An investigation in to the asymmetries of the equine hoof & the influence of body weight & height on hoof conformation

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INTRODUCTION:

The complex equine hoof provides leverage, support and shock absorption for the limb. The ratio of body mass to weight bearing surface is very high in the horse yet the hoof is able to cope with the significant concussive stresses it is subjected to (Parks 2003; MacDonald 2006). Research has identified the shape of the hoof as a significant contributor to the onset of foot disease and prevalent injuries of the distal limb (Dyson et al, 2006; Gill 2007). As the balance and conformation of the hoof dictates the way in which the foot interacts with the ground, hoof shape directly influences the magnitude and direction of the forces entering the limb (Back 2001; Parks 2003). In addition, the forces entering the foot also influence the rate of growth within different regions thus creating a cyclic pattern and predisposing to injury. As disorders of the equine foot are among the most common causes of lameness, a clearer understanding of factors which influence hoof shape could enable better treatment for, or prevention of, some forms of foot-based lameness. The aim of this investigation was therefore to identify whether a relationship exists between body weight and height on hoof conformation.

Figure 1: Lateral digital view of the hoof used to determine TA using Dartfish software

METHOD:

Sixty-four riding school horses of mixed breed, age and gender were selected using convenience sampling. Horses needed to be in a regular shoeing routine of between four to six weeks and needed to have been shod within two weeks prior to data collection. None of the horses used within the study were known to have had any signs of lameness within the previous six months as this would have had implications on the hoof shape and growth.

Height, weight and fore hoof dimensions (coronet band width (CBW), base of the hoof width (HBW), toe angle (TA) and hoof spread (HS = HBW – CBW) were measured. CBW and HBW were measured using Invicta callipers. Lateral digital images were taken and the toe angle determined using Dartfish software (figure 1). The formula recommended by Ellis and Hollands (1998) and Carroll and Huntington (1988) was used to calculate weight with the chest girth and body length measurement taken using a standard tape measure.

$$\text{Weight (kg)} = \frac{\text{Chest girth (cm)}^2 \times \text{Length (cm)}}{11877}$$

Following a Kolmogorov-Smirnov test for normality; TA measurements were compared using a Paired t-test and tests for correlations between all variables was undertaken using Pearson's Product Moment Coefficient.

RESULTS:

Weight (x=562±73.4) positively correlated with CBW and HBW (P≤0.001) in both the left and right hoof and CBW also positively correlated to HBW in both limbs (P≤0.001) (figure 2). These results support the concept that as the weight of the horse increases, so to do the basic hoof dimension. Height (x=161.5±7.2) did not correlate with any of the variables; this suggests that the weight of the individual is a more influential variable than height.

The TA's demonstrated asymmetry in form in that the right TA was significantly greater than left (P≤0.05) (figure 3). Both TA's positively correlated (P≤0.001) to each other suggesting that although there may be a corresponding proportional increase in size, the actual shape of the hooves in a pair differs through differing TA. This was supported by the findings that as the left TA increased, the left HS of the same foot increased; potentially indicating a more upright, but widely splayed hoof. Conversely, as the right TA increased the CBW of the same foot increased suggesting a more upright but boxy hoof. This difference may also clarify the correlation between right CBW and left HBW. Bilateral correlations were also determined between HS and HBW (P≤0.001) demonstrating that as the HBW of both hooves increased, so too did the HS.

