Animal Health Prod and Hyg (2023) 12 (2) : 27 - 35

Animal Health, Production and Hygiene

www.dergipark.or.tr/tr/pub/aduveterinary

Research Article

# Conformational Characteristics in Arabian and Thoroughbred Horses

İsmail Gökçe YILDIRIM[1*], Hasan ERDEN[1]

*[1]Aydın Adnan Menderes University, Faculty of Veterinary Medicine, Department of Anatomy, Aydın, TÜRKİYE*

**ABSTRACT**

Horses are expected to maintain their racing lives with healthy and high performances. The body structure of an ideal racehorse should have ideal athletic characteristics. By selecting horses with good body structure, it is possible to increase both race achievements and breeding values. Studies are ongoing to evaluate the ideal body structure of horses in an objective and measurable way. This helps identify the strengths and weaknesses of horses. The study was aimed at determining the overall body conformations of Arabian and Thoroughbred racing horses by morphometric measurements. Photographs of Arabian and Thoroughbred horses in standard positions were scaled on a computer to measure angle and length values. Using the data obtained, body structures were tried to be revealed for both races. In addition, structural differences that increased the risk of disability in both races were assessed. There were significant differences between the head, leg, and body structures of Arabian and Thoroughbred horses. Lover length measurements were found for Arabians than for Thoroughbreds. It was noted that differences between the two races were significant, especially in distal extremity measures. It was found that in Thoroughbreds, the rump is generally higher than the withers, and this may result in a greater loading on the forelegs. In addition to identifying the body structures and differences of both races, the results of the study are thought to be useful for selection practises and to contribute to the understanding of the aetiology of disabilities.

***Keywords**: Conformation, morphometry, Thoroughbred, Arabian horse.*

# Arap ve İngiliz Atlarında Konformasyon Farklılıkları

**ÖZET**

Atların yarış hayatlarını sağlıklı ve üst düzey performans ile sürdürmesi istenir. İdeal bir yarış atının vücut yapısı ideal atletik özelliklerde olmalıdır. İyi vücut yapısına sahip olan atların belirlenerek seçilmesi ile hem yarış başarılarının hem de damızlık değerlerinin artması mümkündür. Atlarda ideal vücut yapısının objektif ve ölçülebilir şekilde değerlendirilmesi için çalışmalar devam etmektedir. Bu sayede atların güçlü ve zayıf yönlerinin ortaya koyulması mümkün olmaktadır. Bu çalışmada Arap ve İngiliz yarış atlarında genel vücut konformasyonlarının morfometrik ölçümler ile tespit edilmesi amaçlandı. Arap ve İngiliz atlarının standart duruş halinde yandan çekilmiş fotoğraf görüntüleri bilgisayarda ölçeklendirilerek açı ve uzunluk değerleri ölçüldü. Elde edilen veriler kullanılarak her iki ırk için vücut yapıları ortaya koyulmaya çalışıldı. Bunun yanında her iki ırkta sakatlık riskini arttıran yapısal farklılıklar değerlendirildi. Arap ve İngiliz atlarının baş, bacak ve gövde yapıları arasında önemli farklar olduğu görüldü. Arap atlarının uzunluk ölçümlerinde İngiliz atlarına oranla daha düşük değerlere sahip oldukları görüldü. Açısal ölçümlerde ise iki ırk arasında özellikle distal ekstremite ölçümlerinde farklılıkların önemli olduğu dikkati çekti. İngiliz atlarında genellikle sağrının cidagodan daha yüksek olduğu ve bu durumun ön bacaklara daha fazla yüklenmeye neden olabileceği düşünüldü. Çalışma sonuçlarının her iki ırkın vücut yapılarının ve farklılıklarının tanımlanması yanında seleksiyon uygulamalarına faydalı olacağına ve sakatlıkların etiyolojisinin anlaşılmasına katkı sağlayacağı düşünülmektedir.

***Anahtar Kelimeler**: Konformasyon, morfometri, İngiliz atı, Arap atı.*

***Corresponding author**: İsmail Gökçe YILDIRIM, Aydın Adnan Menderes University, Faculty of Veterinary Medicine, Department of Anatomy, Aydın, TÜRKİYE. gyildirim@adu.edu.tr

Received Date: 23.07.2023 - Accepted Date: 11.10.2023
DOI: 10.53913/aduveterinary.1330533

## Introduction

The horse racing industry is experiencing significant expansion (Belloy and Bathe, 1996). In the year 2022, the Jockey Club of Turkish hippodromes saw a total of 3789 Thoroughbred and 3130 Arabian horses in competition (Türkiye Jokey Kulübü, 2022). The number of racehorses increases every year (Figure 1). The significance of the industry becomes more evident with the incorporation of domains such as horse owners, breeders, attendants, and veterinary provisions.

and McIlwraith, 2004). In Sweden horse, a method is used that was originally developed by Magnuson and Thafvelin (1990) for a study on standardbred trotters.

Thoroughbred horse is the fastest of the world's horse breeds and conformation has an important role in performance of this breed (Bakhtiari and Heshmat, 2009). Among horse breeds such as Thoroughbred, Arabian, and Trotter, it has been found that they have an average higher cidago height and a longer body length (Saastamoinen et al., 1998; Sadek et al. 2006;

