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Original Research

Estimation of Actual and Ideal Bodyweight Using Morphometric Measurements and Owner Guessed Bodyweight of Adult Draft and Warmblood Horses

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ABSTRACT

Bodyweight (BW) estimation equations have not been developed for draft and warmblood horses. The objectives were to develop BW estimation equations using morphometric measurements for draft and warmblood horses and investigate horse owner's ability to estimate BW. Morphometric measurements were collected on adult (≥3 years), nonpregnant, draft (n = 138), and warmblood (n = 89) horses. Personnel measured wither height, body length (BL) from the point of the shoulder to the point of the buttock (BL wrap), BL from the point of the shoulder to a line perpendicular to the point of the buttock (BL straight), neck circumference, girth circumference, body condition, and BW using a livestock scale. Equations for the estimation of BW were developed using linear regression. For estimated BW, the model was fit using all individuals and all morphometric measurements, except BL wrap. For ideal BW, the model was fit using individuals with a body condition score of 5, BL straight, and height. Bodyweight (kg) was estimated by taking [girth (cm)$^{1.528}$ × BL straight (cm)$^{0.574}$ × height (cm)$^{0.246}$ × neck (cm)$^{0.261}$]/1,181 (draft) or 1,209 (warmblood)] (R^2 = 0.96; root mean square error [rMSE] = 28 kg). This was an improvement over the previous BW estimation equation (R^2 = 0.94; rMSE = 34 kg). Ideal BW (kg) was estimated by {[4.92 × BL straight (cm)] + [4.64 × height (cm)] − 951 (draft) or 1,016 (WB)} (R^2 = 0.90; rMSE = 33 kg). Owners accurately estimated horse BW (R^2 = 0.87). Morphometric measurements were used to develop BW-related equations for draft and warmblood horses.

1. Introduction

There is a growing problem of overweight and obese horses in the United States and Europe. Many researchers have estimated that ≥14% of horses are overweight as indicated by a body condition score (BCS) of ≥7 [1–6]. Most instances of obesity are the result of an imbalance between energy intake and expenditure [7]. Excess bodyweight (BW) can lead to health issues including insulin resistance and Equine Metabolic Syndrome, both of which can lead to laminitis [7], poor thermoregulation [8,9], and decreased athletic ability [10].

Determining a horse's BW is important for horse health and nutrient management; however, few owners have access to a scale or can accurately estimate horse BW or BCS. Wyse et al [11] determined that horse owners could not

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accurately assess BCS and that owners of obese horses were more likely to underestimate their horse's BCS. Thatcher et al [5] found similar results and determined that owners frequently underestimated the BCS of their horses. Mottet et al [12] also determined that horse owners lacked the ability to detect changes in adiposity over time. Although it has been reported that owners tend to underestimate BCS, there is limited information regarding horse owners ability to accurately estimate horse BW.

To estimate BW, horse owners frequently use BW tapes or equations. Bodyweight estimation equations exist for adult light horse breeds [13], ponies [14], and miniature horses [15] using heart girth circumference and body length (BL) measurements. Recently, new equations were developed for ponies, Arabians, and stock-type horses that improved existing BW estimation equations by adding breed type, neck circumference, and height [6]. Martinson et al [6] also developed ideal BW estimation equations for ponies, Arabian, and stock horses to better equip horse owners and professionals with tools to manage horse BW.

Although BW estimation equations exist for light-breed horses, ponies, and miniature horses, equations have not been developed for draft and warmblood horses. The objectives of this study were to develop BW estimation equations using morphometric measurements for adult draft and warmblood horses and investigate horse owner's ability to estimate BW of these breed types.

2. Materials and Methods

All experimental procedures were conducted according to those approved by the University of Minnesota Institutional Animal Care and Use Committee. All statistical analyses were conducted in R (R Core Team 2012, Vienna, Austria; version 2.15.1) unless otherwise noted.

