



Original Research

Ultrasonographic Assessment of Regional Fat Distribution and Its Relationship With Body Condition in an Easy Keeper Horse Breed



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ABSTRACT

Body scoring system is a functional method to monitor overall adiposity. However, scorer experience, horse breed, gender, or local fat deposits are confounding factors, primarily in breeds with noticeable phenotype and tendency to subcutaneous fat deposition. Therefore, the ultrasonographic evaluation of subcutaneous fat thickness (SFT) could be an objective alternative method to assess fat distribution. The aims of this study were to characterize SFT at seven anatomic locations (over 25%, 50%, and 75% of neck length, behind the shoulder, over the ribs, over the rump, and over the tailhead), to evaluate the relationship between the body condition score (BCS) and SFT and to determine the influence of gender and age on BCS and SFT measurements. A sample of 127 Andalusian horses (78 stallions and 49 barren mares) were included. Body condition score was estimated, and SFT was measured by ultrasonography. The results showed that in the neck area, significant differences in fat accumulation over 25% and 50% of neck length were observed according to the gender and the age; however, regarding the body condition, no significant differences were found. Subcutaneous fat thickness at tailhead was the largest deposit and the most positively correlated parameter with BCS with influence of gender and age. However, SFT at the rump was the only measurement related to the body condition, independent of gender and age. Therefore, the assessment of localized fat deposits by ultrasonography suggests that preferred anatomic sites for fat deposition are evident and BCS systems should be adjusted according to breed-specific criteria.

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1. Introduction

The adipose tissue is a key component for equine health and despite our understanding of its contribution to body composition and its anatomic distribution remains largely unrecognized [1]. In the clinical equine practice, the most commonly used methods to assess adiposity are the body

condition score (BCS) systems based on a numerical scale. Several BCS scales have been specifically developed for use in horses [2–6]. Although condition scoring systems include some objective criteria, it also requires some subjective assessment of physical attributes [7] influenced by scorer experience, horse breed [8], or gender, which may result in confounding factors. In addition, recent studies have shown an exponential relationship between BCS and total body white adipose tissue (WAT) suggesting that BCS is unlikely to be a sensitive index of body fat for equids in moderate-obese states [8–11].

Although references to Andalusian horses in the literature are scarce, body condition evaluations by equine

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practitioners suggest that this breed has a tendency to accumulate large fat deposits. In addition, a recent study [12] where three breeds were compared showed that Andalusians tended to retain their body condition and were relatively resistant to body fat loss, suggesting that this breed could be considered as an example of an easy keeper horse [13]. Because of the fact that these horses commonly exhibit obesity or increased regional adiposity [14,15], it is speculated that this type of horses are in the group of breeds predisposed to the development of endocrinopathic disorders [13]. Then, considering the tendency toward obesity of Andalusians [16] and other easy keeper horses [14] and the fact that BCS systems lose their sensitivity when the BCS exceeds 7/9 [8,11], it is essential to establish objective measurements of body fat to avoid the obesity overestimation in these breeds.

In addition, a greater understanding of regional fat deposition could help to find some pieces of the lipidic metabolism in the horse. Consequently, more objective body fat descriptors are needed to increase the precision of current BCS systems to highlight animals at risk of obesity-related diseases [8,10,11]. In this context, the measurement of subcutaneous fat thickness (SFT) by ultrasonography should be considered as a method to discern regional subcutaneous fat distribution among different body locations in conventional breeds or a method to monitor increased fat pads in horses with phenotypically established fat deposition patterns such is the case of many Andalusian-related breeds (Spanish Mustangs, Paso Fino) considered as easy keeper horses [14].

Hitherto, ultrasonographic assessment of fat thickness has been proposed as the most accurate, objective, and noninvasive method for measuring subcutaneous fat distribution in live horses [17]. Heretofore, there are published studies including only one breed [18], both genders [18–21], age influence [21], and evaluating SFT measurements at different fat deposition areas [19,20,22–24]. However, to our knowledge, there are no studies about SFT including large numbers of only one breed horses and considering gender and age at the same time. The main hypothesis was that Andalusians, due to their breed phenotypic characteristics, have a tendency to accumulate large fat deposits in specific areas that can vary with gender and age, confounding a correct BCS evaluation.

Therefore, the aims to address this hypothesis were to characterize the fat thickness measurements at different adipose deposits, to evaluate whether BCS and ultrasonographic measurements are influenced by gender and age in Andalusian horses, and to establish accurate correlations between BCS and ultrasonographic measurements.

2. Materials and Methods

2.1. Study Design

As part of a larger study investigating insulin resistance (IR) and obesity, a census of Andalusian horses located in the South-East of Spain was carried out. A cross-sectional study was developed from June to August of 2012. Owners were contacted by telephone and asked if they

were willing to take part in the study. The study population included 1722 Andalusian horses between 2 and 15 years.

Based on previously reported IR prevalence data for equine population, a sample with randomly generated numbers and with representative proportion of both genders and different ages was selected. Sample size to estimate a proportion was calculated with WinEpi 2.0 (<http://www.winepi.net/winepi2>) assuming a 34.1% of expected prevalence [25] with an accepted error of 7.5% and a confidence level of 95% ($n = 149$), with an additional correction of +5% ($n = 157$). Selected final sample size after rounding-up applied during stratification included 166 animals. Considering the bibliography that establishes that the tendency to become obese increases with age [26–28], two age groups were defined: young horses (2–5 years) and adult horses (6–15 years). The evaluated horses were selected from 44 breeding farms, horse riding schools, and private stables. Every owner or person in charge signed an informed consent before the noninvasive procedures were performed. According to Spanish regulations, an Animal Care and Ethics Committee approval was not necessary.

The inclusion criteria were that all included animals should be healthy based on the results of physical examination, complete blood count, and serum biochemical analysis. Only horses on a normal herd health schedule, adequate management and fed with a proper diet (0.5–1 kg concentrate/100 kg BW and at least, double quantity of forage) [29] were included.

For the present study, additional exclusion criteria were applied: pregnant mares, lactating mares, and horses undergoing medical treatment. In the random selection, only one gelding horse was selected. Considering its low representativeness for the statistics, this was excluded. Finally, 127 horses were included in this study.

2.2. Body Condition Score and Ultrasonographic Measurements

Two independent and trained evaluators (T.M. and F.M.) determined BCS [3], and the average of both scores was used. Based on their BCS, obese horses were defined as $BCS \geq 7$ and nonobese as $BCS < 7$ [26,30,31].

All measurements of SFT were performed via B-mode with commercial ultrasonographic imaging system (Honda Electronics HS-1500V, Aichi, Japan) equipped with a 7.5 MHz linear transducer [24,32]. All images were taken on the left side, assuming that bilateral variation errors were small enough to consider only one side necessary to be measured [33]. The horses were standing in a normal position and individually restrained to minimize movements. Because of the time of year during which the study was conducted, it was not necessary to clip the hair and alcohol was used as a coupling medium. The scanning and the interpretation of the images were performed by the same researcher (T.M.-G.) to avoid variability in the measurement technique.

The depth of seven local fat deposits, three of them along the neck length and four over the trunk, were measured to the nearest 0.01 mm by transcutaneous ultrasonography. The probe was positioned perpendicular to the floor. Anatomic landmarks used to guide the transducer

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