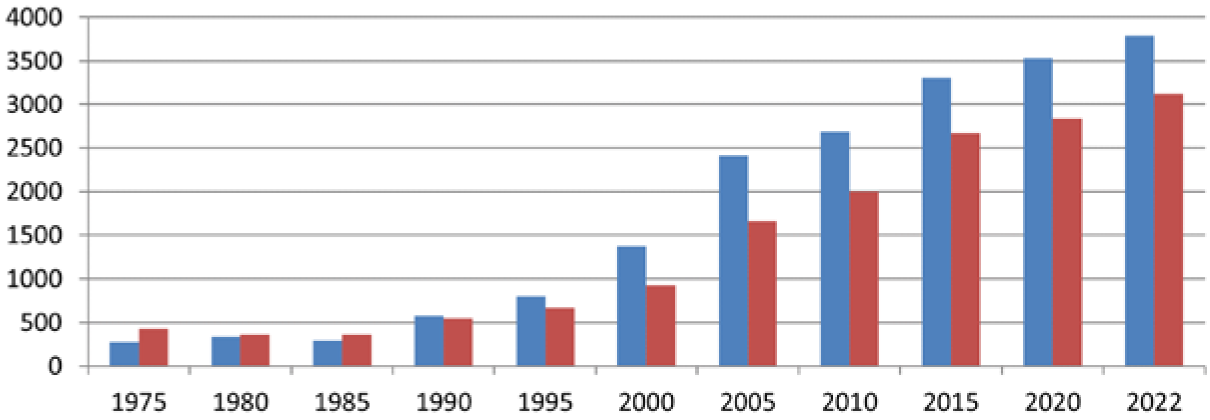


**Figure 1.** Arabian (red bars) and Thoroughbred (blue bars) racing horse population in Jockey Club of Türkiye hippodromes.

In the horse racing industry, it is necessary for horses to maintain healthy racing lives and show the highest level of performance. It is requested that horses can last many years without dividing their racing performance by disabilities (Belloy and Bathe, 1996). Horse injuries are harming the racing industry (Stover, 2003).

Conformation in horses is used to define the body structure suitable for work. The effects on balance and the structural compatibility of conformation in horses have been known for a long time (Green, 1975; Harris, 1993). Working on the relationship between conformation and performance is of great importance (Moore, 2010). Because insufficient knowledge about the effect of conformation on performance and health can lead to the wrong horse selection (Sanchez et al., 2013). The goal of raising racing horses should focus on conformation characteristics (Jakubec et al., 2009). The ultimate goal of the selection programmes is to obtain horses with the ideal conformation characteristics that stand out in sporting performance (Belloy and Bathe, 1996).

Clinical experience has shown that some diseases of the movement system in sports horses are associated with defects in the extremities. It is therefore suggested that conformity information can be used as a pre-selection criterion for racing horses (Dolvik and Klemetsdal, 1999).

Quantitative conformation studies may help us get new data about different breeds (Belloy and Bathe, 1996). Quantitative methods to understand conformation can be used for an objective evaluation, and some studies have been carried out in this area (Fedorski and Pikula, 1988; Delahunty et al., 1991; Mawdsley et al., 1996; Kavazis and Ott, 2003; Stover, 2003; Anderson

Molina et al., 1999; Gharahveysi et al., 2008). The cidago height of adult horses is positively associated with racing performance (Dolvik and Klemetsdal, 1999) and step length (Galisteo et al., 1998). Munahi (2016) studied the head and neck structure of Arabian horses and shared some data. Cervantes et al. (2009) have worked on body structure in Arabian horses and have some values.

The increased incidence of injuries in the front legs, which carry more than 60% of the horse's weight when standing, and more than 40% when carrying it, is supported by the findings of epidemiological studies (Williams et al., 2001; Ely et al., 2004; Perkins et al., 2005; Cogger et al., 2008). The high tensions experienced by the superficial digital tendency (SDFT) undoubtedly contribute to the high incidence of injury (Ely et al., 2015). However, the increasing incidence with age suggests that injury is not caused by a simple mechanical overload (Kasashima et al., 2004). Also, some horses compete at the highest level and never suffer tendon damage (Thorpe et al., 2010). Conformity and incoordination defects are among the causes of SDFT disabilities (Jorgensen et al. 2003; Weller et al. 2006). In a study on carpal joint disabilities, it was found that conformity had a close relationship with the frequency of disability (Steel et al., 2006).

A short, streep croup with a short pelvis is a weak hindquarter. A very flat croup may place the hind legs far back, making it difficult for the horse to engage his hind legs. A long line from hip to hock permits a long stride with better engagement of the hind leg. This goes with short hind cannons and hocks well let down, which is a more powerful conformation (Harris, 1993). Meanwhile, a long and forwardly sloping femur places the hindlimb more under the horse, which allows the horse to keep its balance more easily and carry more weight on the hindlimbs. In standardbred trotters, a positive correlation has been found between stifle angle and performance (Magnusson and Thafvelin, 1990).

The angle of the pastern is important for the equine athlete and crucial to length of stride, ease of gait, and durability. The actual "ideal" angle varies depending on a horse's leg and body conformation. A 45-55 degree angle in the front pasterns is usually appropriate, with a corresponding 49-59 degree angle in the hind pasterns. If pasterns have steeper angles and are too upright, the front legs will suffer excessive concussion, and the horse will ride rough. Pasterns that slope too much with an angle less than 45 degrees tend to be weak and more prone to breakdown (Thomas, 2005).

Conformation data is used to understand the causes of the injuries in addition to evaluating horses breeds (Bakhtiari and Heshmat, 2009; Mostafa and Elemmawy, 2020). Horses with good conformity get better market prices.

The aim of this study is to demonstrate the conformation characteristics of Arabian and Thoroughbred horses in Turkey using objective values. The information obtained makes it possible to reveal the current state of conformation and the differences among these breeds. The results of the study provide information that will help the breeding programmes.

**Materials and Methods**

*Study Population*

In this study, 400 horses were controlled, but only 50 Arabian and 50 Thoroughbred racing horses were used. The horses have not had any orthopaedic problems or injuries, and they were training during the study (Table 1). All horses were healthy and active racehorses. In the selection of horses, the conditions were that they were healthy, had no orthopedic defects, registered in the stud book, and actively participating in races during the study period.