2.1. Morphometric Measurements and Demographics

Morphometric measurements were taken on 227 adult draft and warmblood horses at the Scott County Fair Draft Horse Show (Jordan, Minnesota) (n = 138) and the Fall Harvest Horse Show (St. Paul, Minnesota) (n = 89), respectively, in 2014. The Scott County Fair Draft Horse Show was primarily draft horse hitch teams, whereas the Fall Harvest Horse Show was mostly hunters and jumpers. The Fall Harvest Horse Show was not breed specific, but most horses present were warmblood horses or warmblood crosses; only warmblood and warmblood crosses were used to develop BW estimation equations.

Data were collected on adult horses that were ≥3 years old and nonpregnant. The same six trained personal in teams of two collected the following measurements: BCS on a scale of 1 (poor) to 9 (extremely fat) [16] and height at the third thoracic vertebra (team 1); neck circumference at the midway point between the poll and the third thoracic vertebra [17] and girth circumference at the third thoracic vertebra (team 2); and BL from the point of the shoulder to the point of the buttock (BL wrap) [18] and BL from the point of the shoulder to a line perpendicular to the point of the buttock (BL straight) [6] (team 3; Fig. 1). The two-person team assessing BCS mutually agreed on the horse's BCS. Body length wrap was collected for use with the Hall equation [13], whereas BL straight was collected for use in developing new equations and for use in the Martinson et al [6] equation. Each horse was weighed using a calibrated portable livestock scale (Weigh-Tronix, Fairmount MN, PS2000 [warmblood horses] and PS5000 [draft horses]). Age, gender, breed, and discipline were also recorded. For draft horses only, shoe height was measured and actual height (wither height minus shoe height) was used in developing equations. Owners or the horse's exhibitor were also asked to estimate the horse's BW before weighing horses on the livestock scale. The owner estimated BW was later compared with actual BW using Student's t test with significance set at $P \leq .05$ and PROC CORR in SAS (SAS Inst. Inc., Cary, NC; version 9.3).

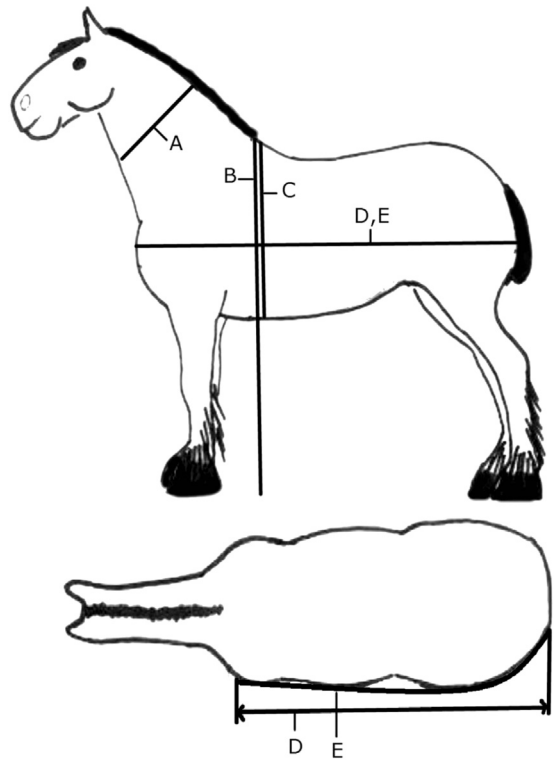

Fig. 1. Morphometric measurements collected on 227 adult draft and warmblood horses in Minnesota, including neck circumference located halfway between the poll and the withers (A), height at the third thoracic vertebra (B), girth circumference at the third thoracic vertebra (C), body length (BL straight) from the point of the shoulder to a point perpendicular to the point of the buttock (D), and body length (BL wrap) from the point of the shoulder to the point of the buttock (E).

2.2. Determination of Breed Types

Horses were grouped by type (draft or warmblood), and this grouping was confirmed using multivariate analysis of variance (ANOVA) analyses. Means (± standard deviation [SD]) of age, BCS, neck circumference, girth circumference, height, and both BL (BL straight and BL wrap) measurements were calculated. Breeds were divided into two breed types: draft and warmblood.