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Research Article

Estimating the Body Weight of Byzantine Dogs from the Theodosius Harbour at Yenikapı, Istanbul [1]

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Abstract

In the present study, humeral and femoral midshaft circumferences were used in the weight estimation of dogs from the ancient site of the Theodosius Harbor in Istanbul. According to the calculations taken on each humerus and femur, body weight distribution of the Byzantine dogs from the Theodosius harbour was observed to be 7.953-22.385 kg. The relative ease to accommodate Terrier-size dogs in urban environments may have led to a preference for such breeds in Constantinople. It is possible that these 'light- and medium-sized mesocephalic dogs' were also used as 'alarm' guards in Constantinople. We suggest that the presence of several bones in the Yenikapı excavation area may indicate that dogs were simply buried or dumped as rubbish after death in everyday life in Constantinople.

Keywords: *Body weight, Byzantine dogs, Theodosius harbour, Yenikapı*

İstanbul Yenikapı Theodosius Limanından Bizans Köpeklerinin Vücut Ağırlığı Tahmini

Özet

Bu çalışmada, humeral ve femoral orta şaft çevreleri kullanılarak İstanbul Theodosius antik limanından elde edilen köpeklerin vücut ağırlıkları tahmin edildi. Her bir humerus ve femur'dan yapılan hesaplamalara göre, Theodosius limanı Bizans köpeklerinin vücut ağırlığı dağılımı 7.953-22.385 kg oldukları tespit edildi. Şehirleşmiş bölgelerde Terrier ebatında (büyüklüğünde) köpeklerin beslenmesinin nispeten daha kolay olduğunun bilinmesi gerçeği Konstantinapolis'de bu ırklara benzer köpeklerin bakılmasının tercih edildiği fikrine ulaşmamızı sağlayabilir. Muhtemelen Konstatinapolis'te bu "küçük ve orta büyüklükteki mezosefalik köpekler" bekçi köpeği olarak kullanıldılar. Yenikapı kazı alanındaki fazlaca kemik varlığının Konstantinapolis'in günlük yaşantısında köpeklerin ölümlerinden sonra basitçe gömülmüş veya çöp olarak atılmış olduğuna işaret ettiğini düşünmekteyiz.

Anahtar sözcükler: *Vücut ağırlığı, Bizans köpekleri, Theodosius limanı, Yenikapı*

INTRODUCTION

The body size of an animal is one of the most important ecological factors and crucial with respect to the mechanical properties of the skeleton in animals [1,2]. Besides, it is related to biomechanical and physiological demands [3]. Many life-history traits of animal species are correlated with body size [2,4]. Therefore, the interspecific frequency distribution of animal body sizes has long been a subject of interest [4].

Most analyses of body size relations begin by converting or transforming observed values into their logarithms. It has been reported that logarithmic transformation is a

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simple device to ease and improve diagrammatic and statistical descriptions of the effect of body size on other attributes [2].

The morphological appearance of animals has a marked effect on an animal's life history. Besides, body size is of major importance in the morphologies of animals [2,5]. Regressions of postcranial dimensions and various skeletal measurements relative to body mass have been used for estimating body size in a wide variety of mammals [3]. Therefore, it has been possible to form a logical estimate of the body weight and size and morphologies of animals [6-10]. Although dental and craniometric measurements, which are more intensively studied and easily available in archaeological sites, have been more frequently used [11,12], especially in both extant and extinct carnivores, it has been accepted that osteometric measurements of the long bones provide more reliable estimates of body mass [6]. Various scholars have used different formulations based on diameters and circumference of the long bones [1,6,8,10,13-18]. Therefore, body weight has been estimated by using these measures.

The Yenikapı excavation area covers an area of 58.000 square meters located 1.5 km inland from the Marmara Sea *(Fig. 1)*. In 2004, preliminary archaeological excavations conducted under the auspices of the Istanbul Archaeological Museum at the Yenikapı unearthed the remains of Constantinople's Theodosius Harbour [19-22]. The harbour was built by emperor Theodosius I (A.D. 379-395) to sustain the growing capital of the eastern Roman Empire.