*Photographs Characteristic*

The staff maintains horses' proper body posture on level ground. After a proper body posture was achieved, a photo was taken with a digital camera (Canon EOS 350D) with a resolution of 3456x2304 dpi, from the left side of the horse (Anderson and McIlwraith, 2004; Sadek et al., 2006), from a distance of three metres, using a fixed tripod, in the horizontal plane from the middle point of the body.

*Image Analysis*

All image analysis was performed by the first author (IGY). Photographs were transferred to a computer and calibrated in the Vet Eickemeyer® Medizintechnik für Tierärzte (EIVIS) programme. Each photograph was calibrated using the length of the withers. The following measurements and angles were recorded from the left lateral view of each horse.

*Measuring*

All reference points are shown in Figure 2 and described in Table 2.

*Data Analysis*

The same investigator (IGY) completed all measurements in an attempt to eliminate any possibility of interobserver variability. The statistical analysis of the data was performed using the statistical package program (SPSS 13, IBM SPSS Statistics®, Chicago, IL, USA). The mean, standard deviation, range and minimum-maximum were calculated for each parameter. Student's t-test was used to compare horses. Statistical significance was described at $P<0.05$ level.

**Results**

The study's goal was to find out objectively what Arabian and Thoroughbred horses in Turkey look like in terms of their conformation. The information gathered showed the current conformation values and how these breeds are various (Table 3).

Thoroughbreds have a larger head area than Arabian horses. The nose and neck angles used to assess the structure of the head were found to be larger in Thoroughbred horses, while the angle of the mandibula was smaller. The head was found to have structural differences in Thoroughbreds and Arabian horses.

When measurements were made with regard to the front leg, it was found that all the length values were greater in Thoroughbred horses. While there is no general difference between the field values, it was noted that the front wrist angle and axle values are lower in Thoroughbred horses. When compared to Arabians, it was found that the front wrist structures of Thoroughbreds had a more flexible structure.

In the back legs, length measurements such as the femur, tibia, metatarsus, and rear pastern height were found to have higher values than in Thoroughbreds. *Articulatio coxae, articulatio genu, articulatio tarsi*, and rear hoof angle measurements were statistically higher in Arabian horses.

When measurements of the overall body structure between the two breeds were assessed, it was found that the measurements of the height of the withers, the head height, the length of the body, the back length, the thorax height, the abdomen depth, the front thorax angle, and the croup angle had higher statistical values in Thoroughbreds. The rear thorax angle and abdomen angle measurements were found to have greater values in Arabian horses.

The difference between the conformation structures in the ways in which the values obtained from body measurements of Arabian and Thoroughbred horses are drawn using averages for both breeds is more visible (Figure 3).

In these models drawn from the mean values of the two races, the differences between the length values across the body between the two breeds are usually statistically

**Table 1.** The descriptive properties about the horses in the study.

| Races | Sex | n | Age (year) mean (min-max) | Withers Length (cm) mean (min-max) |
|---|---|---|---|---|
| Arabian | ♂ | 25 | 3.96 (3-4) | 152 (147-155) |
| | ♀ | 25 | 3.68 (3-4) | 151 (145-156) |
| Thoroughbred | ♂ | 25 | 3.40 (3-4) | 165 (160-170) |
| | ♀ | 25 | 3.36 (3-5) | 164 (160-168) |

valuable, and when the angular values for the race are examined, the statistical differences in angular value for the back legs appear to be greater.

It has been found that the height of the withers in Arabian horses is greater than the height of the withers in Thoroughbred horses.

## Discussion

Some values for the conformational characteristics of healthy and injured thoroughbred horses have been reported (Mostafa and Elemmawy, 2020). Between the two studies, the length of the radius, Mc3, femur, tibia, and Mt3 measurements have very similar values. In addition, the angular angles of the carpi, front and rear pastern, hock, and hip also yielded extremely compatible results. When the data are consistent between the two studies, the effect is great because the measurement points are taken from the same anatomical points. This should be taken into account when determining measurement points and taking measurements in conformation studies. Sadek et al. (2006) in their study on Arabians, measured the height of withers as 142 cm (in study 151.56 cm), height of croup 141 cm (in study 148.64 cm), body length as 135 cm (in study 151.62 cm), thorax depth as 51 cm (in study 69.60 cm). Based on the fact that the measured values were higher, it is believed that the Arabian horses used in the study were selected for very long years for racing purposes.

