racehorses and greyhound dogs exhibit a gender difference in running speed?. Equine Comp Ex Physiol. 2007;4(3):135-140. 10.1017/S1478061507851036
41. Van Damme R, Entin P, Vanhooydonc B, Herrel A. Causes of sexual dimorphism in performance traits: A comparative approach. Evolut Ecol Res. 2008;10(2):229-250. [available at]
42. Doligez E, Baudouin N. The foal, growth and development: A practical guide. Nat Stud Farms. 9006;95. [available at]
43. Paragon BM, Blanchard G, Valette JP, Medjaoui A, Wolter R. Zootechnical monitoring of 439 foals in the Basse Normandie region: Weight growth, height and weight estimation. Vet Res Equine. 2000;3-11. [available at]

التوصيف المورفومتري للخيول العربية الأصيلة لسباقات العدو (المولودة والمترعرعة في الجزائر)

أحمد رضا بنية١، سيدي محمد عمار سلسس١ و ناصر بن اعمر٢

١ قسم البيوطبي، معهد العلوم البيطرية، جامعة تيارت، تيارت، الجزائر
٢ قسم علوم الطبيعة والحياة، كلية علوم الطبيعة والحياة، جامعة تيارت، تيارت، الجزائر

الخلاصة

تهدف هذه الدراسة إلى تحديد الخصائص المرفولوجية للخيول العربية الأصيلة التي ولدت وترعرعت في الجزائر والمتخصصة في سباق الخيل (حسب العمر والجنس). تم قياس الدراسة في مضمار سباق الخيل قايد أحمد في تيارت (الجزائر). كان متوسط الارتفاع عند كتف الخيول (ن = ٩٥) ١٥٢,١٥±٥,٠٧ سم ومحيط الصدر ١٦٦,٤٤±٦,٤٣ سم. مقارنتا بالارتفاع عند الكتفين، كان الارتفاع عند الردف أقل قليلا (١٥١,٦١±٤,٧٩ سم) وكان طول الجسم متطابقا تقريبا (١٥٢,٨٢±٦,٣٠ سم) بمتوسط الوزن ٣٩٥,٨٣±٤٠,٥١ كغ حيث تعتبر صغيرة. تبدو أطراف خيولنا سميكة جدا بالنسبة إلى أحجامها بمتوسط محيط المدافع الأمامية والخلفية ١٨,٣٠±٠١,٧٠ سم و ١٩,٦٨±٠١,٧٩ سم على التوالي، وكذلك في التمدد (أطوال الذراع ٣٠ ،٩٠±٠٢,٦٦ سم والساعد ٣١,٧٧±٠٢,٨١ سم). المؤشرات المختلفة المحسوبة تؤهلهم كخيول مدمجة، خفيفة، مربعة وطويلة. تُظهر دراسة لون الخيول هيمنة الأشقر بنسبة ٥١,٥٧٪ وشكل الكمامة يغلب عليها بنسبة ٥٦,٨٤٪ مما يمنحها رأسا قصيرا بجبهة عريضة وكمامة مقعرة. كما حدد التحليل الإحصائي أن الذكور كانوا أكبر من الإناث وكذلك البالغين مقارنة بالشباب.