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BODY WEIGHT, WITHER HEIGHT AND GROWTH RATES IN THOROUGHBREDS RAISED IN AMERICA, ENGLAND, AUSTRALIA, NEW ZEALAND AND INDIA

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Introduction

Past studies on the growth of Thoroughbreds have been limited to small populations located primarily in the northern hemisphere (Green, 1969; McCarthy and Mitchell, 1974; Hintz, 1978; Hintz et al., 1979; Thompson, 1995; Jelan et al., 1996; Pagan, 1996; Jones and Hollands, 2005). There are fewer data available on Southern Hemisphere populations (Grace et al., 1999 and 2001; Nash, 2001; Brown Douglas et al., 2005) and there has been no detailed comparison made between the growth patterns of Thoroughbreds in different countries.

Thoroughbred populations around the globe are of similar genetic makeup so it could be assumed that the patterns of growth would be comparable between countries, and growth curves described by scientists in one country may be applied to Thoroughbreds in another.

The purpose of this study was to obtain growth data from populations of Thoroughbreds born and raised in the USA, England, Australia, New Zealand, and India and present and compare body weight, daily weight gain, and wither height growth curves.

Materials and Method

Thoroughbreds born and raised on commercial and private farms in America, England, Australia, New Zealand, and India were weighed monthly during the years 1996 to 2006 (Table 1). Wither height was also measured in approximately 85% of the horses.

The data were split into foal-age categories: 1-15 days (7 days), 16-45 days (1 month), 46-75 days (2 months), 76-105 days (3 months), 106-135 days (4 months), 136-165 days (5 months), and so on up to 18 months of age. Splits were chosen such that the relationship between foal age and foal weight was approximately linear and to ensure that the vast majority of the foals were measured only once per age category.

Table 1. Summary of data collected from Thoroughbreds in America, England, Australia, New Zealand, and India.

| <i>Population</i> | <i>Number</i> | <i>Colts</i> | <i>Fillies</i> | <i>Sires</i> | <i>Farms</i> |
|-------------------|---------------|--------------|----------------|--------------|--------------|
| Kentucky | 6783 | 3359 | 3424 | 682 | 76 |
| Australia | 2653 | 1290 | 1363 | 266 | 17 |
| England | 1233 | 607 | 626 | 235 | 38 |
| India | 939 | 468 | 471 | 110 | 8 |
| New Zealand | 925 | 374 | 551 | 136 | 8 |
| Rest of USA | 896 | 472 | 424 | 268 | 12 |
| Total | 13429 | 6570 | 6859 | 1117 | 159 |

Data Analysis

All growth data from each country for the ten seasons were initially analyzed separately, but as there were no significant differences for any parameter between the seasons ($p < 0.05$), data were combined for further analysis.

A linear regression model with foal age as the explanatory variable and country as the response variable was used to predict weight, height, and ADG and provide a confidence interval for the mean response at a specified age within each month of age category. When gender was being considered, it was included as an explanatory variable. When a significant ($p < 0.05$) main effect or interaction was found, multiple comparisons were made using the least significant difference method. Computations were done using JMP 6.0 (SAS, Inc., Cary, NC). Results are expressed as mean \pm 95% confidence interval and significance is reported at the 5% level.

Results

Australian Thoroughbreds were significantly heavier and taller at 7 days and 18 months of age than Thoroughbreds in all other countries. Australian and New Zealand Thoroughbreds were significantly heavier than other populations between one and four months of age, and seven and eighteen months of age. English Thoroughbreds were significantly lighter than in all other countries except India between 7 days and 4 months of age. At 4 months of age there were no significant differences in foal body weight between countries, with the exception of foals in India, which were significantly smaller (Table 2 and 3, Figure 1 and 2).

Table 2. Body weight (kg) ± 95% confidence interval of Thoroughbreds reared in America, Australia, England, India, and New Zealand compared with the world average. Differing superscripts within a row indicate significant differences (p<0.05).

| Age (mth) | Kentucky | USA (excl KY) | Australia | England | India | New Zealand | World Avg |
|-----------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|-----------|
| 0 | 67.5±0.3 ^b | 69.8±1.1 ^a | 69.6±0.5 ^a | 64.5±0.9 ^c | 62.2±0.6 ^d | 65.6±2.1 ^b | 66.9 |
| 1 | 99.3±0.4 ^b | 100.8±1.1 ^b | 102.4±0.7 ^a | 95.4±1.0 ^c | 90.5±0.7 ^d | 102.0±2.2 ^a | 98.6 |
| 6 | 250.7±0.7 ^a | 246.0±1.6 ^b | 251.4±1.3 ^a | 248.0±2.0 ^b | 224.8±1.4 ^c | 248.1±1.8 ^b | 247.1 |
| 12 | 353.3±1.0 ^b | 349.6±2.3 ^b | 357.8±1.6 ^a | 349.6±2.8 ^b | 326.2±2.1 ^c | 357.5±3.9 ^a | 350.7 |
| 18 | 453.9±1.7 ^b | 455.9±5.4 ^b | 460.7±3.9 ^a | 442.8±6.0 ^c | 408.8±2.9 ^d | . | 444.9 |