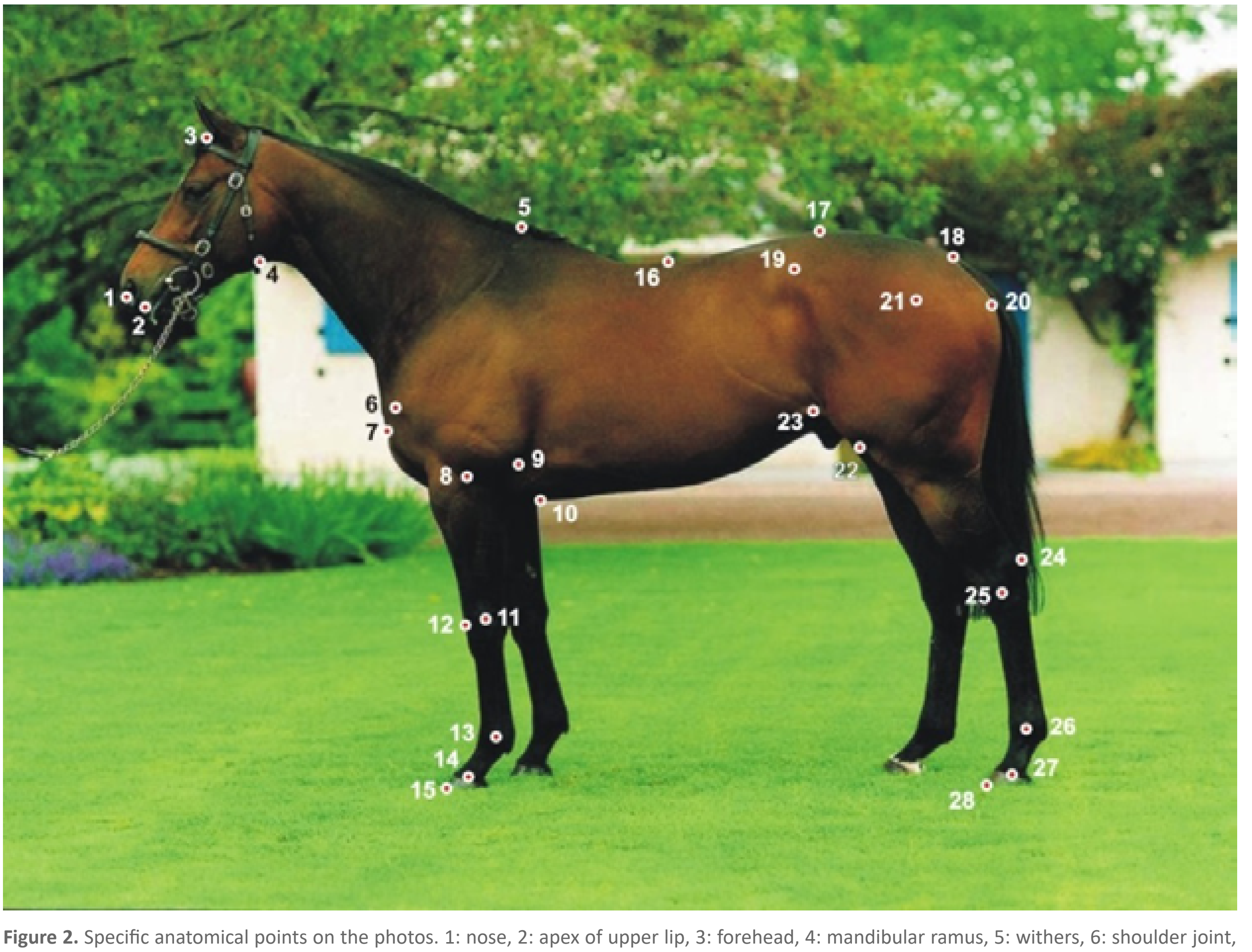


**Figure 2.** Specific anatomical points on the photos. 1: nose, 2: apex of upper lip, 3: forehead, 4: mandibular ramus, 5: withers, 6: shoulder joint, 7: shoulder, 8: elbow joint (midpoint), 9: olecranon, 10: deep point of thorax, 11: mid-carpus, 12: dorsal surface of carpal joint, 13: mid-metacarpophalangeal joint, 14: mid-hoof the coronary band, 15: front hoof apex, 16: deepest point of back, 17: croup, 18: origin of tail, 19: hip, 20: buttock, 21: articulatio coxae, 22: patella, 23: plica lateris, 24: calcaneal tubercle, 25: mid-hock, 26: mid-metatarsophalangeal joint, 27: mid-hoof the coronary band, 28: rear hoof apex

**Table 2.** List of 37 traits of the variables studied.

| Traits | Units | Description |
|---|---|---|
| Head Area | $cm^2$ | Nose to forehead to ramus mandible |
| Nasal Angle | degree | Forehead to nose to ramus mandible |
| Forehead Angle | degree | Nose to forehead to ramus mandible |
| Mandibular Angle | degree | Nose to ramus mandible to forehead |
| Length of Scapula | mm | Prominence of withers to shoulder joint |
| Length of Humerus | mm | Shoulder joint to elbow joint |
| Length of Radius | mm | Elbow joint to mid-carpal joint |
| Length of Mc3 | mm | Mid-carpal joint to mid-metacarpophalangeal joint |
| Height of Front Pastern | mm | Mid-metacarpophalangeal joint to ground |
| Angle of Scapula | degree | Prominence of withers to shoulder joint to a line parallel with the ground (horizontal axis) |
| Shoulder Angle | degree | Scapulohumeral angle: Withers to shoulder joint to lateral epicondyle of humerus |
| Elbow Angle | degree | Shoulder joint to lateral epicondyle of humerus to mid-carpus |
| Carpal Angle | degree | Radius to mid-carpus to mid-metacarpophalangeal joint for carpi |
| Front Pastern Angle | degree | Mid-carpus, along the third metacarpal bone to mid-metacarpophalangeal joint to hoof axis |
| Front Hoof Pastern Axis | degree | Mid-metacarpophalangeal joint to mid-hoof the coronary band to hoof axis |
| Front Hoof Angle | degree | Dorsal surface of the front hoof to a line parallel with the ground |
| Length of Femur | mm | Greater trochanter of femur to lateral condyle of the tibia |
| Length of Tibia | mm | Lateral condyle of the tibia to mid-hock at the talus |
| Length of Mt3 | mm | Mid-hock to mid-metatarsophalangeal joint |
| Height of Rear Pastern | mm | Mid-metatarsophalangeal joint to ground |
| Coxae Angle | degree | Tuber coxae to articulatio coxae to patella |
| Genu Angle | degree | Articulatio coxae to patella to mid-hock |
| Hock Angle | degree | Patella to mid-hock to mid-metatarsophalangeal joint |
| Rear Pastern Angle | degree | Mid-hock to, along the third metatarsal bone to mid-metatarsophalangeal joint to hoof axis |
| Rear Hoof Pastern Axis | degree | Mid-metatarsophalangeal joint to mid-hoof the coronary band to hoof axis |
| Rear Hoof Angle | degree | Dorsal surface of the rear hoof to a line parallel with the ground |
| Wither Height | mm | Highest point of withers to ground. |
| Croup Height | mm | Highest point of croup to ground. |
| Body Length | mm | Shoulder to buttock |
| Back Length | mm | Withers to croup |
| Thoracic Depth | mm | Withers to deep point of thorax |
| Abdomen Depth | mm | Croup to plica lateralis |
| Front Thorax Angle | degree | Withers to shoulder joint to deep point of thorax |
| Rear Thorax Angle | degree | Withers to articulatio coxae to deep point of thorax |
| Back Angle | degree | Withers to the deepest point of back to croup |
| Abdomen Angle | degree | Shoulder to deep point of thorax to plica lateralis |
| Croup Angle | degree | Croup to origin of tail to a line parallel with the ground |

