

# Associations Between Yearling Body Measurements and Career Racing Performance in Thoroughbred Racehorses

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## ABSTRACT

Yearling morphometric measurements and variables related to career racing performance were collected on 260 Thoroughbreds to determine correlations between and among these traits. Morphometric measurements were adjusted to 365 days based on interpolation from adjacent age points and included wither and hip height, body length, distal limb length, cannon circumference, heartgirth circumference, and chest width. Measures of career racing ability included total earnings, win percentage, and Standard Starts Index (SSI). Wither height and hip height were favorably correlated with lifetime earnings, SSI, and win percentage. Body length and heartgirth were positively correlated with SSI and win percentage. Leg traits were not correlated with any performance parameters. Horses that had placed in or won a stakes race tended to be taller at the wither and hip as yearlings. Horses categorized as preferring turf tended to be taller at the wither and hip at 365 days than those that preferred to run on dirt. No significant difference in yearling morphometric measurements between sprinters and routers was detected. In addition to phenotype and pedigree information, morphometric measurements taken in the yearling year may allow for more accurate estimation of future performance in the Thoroughbred racehorse.

**Key words:** conformation; growth; height; earnings; correlation

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## INTRODUCTION

American Thoroughbreds are often sold at auction during their yearling year. However, because Thoroughbreds do not begin their racing careers until 2 years of age, no direct measures of racing performance are available at the time of purchase. Buyers are instead forced to assess yearlings based on subjective evaluation of conformation and gait and recorded performance data of relatives.

Wither height of mature horses is positively correlated with racing performance<sup>1</sup> and stride length.<sup>2</sup> In Thoroughbreds, yearling measurements can be used to predict mature dimensions with reasonable accuracy.<sup>3,4</sup> Thus it is logical to assume that morphometric measurements of yearling horses may have predictive value for future racing performance. The objective of this study was therefore to estimate correlations between yearling skeletal measurements and subsequent career racing performance, with the hypothesis that a significant association exists.

## MATERIALS AND METHODS

Data were collected on 260 Thoroughbreds born on 13 farms in Virginia: 121 foals born in 1981 (67 fillies; 54 colts) and 139 foals born in 1982 (71 fillies; 68 colts). These data were a subset of a larger dataset<sup>5</sup> limited to only those foals that went on to successfully start in at least one race in their lifetime. Morphometric measurements of horses born in 1981 were obtained at 6-week intervals from February of their yearling year through the 3<sup>rd</sup> week in July of their yearling year. Measurements of horses born in 1982 were obtained at 2-month intervals from birth through the 3<sup>rd</sup> week in July of their yearling year. Skeletal measurements included the vertical distance from the highest point of the withers to the ground (wither height; WH), the distance from the highest point of the croup to the ground (hip height; HH), the length from the point of the shoulder to the

**Table 1** Mean values of morphometric measurements and significance of difference between sexes

Trait	Mean ± SE	
	Male (n = 122)	Female (n = 138)
WH (cm)**	147.30 ± 0.35	145.93 ± 0.31
HH (cm)	150.87 ± 0.37	149.97 ± 0.31
BL (cm)*	141.79 ± 0.45	140.49 ± 0.38
DL (cm)**	39.86 ± 0.14	39.33 ± 0.11
CC (cm)**	19.47 ± 0.06	19.01 ± 0.05
HG (cm)	162.41 ± 0.47	162.11 ± 0.58
CW (cm)**	38.68 ± 0.22	37.89 ± 0.12
Weight (kg)**	362.38 ± 3.07	348.09 ± 2.44

\**P* < .05  
\*\**P* < .01

**Table 2** Correlation coefficients between SSI and morphometric measurements

Trait	Correlation Coefficient	
	Male	Female
WH	-0.21	-0.26*
HH	-0.32**	-0.25*
BL	-0.21	-0.29*
DL	-0.14	0.08
CC	-0.14	-0.17
HG	-0.19	-0.20*
CW	-0.10	-0.16

\**P* < .05  
\*\**P* < .01

furthest protruding point of the buttocks (body length; BL), the vertical distance from the distal point of the carpus to the ground (distal limb length; DL), the circumference of the mid-shaft portion of the third metacarpus (cannon circumference; CC), the circumference around the body at the point where the wither height was obtained (heartgirth; HG), and the horizontal distance between the two points of the shoulders (chest width; CW). A formulaic approximation of weight was calculated from heartgirth.<sup>5,6</sup> Each horse was held to stand quietly and squarely while measurements were being recorded, and all measurements were recorded by the same technician. Measurements were made on both sides of the horse, with the average of paired measurements used for this study. All data were adjusted to 365 days, using interpolation from adjacent age points.<sup>7</sup> Mean values for morphometric measurements are reported in [Table 1](#).