Excavations at Yenikapı provided skeletal remains belonging to a large variety of aquatic and terrestrial species including, notably, horses, then dogs, cattle, sheep, dolphins, pigs, camels [21,23]. Animal bones are usually in a fragmentary condition and scattered across the excavation site.

In this study, further to our previous study performed on the Yenikapı Byzantine dogs [20]; we examined humeral and femoral circumferences, and tried to estimate the body weight of those dogs. Thus, we aimed to provide information about the morphological evaluation of the Byzantine dog population.

MATERIAL and METHODS

A total of 500 skulls of Yenikapı Byzantine dogs had previously been examined with to respect to typology [20]. In this study we used long bones (humerus and femur) of the dogs unearthed from the Yenikapı Metro and Marmaray Excavations which dates the time period to between the Early Byzantine (4th-7th centuries) and the Late Byzantine periods (15th century) [24].

As the first step in estimating body weights, osteometric measurements (humeral and femoral midshaft circumference measurements) of the long bones were taken and the calculation was carried out with the aid of formulations proposed by other authors for estimation of the body weight of carnivores [6,10,17]. As it is considered a reliable method, the "Anyonge equations" were used in estimating body weights in this study [6], as quoted by Onar [17].

Fig 1. Yenikapı excavation area [23]

Şekil 1. Yenikapı kazı alanı [23]

The following formulae were used:

Body weight in grams = $10^{(2.88 \times \log (f)) - 3.4}$

Body weight in grams = $10^{(2.47 \times \log (h)) - 2.72}$

Log (f): femoral circumference taken at the midpoint on the long axis.

Log (h): humeral circumference taken at a point 35% back from the distal end of the humerus.

The long-bone measurements obtained are shown in *Fig. 2*.

The body weight obtained were then compared with values from contemporary canine breed [25,26], and other mediaval [27] and Iron-Age archaelogical sites [17]. This was how we obtained data that would give an idea of the size and morphologies of the Yenikapı Byzantine dogs.

Fig 2. Long-bone measurements. Left: humerus (posterior view); right: femur (posterior view); HC - humeral circumference; FC - femoral circumference

Şekil 2. Uzun kemik ölçümleri. Sol: humerus (arkadan görünüş); sağ: femur (arkadan görünüş); HC - humerus çevresi; FC - femur çevresi

RESULTS

Humerus and femur mid-shaft circumferences were measured for both the right and left bones unearthed from the Yenikapı Excavations. A total of 97 humeri and 94 femurs were used in this study. Body weights were considered in six groups to better understand the distribution (5-10 kg; 10-15 kg; 15-20 kg; 20-25 kg; 25-30 kg and 30 kg and upper). Osteometric data obtained from the humerus and femur of Yenikapı Byzantine dogs and estimated body weights are given in *Table 1* and *Table 2*.

According to the calculations conducted on each humerus and femur, body weight distribution was observed to be within the 11-15 kg and 16-20 kg ranges. The curves showing this distribution are given below *(Fig. 3)*.

Our results were calculated where the right and left bones are not separated. As a result of the calculations on the humeral and femoral midshaft circumference, it was observed that the occurrence of heavy-bodied dogs (31 kg and upper) is less common.

DISCUSSION

In the present study, humeral and femoral midshaft circumferences were used in weight estimation. These measurements are highly correlated with an animal's body weight for living terrestrial vertebrates [6,13]. The skull typology of Byzantine dogs from the Theodosius Harbour at Yenikapı had been determined in an earlier study [20]. Craniometric data for these dogs were used for comparison with modern breeds in that study. However, body conformation has not been considered. It is believed that this calculation method for body weight offers a clearer picture of the dog's conformation. The body weight distribution of the Byzantine dogs from the Theodosius harbour was observed to be within the range of 7.953-22.385 kg (according to the femoral calculations). Results show that the majority (84.05%) of the Byzantine dogs from the Yenikapı excavations were in the above range. This range shows similarities with the medieval mesocephalic

Table 1. *Estimated body weight according to humerus midshaft circumference*
Tablo 1. *Humerus orta şaft çevresine göre vücut ağırlığı tahmini*

Statistical Values	Body Weight					
	5-10 kg	11-15 kg	16-20 kg	21-25 kg	26-30 kg	31 kg and upper
N	32	54	42	32	15	16
Min	4.733	10.248	15.208	19.473	25.039	31.120
Max	9.948	14.718	19.488	24.476	28.496	46.993
Mean	7.955	12.054	17.221	22.253	26.406	36.556
%	16.75	28.27	21.99	16.75	7.85	8.38