Pura Raza Espanola horses they used in their study were obtained in the past by melting Arabian and Thoroughbred horses. Pura Raza Espanola horses have been as height of withers 157.89 cm, heights of croup 158.02 cm (Sanchez et al., 2013). In study, Thoroughbred horses had a height of withers of 164.98 cm and a height

**Table 3.** The conformational measurements on the horses (mean and standard deviation)

| Measurement | n | Arabian | n | Thoroughbred | P |
|---|---|---|---|---|---|
| Head Area | 46 | 76.47 (11.02) | 44 | 83.20 (12.71) | 0.005 |
| Nasal Angle | 46 | 43.60 (2.08) | 44 | 44.44 (1.74) | 0.042 |
| Forehead Angle | 46 | 56.00 (4.59) | 44 | 58.58 (3.46) | 0.003 |
| Mandibular Angle | 46 | 81.31 (4.79) | 44 | 77.43 (4.26) | 0.000 |
| Length of Scapula | 50 | 57.50 (4.03) | 50 | 60.88 (2.92) | 0.000 |
| Length of Humerus | 50 | 26.65 (2.74) | 50 | 29.76 (2.55) | 0.000 |
| Length of Radius | 50 | 42.12 (2.82) | 50 | 45.94 (29.59) | 0.000 |
| Length of Mc3 | 50 | 27.33 (1.88) | 50 | 29.95 (1.77) | 0.000 |
| Height of Front Pastern | 50 | 16.67 (1.10) | 50 | 17.98 (1.10) | 0.000 |
| Angle of Scapula | 50 | 56.38 (4.43) | 50 | 56.71 (4.47) | 0.717 |
| Shoulder Angle | 50 | 102.51 (4.76) | 50 | 101.01 (5.05) | 0.130 |
| Elbow Angle | 50 | 116.36 (10.45) | 50 | 114.06 (4.21) | 0.152 |
| Carpal Angle | 50 | 180.59 (1.47) | 50 | 181.06 (1.82) | 0.163 |
| Front Pastern Angle | 50 | 150.25 (4.91) | 50 | 144.38 (4.94) | 0.000 |
| Front Hoof Pastern Axis | 49 | 168.30 (3.77) | 50 | 171.16 (6.14) | 0.006 |
| Front Hoof Angle | 49 | 54.67 (2.11) | 50 | 53.88 (3.27) | 0.157 |
| Length of Femur | 50 | 44.83 (3.51) | 50 | 49.24 (3.52) | 0.000 |
| Length of Tibia | 50 | 48.88 (4.92) | 50 | 55.75 (4.29) | 0.000 |
| Length of Mt3 | 50 | 33.91 (2.86) | 50 | 36.22 (2.56) | 0.000 |
| Height of Rear Pastern | 50 | 16.79 (1.24) | 50 | 18.83 (1.22) | 0.000 |
| Coxae Angle | 48 | 98.72 (7.66) | 50 | 89.70 (8.05) | 0.000 |
| Genu Angle | 49 | 126.78 (6.38) | 50 | 123.58 (6.11) | 0.013 |
| Hock Angle | 48 | 146.19 (3.71) | 50 | 144.19 (2.98) | 0.004 |
| Rear Pastern Angle | 49 | 155.78 (4.50) | 50 | 154.52 (4.89) | 0.186 |
| Rear Hoof Pastern Axis | 47 | 170.67 (4.93) | 50 | 171.97 (6.07) | 0.251 |
| Rear Hoof Angle | 47 | 58.50 (1.73) | 50 | 56.56 (3.32) | 0.001 |
| Wither Height | 50 | 151.56 (2.96) | 50 | 164.98 (2.81) | 0.000 |
| Croup Height | 50 | 148.64 (6.09) | 50 | 166.12 (6.73) | 0.000 |
| Body Length | 50 | 151.62 (7.40) | 50 | 163.69 (4.79) | 0.000 |
| Back Length | 50 | 74.99 (4.44) | 50 | 81.96 (4.68) | 0.000 |
| Thoracic Depth | 50 | 69.60 (2.92) | 50 | 75.38 (2.14) | 0.000 |
| Abdomen Depth | 50 | 54.24 (3.56) | 50 | 56.66 (2.81) | 0.000 |
| Front Thorax Angle | 50 | 78.01 (3.00) | 50 | 80.50 (2.80) | 0.000 |
| Rear Thorax Angle | 50 | 39.75 (2.47) | 50 | 38.56 (1.91) | 0.008 |
| Back Angle | 50 | 152.65 (3.72) | 50 | 153.25 (2.81) | 0.372 |
| Abdomen Angle | 50 | 145.08 (4.73) | 50 | 140.60 (3.70) | 0.000 |
| Croup Angle | 50 | 20.29 (1.60) | 50 | 22.73 (1.75) | 0.000 |

Measurements were made using units “cm and degree”

of croup of 166.12 cm. Height of withers 151.56 cm, height of croup148.64 cm were found in Arabian horses. These values for Pura Raza Espanola horses were found to be close to the averages of the two breeds.