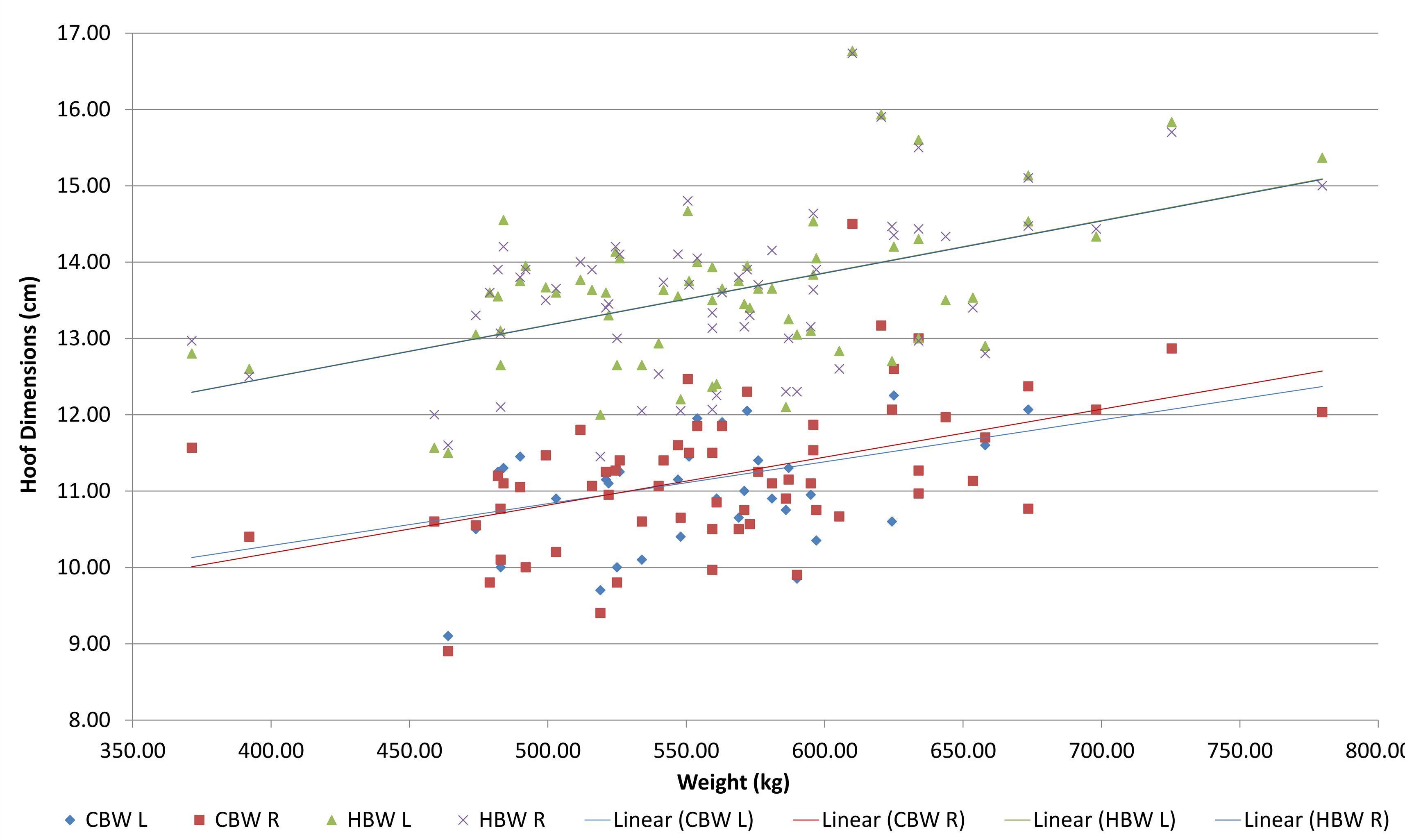

Figure 2: Illustration of the positive correlations identified between weight (kg) and the hoof dimensions of left CBW (r=0.439), right CBW (r=0.484), left HBW (r=0.501) and right HBW (r=0.479)

CONCLUSIONS:

The significant asymmetries observed between the forefeet of the horses within this study suggest that hoof conformation is not symmetrical for the majority of hoses within a population. Furthermore the results indicate a more splayed conformation in the left hoof compared to a more upright, boxy conformation of the right hoof. This is supported by the significant differences observed in the toe angles of the left and right feet which also imply that there may be asymmetries in the distal phalangeal alignment.

These results propose that weight has a stronger influence on conformational changes on the hoof than the height of the horse. From this it could be suggested that additional weight placed on the horse, for example through obesity, can have wider implications in terms of compensatory mechanisms and injury than previously considered. These asymmetries are likely to have undesirable implications for sustained soundness and the manifestation of pathologies in the horse however the positive complexities of such a relationship remain difficult to define. The working demands of the horses within this study were not directionally biased and therefore are not considered influential on the asymmetries reported. Laterality may potentially be of influence in these asymmetries, however this was not tested for within this study, and to date, the influence of laterality on the hoof conformation of adult horses is an area lacking in research.

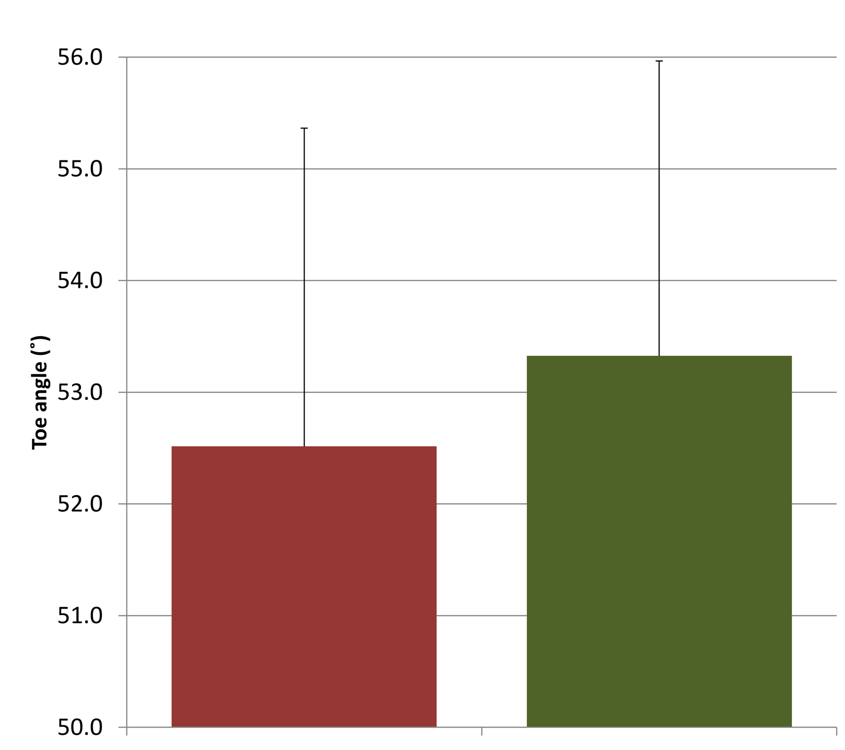

Figure 3: Mean toe angles including SD

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