Table 2. *Estimated body weight according to femur midshaft circumference*
Tablo 2. *Femur orta şaft çevresine göre vücut ağırlığı tahmini*

Statistical Values	Body Weight					
	5-10 kg	11-15 kg	16-20 kg	21-25 kg	26-30 kg	31 kg and upper
N	20	28	17	14	6	9
Min	4.733	10.248	15.215	20.155	25.250	31.120
Max	9.820	14.660	19.488	24.476	26.360	45.386
Mean	7.953	11.884	16.992	22.385	25.830	36.466
%	21.28	29.79	18.09	14.89	6.38	9.57

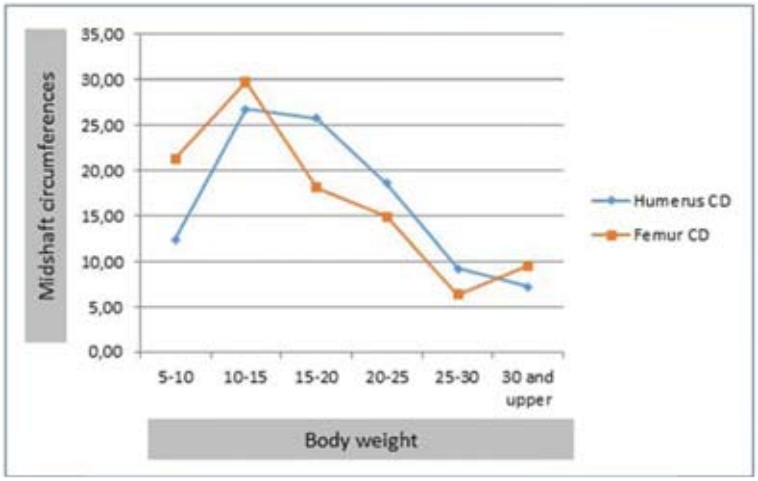

Fig 3. The distribution curve of body weight calculated from humerus and femur midshaft circumferences

Şekil 3. Humerus ve femur orta şaft çevrelerinden hesaplanan vücut ağırlığının dağılım eğrisi

dogs from the excavations at Novgorod in Russia [27]. In that study, by using humeral and femoral circumferences on medieval dogs from Novgorod, Russia (X-XIV century), it has been reported that these dogs range from size of the modern Finnish Spitz (6.8 kg) to that of the Harrier (23.1 kg), and this research showed that the "classical" light- and medium-sized mesocephalic dogs were the most widespread in that city [27]. Body weight distribution of the Van-Yoncatepe dogs unearthed from the necropolis of the Van-Yoncatepe Castle in Eastern Anatolia, which dates back to the beginning of the 1st millennium BC (Early Iron Age), was observed to be in the range of 20.963-28.105 kg. These dogs were considered to form part of the group of large-size dolichocephalic dogs [17].

When we compared the data obtained from the estimated body weight of the Yenikapı Byzantine dogs with that of today's dog breeds [25,26] and other archaeological sites [17,27], we concluded that the Yenikapı Byzantine dogs were close to the light- and medium-sized mesocephalic breeds. In addition, it is thought that the remains from the Yenikapı excavations generally represent various mesocephalic breeds growing slightly larger than Terrier breeds. The relative easy accommodation of Terrier-size dogs in urban environments may have led to a preference for such breeds in Constantinople. It is possible that these 'light- and medium-sized mesocephalic dogs' were also used as 'alarm' guards in Constantinople; given that these dogs need less food for maintenance in everyday life than larger breeds. For this reason, it has been possible to assume that, while the light-sized mesocephalic might have been used as pets, larger individuals served as 'alarm' guard partners.

In conclusion, we discussed the results of body conformation by using body weight estimations on adult dogs from Constantinople's Theodosius harbour in the present paper. There is no evidence that the dog's meat was consumed in Constantinople. We suggest that the presence of several bones in the Yenikapı excavation area may indicate that in everyday life dogs were simply buried or dumped as rubbish after death in Constantinople.

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