According to the results obtained in a study on Arabian horses (Cervantes et al., 2009); height of withers 150.02cm (in study 151.56 cm) , length of scapula 60.64 cm (in study 57.50 cm), body length 147.64 cm (in study 151.62 cm) , length of back 104.74 (in study 74.99 cm), height of thorax 62.56 cm (in study 69.60 cm), length of radius 41.25 cm (in study 42.12), length of metacarpus 25.63 cm (in study 27.33 cm), length of metatarsus 34.74 cm (in study 33.91 cm) was reported. These measurements appear to be compatible with our work. Cervantes et al. (2009) found in angular measurements; art. cubiti angle 30.97 degree (in study 116.36 degree), front pastern angle 56.94 degree (in

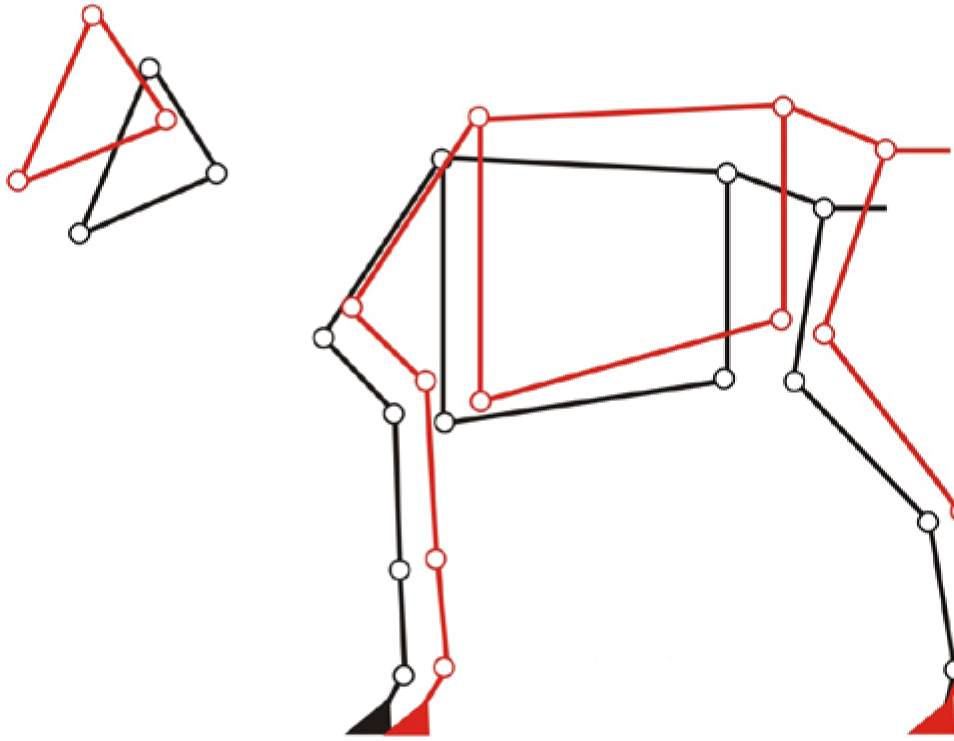

**Figure 3.** Schematic representation of Arabian and Thoroughbred horses in accordance with the average results obtained in the study.

study 150.25 degree), rear pastern angle 59.43 degree (in study 155.78 degree). The difference between the two measurements is thought to be due to the use of the angle between the joint and the horizontal axis in studies by Cervantes et al. It is thought and suggested that measuring the angle between the bones that form the joint in the measurement of joint angles can reduce the difference between studies.

A study on the body structure of Thoroughbred horses found that the length of humerus 29.97 cm (in study 29.76 cm), length of radius 43.38 cm (in study 45.94 cm), length of Mc3 30.25 cm (in study 29.95 cm), scapula angle 55.54 degree (in study 56.71 degree), shoulder angle 104.90 degree (in study 101.01 degree), carpal angle 181.38 degree (in study 181.06 degree) results are consistent with our study (Andersson and McIlwraith, 2004). The difference in measurements between the two studies is believed to be due to the measurement difference in the front pastern angle 54.24 degree (in study 144.38), and rear pastern angle 52.85 degree (in study 154.52 degree).

The horse may move forward with a direct driving force from its hind legs. A horse's speed and agility are significantly influenced by its hindquarter angles. More range of movement and typically greater agility are characteristics of a horse with acute angles and a longer swing of the leg. Wide angles and a shorter stride enable him to normally outrun the horse while exerting less effort (Thomas, 2005). According to our research, Arabian horses' back legs are shorter on average, and higher angular values could shorten their steps and put them in risk.

The front pastern and nail angles should ideally be between 45 and 55 degrees; greater angles could result in more trauma to the front legs, whilst lower values would make the legs weaker since they are too inclined (Thomas, 2005). Andersson and McIlwraith (2004) on Thoroughbred horses as front hoof angle 48.01degree (in study 53.88 degree), rear hoof angle 48.28 degree (in study 56.56 degree). In study, we found that hoof angles have higher values. Higher angular and axial values in Arabian horses were hypothesised to affect the prevalence of impairments in this location in our investigation. Researchers believe that studies on the incidence of disabilities in the front wrist region between the two breeds will be more obvious.

In our research, we discovered that both Arabian and Thoroughbred horses had high hoof angles. This circumstance has been interpreted in such a way that the frequency of impairments may increase in tandem with the observation of values below the required axis angles of 180 degrees. Hoof maintenance and trimming should be performed more frequently and at the proper angles on racehorses.

For optimal agility, balance, and locomotion, the croup and withers should be the same height. If the croup is higher than the withers, the rear legs are disproportionately longer than the front legs, which can cause stride and forging issues. A croup that is too elevated causes the saddle to move forward over the withers. The long hind legs provide the rider with more propulsion with each stride, resulting in a more uncomfortable voyage (Thomas, 2005). Changes in conformation shift the centre of gravity forward and cause variations in gait and leaping techniques, placing asymmetrical loads on the musculoskeletal system and predisposing the individual to jump (Ross and Dyson, 2011). Higher values for the height of the cidago in Thoroughbred horses would cause the body weight to place a greater burden on the front legs, according to the results of our study. This should not be overlooked because it can result in injuries to the front legs, particularly in high-performance horses. This should be considered during the selection programs.