Table 3. Withers height (cm) ± 95% confidence interval of Thoroughbreds reared in America, Australia, England, India, and New Zealand compared with the world average. Differing superscripts within a row indicate significant differences (p<0.05).

| Age | Kentucky | USA (excl KY) | Australia | England | India | New Zealand | World Avg |
|--------|------------------------|-------------------------|------------------------|------------------------|------------------------|--------------------------|-----------|
| 7 days | 105.7±0.2 ^b | 105.2±0.6 ^{bc} | 110.9±0.4 ^a | 104.5±0.7 ^c | 102.2±0.5 ^d | 105.2±4.3 ^{bcd} | 106.1 |
| 1 mo. | 112.6±0.1 ^a | 112.5±0.4 ^a | 112.2±0.4 ^a | 111.5±0.5 ^b | 108.0±0.3 ^c | 113.1±1.4 ^a | 112.0 |
| 6 mo. | 135.9±0.1 ^a | 135.4±0.4 ^a | 135.0±0.4 ^a | 134.4±0.5 ^a | 131.2±0.3 ^b | 134.7±0.4 ^a | 135.0 |
| 12 mo. | 147.8±0.3 ^a | 147.8±0.5 ^a | 147.4±0.3 ^a | 145.8±0.5 ^b | 144.2±0.3 ^c | 147.4±0.6 ^a | 147.1 |
| 18 mo. | 154.7±0.2 ^b | 154.4±0.8 ^b | 156.0±0.7 ^a | 153.1±0.8 ^b | 151.2±0.3 ^c | . | 153.8 |

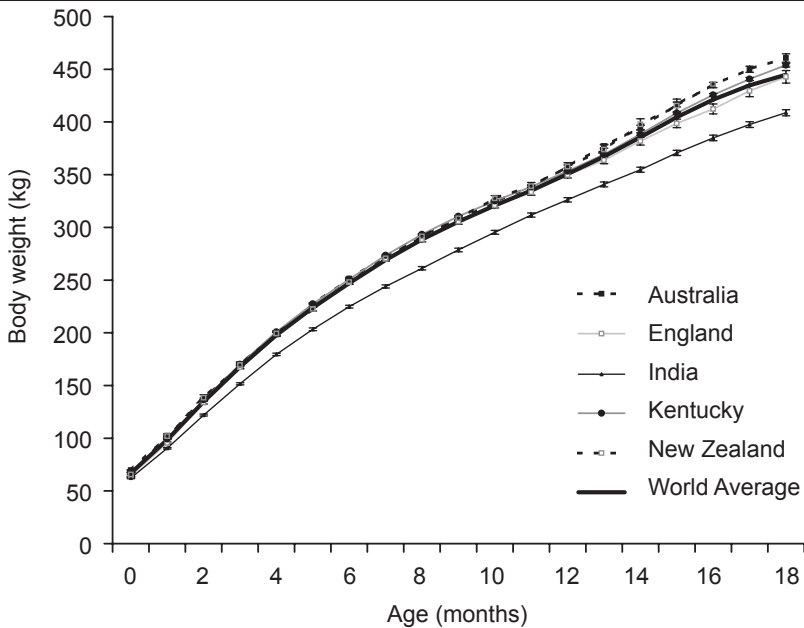


Figure 1. Body weight ± 95% confidence interval (kg) of Thoroughbreds reared in Australia, England, India, America, and New Zealand compared with the world average.

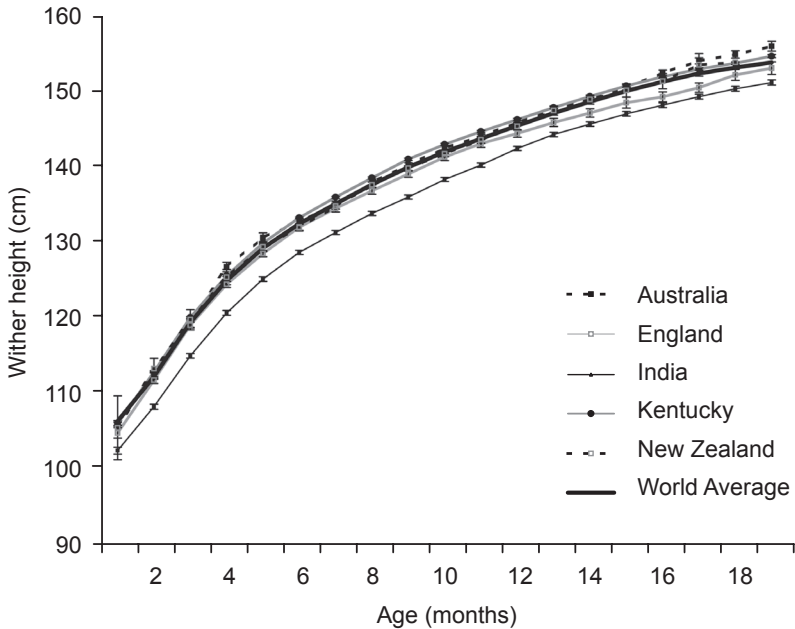


Figure 2. Wither height \pm 95% confidence interval (cm) of Thoroughbreds reared in Australia, England, India, America, and New Zealand compared with the world average.