**Table 3** Correlation coefficients between win percentage and morphometric measurements

Trait	Correlation Coefficient	
	Male	Female
WH	0.21	0.28*
HH	0.24*	0.31**
BL	0.24*	0.29*
DL	0.11	-0.04
CC	0.20	0.14
HG	0.27*	0.27*
CW	0.18	0.12

\**P* < .05  
\*\**P* < .01

Measurements of career performance were also documented for each horse, using information available in the American Produce Records.<sup>8</sup> These data included total lifetime earnings (ER), lifetime win percentage (the number of wins divided by the number of total starts) (WP), and Standard Starts Index (SSI; a comparable index of earnings per start for each sex which has been standardized by year of birth). Statistical transformations were applied to the performance data. Transformations of data for LE (log), WP (arcsine square root), and SSI (inverse log) were performed to generate normal distributions.

Pearson correlation coefficients were calculated between and among morphometric measurements and the transformed career performance data. Using PROC GLM of SAS, t tests were performed to detect significant differences in the morphometric data due to the binomial fixed effects of surface (dirt vs turf), distance (horses that primarily raced—less than 1.41 km vs horses that primarily raced longer than 1.81 km), and blacktype (horses that won or placed in a stakes race in one group and those that did not in the alternate group).

## RESULTS

No significant effects due to birth year were detected for morphological measurements, so data were collapsed and analyzed as one dataset. No significant correlations between measurements and ER were found, although a trend (*P* < .10) for WH (*r* = 0.19) and HH (*r* = 0.20) with ER was noted in females. WH, HH, BL, and HG were moderately and favorably correlated with SSI for females, whereas for males only HH was moderately and favorably correlated with SSI ([Table 2](#)),

**Table 4** Correlations among morphometric measurements ( $P < .05$ ).

	WH	HH	BL	DL	CC	HG	CW
WH	—	0.91	0.69	0.63	0.54	0.52	0.42
HH		—	0.69	0.63	0.53	0.53	0.44
BL			—	0.43	0.54	0.52	0.44
DL				—	0.32	0.40	0.34
CC					—	0.41	0.52
HG						—	0.44
CW							—

with a trend toward association ( $P < .10$ ) was noticed for both WH and BL with SSI in males. The inverse log transformation of the SSI data causes these correlation coefficients to be negative. Yearling measurements for HH, BL, and HG were moderately and favorably correlated with win percentage for both females and males (Table 3). None of the limb parameters was significantly correlated with performance parameters. As expected, all morphometric measurements were highly correlated with each other (Table 4).

Horses that had either won or placed in a stakes race during their racing careers had been significantly taller at both the withers and hip at 365 days than horses that had not won or placed in a stakes race ( $P < .05$ ). Horses that primarily ran on turf were taller at 365 days for both WH ( $P = .05$ ) and HH ( $P = .07$ ) than horses that primarily ran on dirt. There was no significant difference between sprinters and routers for any of the yearling body measurements.

## DISCUSSION AND CONCLUSION

The favorable correlation of wither height to lifetime earnings, SSI, and win percentage is not entirely surprising, as wither height in mature horses is favorably correlated with stride length,<sup>2</sup> and in turn a longer stride length is favorably correlated with a higher winning percentage in Thoroughbreds.<sup>9</sup> Because yearling morphometric measurements can be used to predict adult dimensions,<sup>3</sup> the current study confirms the suggested correlation between yearling wither height and lifetime earnings, SSI, and winning percentage. That horses winning or placing in a stakes race were significantly taller at the withers is not surprising, because generally taller horses would have longer strides,<sup>2</sup> and horses with longer strides tend to have a higher win percentage.<sup>9</sup> Linear measures of wither height, hip height, and body length were strongly and favorably correlated,<sup>10</sup> so correlations between any one of these traits and measures of racing performance followed similar

trends. Limb traits were not associated with performance traits, which may be attributable in part to relatively low variability among animals and small changes in longitudinal bone growth that reach a plateau within the yearling year.<sup>3,11</sup> Magnitudes of correlations were slightly higher in females for most traits, which could be attributed to a larger number of females in the study as compared with males.

In addition to the current subjective methods of yearling evaluation by potential buyers, morphometric measurements taken in the yearling year may allow for more accurate estimation of future racing performance, especially measurements of WH, HH, BL, and HG.

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