The sacral slope has allowed horses to extend their hind legs and gallop faster (Thomas, 2005). This information led to the conclusion that Thoroughbred horses had larger sacrum angles than Arabians.

It has been hypothesised that the differences in certain conformational values are the result of different measurement sites (Belloy and Bathe, 1996). In order to eliminate these disparities, it will be possible to establish more standardised measurement points and decrease measuring disparities between studies. Although much progress has been made in the determination of body structure in the cattle industry, it is thought that more studies should be done on this issue in the horse industry.

The study examined differences in cranium structure between Thoroughbred and Arabian horses. The larger angle of the mandible in Arabian horses was interpreted as indicating that the upper respiratory system has a larger area to settle. Due to their lengthy heads and faces, it was believed that Thoroughbreds had a large nose and forehead angle. It is believed that in-depth research is required to disclose the potential consequences of these structural differences in the head region between breeds.

Limitation of this study: The purpose of the study was to compare and contrast the conformation structures of Arabian and Thoroughbred horses. Therefore, an equal number of females and males measurements were obtained, and the effect of gender was not considered in statistical comparisons.

## Conclusion

The horse's body structure must be proportional to the labour it performs. This is particularly significant in horse competition. Otherwise, the horse's racing career will be brief. Only horses with optimum conformation should be selected for breeding purposes. Using morphometric measurements such as length and angle, the research aimed to establish the body structure and reference values of Arabian and Thoroughbred horses. It is believed that the results could be useful for Arabian and Thoroughbred horse industry. It is expected that this study will make a scientific contribution to the horse industry and form the basis for future research on breeder selection and racing performance.

## Acknowledgements

This research was supported by the Aydın Adnan Menderes University Research Foundation (VTF-06014) and was part of the unpublished master's thesis of the first author.

The study summary was presented orally at the VII. National Veterinary Anatomy Congress, Antalya, Türkiye.

## Conflict of interest

The authors declare that they have no conflict of interest in this study.

## References

Anderson, T.M., & McIlwraith, C.W. (2004). Longitudinal development of equine conformation from weanling to age 3 years in the Thoroughbred. *Equine Veterinary Journal*, 36(7), 563–570. https://doi.org/10.2746/0425164044864507

Bakhtiari, J., & Heshmat, G. (2009). Estimation of genetic parameters of conformation traits in Iranian Thoroughbred horses. *Livestock Science*, 123 (2-3), 116-120. https://doi.org/10.1016/j.livsci.2008.10.014

Belloy, E., & Bathe, A.P. (1996). The importance of standardising the evaluation of conformation in the horse. *Equine Veterinary Journal*, 28(6), 429–430. https://doi.org/10.1111/j.2042-3306.1996.tb01613.x

Cervantes, I., Baumung, R., Molina, A., Drum, I.T., Gutierrez, J.P., Solkner, J., & Valera, M. (2009). Size and shape analysis of morphofunctional traits in the Spanish Arab horse. *Livestock Science*, 125(1), 43-49. https://doi.org/10.1016/j.livsci.2009.03.006

Cogger, N., Evans, D.L., Hodgson, D.R., Reid, S.W., & Perkins, N. (2008). Incidence rate of musculoskeletal injuries and determinants of time to recovery in young Australian Thoroughbred racehorses. *Australian Veterinary Journal,* 86(12), 473–480. https://doi.org/10.1111/j.1751-0813.2008.00359.x

Delahunty, D.A., Webb, S.P., Kelly, E.P., & Smith, F. (1991). Intermandibular width and cannon bone length in "winners" versus "others". *Journal of Equine Veterinary Science*, 11, 258-259.

Dolvik, N.I., & Klemetsdal, G. (1999). Conformational Traits of Norwegian Cold-blooded Trotters: Heritability and the Relationship with Performance. *Acta Agriculture Scandinavica Section A-Animal Science,* 49, 156-162. https://doi.org/10.1080/090647099424060

Ely, E.R., Verheyen, K.L., & Wood, J.L. (2004). Fractures and tendon injuries in National Hunt horses in training in the UK: a pilot study. *Equine Veterinary Journal*, 36(4), 365–367. https://doi.org/10.2746/0425164044890607

Fedorski, J., & Pikula, R. (1988). Heritability of some body conformation traits in the Thoroughbred horse. *Animal Science Papers and Reports*, 3, 53–57.

Galisteo, A.M., Cano, M.R., Morales, J.L., Vivo, J., & Miró, F. (1998). The influence of speed and height at the withers on the kinematics of sound horses at the hand-led trot. *Veterinary Research Communications*, 22(6), 415–423. https://doi.org/10.1023/a:1006105614177

Gharahveysi, S., Kashan, N.E.J., Gerami, A., & Torshizi, R.V. (2008). Estimation of genetic parameters of Iranian Arab Horses population. *Pakistan Journal of Biological Sciences*, 11 (2), 280–284. https://doi.org/10.3923/pjbs.2008.280.284

Green, B.K. (1975). Horse Conformation as to Soundness and Performance. Northland Press.

Harris, S.E. (1993). Horse Gaits, Balance, and Movement. Wiley Publishing, Inc., Hoboken, New Jersey. 19-74.

Jakubec, V., Vostry, L., Schlote, W., Majzlik, I., & Mach. K. (2009). Selection in the genetic resource: genetic variation of the linear described type traits in the Old Kladrub horse. *Archiv Tierzucht 52*(4), 343-355. https://doi.org/10.5194/aab-52-343-2009

Jorgensen, J., Genovese, R., Ross, M., & Dyson, S. (2003). Superficial digital flexor tendonitis. In M.W. Ross & S.J. Dyson (Eds.), *Diagnosis and Management of Lameness in the Horse*, 628-643. https://doi.org/10.1016/B978-0-7216-8342-3.50077-2

Kasashima, Y., Takahashi, T., Smith, R.K., Goodship, A.E., Kuwano, A., Ueno, T., & Hirano, S. (2004). Prevalence of superficial digital flexor tendonitis and suspensory desmitis in Japanese Thoroughbred flat racehorses in 1999. *Equine Veterinary Journal*, 36(4), 346–350. https://doi.org/10.2746/0425164044890580

Kavazis, A.N., & Ott, E.A. (2003). Growth rates in thoroughbred horses raised in Florida. *Journal of Equine Veterinary Science*, 23(8), 353–357. https://doi.org/10.1016/S0737-0806(03)01024-4

Magnusson, L.E., & Thafvelin B.C. (1990). Studies on the Conformation and related traits of Standardbred Trotters in Sweden, *Journal of Animal Breeding and Genetics*, 107(1-6), 135-148. https://doi.org/10.1111/j.1439-0388.1990.tb00019.x

Mawdsley, A., Kelly, E.P., Smith, F.H., & Brophy, P.O. (1996). Linear assessment of the Thoroughbred horse: an approach to conformation evaluation. *Equine Veterinary Journal,* 28(6), 461-467.

Molina, A., Valera, M., Santos, D.R., & Rodero, A. (1999). Genetic parameters of morphofunctional traits in Andalusian horse. *Livestock Production Science,* 60(2-3), 295–303. https://doi.org/10.1016/S0301-6226(99)00101-3

Moore, J. (2010). General Biomechanics: The horse as a biological machine. *Journal of Equine Veterinary Science* 30(7), 379-383. https://doi.org/10.1016/j.jevs.2010.06.002.

Mostafa, M.B., & Elemmawy, Y.M. (2020). Relationships between morphometric measurements and musculoskeletal disorders in jumping Thoroughbred horses. *Journal Of Equine Science,* 31(2), 23–27. https://doi.org/10.1294/jes.31.23

Munahi, AK. (2016). Anatomical parameters of head and neck with referring to their conformation of Local Arabian Horses, *Al-Qadisiyah Journal of Veterinary Medicine Sciences* 15(1), 58-69.

Perkins, N.R., Reid, S.W., & Morris, R.S. (2005). Risk factors for musculoskeletal injuries of the lower limbs in Thoroughbred racehorses in New Zealand. *New Zealand Veterinary Journal,* 53(3), 171–183. https://doi.org/10.1080/00480169.2005.36502

Ross, M.W., and Dyson, S.J. (2011). Diagnosis and Management of Lameness in the Horse, 2nd ed. (eds*.),* Elsevier Saunders, St. Louis. pp. 16–32. https://doi.org/10.1016/C2009-0-50774-X

Saastamoinen, M.T., Suontama., M., & Ojala, M. (1998). Heritability of conformation traits and their relationships to racing performance in the Finnhorse Trotter. *Proceedings of the 6th World Congress on Genetic Applied to Livestock Production,* Armidale, Australia.

Sadek, M.H., Al-Aboud, A.Z., & Ashmawy, A.A. (2006). Factor analysis of body measurements in Arabian horses. *Journal Of Animal Breeding and Genetics = Zeitschrift Fur Tierzuchtung Und Zuchtungsbiologie*, 123(6), 369–377. https://doi.org/10.1111/j.1439-0388.2006.00618.x

Sanchez, M.J., Gomez, M.D., Pena, F., Monterde, J.G., Morales, M.A., & Valera, M. (2013). Relationship between conformation traits and gait characteristics in Pura Raza Espanol horses, *Archiv Tierzucht,* 56(13), 137-148. https://doi.org/10.7482/0003-9438-56-013

Steel, C.M., Hopper, B.J., Richardson, J.L., Alexander, G.R., & Robertson, I.D. (2006). Clinical findings, diagnosis, prevalence and predisposing factors for lameness localised to the middle carpal joint in young Standardbred racehorses. *Equine Veterinary Journal*, 38(2), 152–157. https://doi.org/10.2746/042516406776563332

Stover, S.M. (2003). The epidemiology of Thoroughbred racehorse injures. *Clinical Techniques In Equine Practice*. 2(4), 312–322. https://doi.org/10.1053/j.ctep.2004.04.003.

Thomas, H.S. (2005). *The Horse Conformation Handbook*. Versa Pres, United States; 105-190

Thorpe, C.T., Clegg, P.D., & Birch, H.L. (2010). A review of tendon injury: why is the equine superficial digital flexor tendon most at risk? *Equine Veterinary Journal*, 42(2), 174–180. https://doi.org/10.2746/042516409X480395

Türkiye Jokey Kulübü (2022). *Arabian and Thorughbred Horse Population in Turkey.* https://www.tjk.org/TR/YarisSever/Static/Page/AyrintiliIstatistikler (accessed 6 June 2023).

Weller, R., Pfau, T., Verheyen, K., May, S.A., & Wilson, A.M. (2006). The effect of conformation on orthopaedic health and performance in a cohort of National Hunt racehorses: preliminary results. *Equine Veterinary Journal*, 38(7), 622–627. https://doi.org/10.2746/042516406x159034

Williams, R.B., Harkins, L.S., Hammond, C.J., & Wood, J.L. (2001). Racehorse injuries, clinical problems and fatalities recorded on British racecourses from flat racing and National Hunt racing during 1996, 1997 and 1998. *Equine Veterinary Journal*, 33(5), 478–486. https://doi.org/10.2746/042516401776254808