Indian Thoroughbreds were significantly smaller (lighter and shorter) than all other Thoroughbred populations throughout the study ($P < 0.05$). Birth weights of Indian foals were significantly less than those raised in Kentucky, Australia, and England at 49.4 ± 0.5 kg (95% CI) vs. 54.4 ± 0.4 kg, 54.9 ± 0.5 kg, and 53.1 ± 0.5 kg, respectively ($P < 0.05$).

At 6 months of age, Kentucky and Australian foals were heavier than those born in England, New Zealand, and India. However, there was no significant difference in height between foals of any countries except for those in India, which were significantly shorter. At 12 months of age Australasian (Australian and New Zealand) and American foals were heavier and taller than English and Indian foals. Between 15 and 18 months Australasian Thoroughbreds were significantly heavier than those of all other countries. There were no significant differences in height between Australian and American Thoroughbreds between 12 and 16 months, but Australian Thoroughbreds were taller at 17 and 18 months.

Thoroughbreds raised in America, England, Australia, and New Zealand exhibited a similar pattern of ADG over the first 11 months of their life (Figure 3). Over this 11-month period, ADG declined at a constant rate from maximum values immediately after birth (between 1.4 and 1.6 kg/d at 1 month of age) to reach a low of 0.5 to 0.6 kg/d at 11 months of age. Between 13 and 16 months of age Thoroughbreds in America, England, Australia, and New Zealand exhibited ADGs of between 0.7 and 1.0 kg/d.

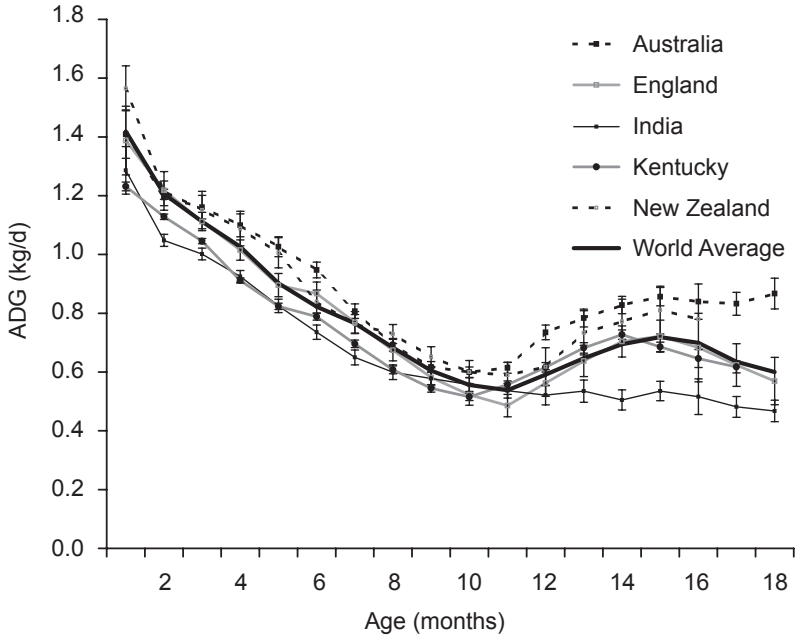


Figure 3. Average daily gain \pm 95% confidence interval (kg/d) of Thoroughbreds reared in Australia, England, India, America, and New Zealand compared with the world average.

ADG in Indian horses steadily declined from 1.3 kg/d at 1 month of age to 0.5 kg/d at 18 months of age and did not exhibit the increase in ADG between 10 and 14 months of age of other Thoroughbred populations. The ADGs of Indian Thoroughbreds were significantly less than in other countries of the world between 13 and 15 months of age ($P < 0.05$).

Discussion

Significant differences in body weight, wither height, and average daily gain were observed between the populations of Thoroughbreds. In general, Australian and New Zealand Thoroughbreds tended to be larger than American Thoroughbreds, which in turn were larger than those reared in England.

Body weights and wither heights for Kentucky Thoroughbreds reported in this study are within 1 to 2% of those reported in an earlier study of Kentucky Thoroughbreds (Pagan, 1996). However, in contrast to published English data collected from 200 horses (Jones and Hollands, 2005), body weights of 1233 English Thoroughbreds in this study were up to 20% heavier (Table 4). The data from our study, while still showing that English Thoroughbreds are smaller than American Thoroughbreds, indicates that large numbers of the population should be sampled to create accurate references.

Table 4. Body weight comparisons between English and Kentucky Thoroughbreds in this and prior studies. Percentages in brackets indicate the percentage difference between body weights of English Thoroughbreds in the present study and published data for English Thoroughbreds.

| Country | Study | 14 d | 32 d | 183 d | 350 d | 490 d |
|---------------------|---------------------------------|----------------|----------------|-----------------|----------------|----------------|
| UK (n=200) | Jones and Hollands (2005) | 64.2 | 78.9 | 224.4 | 358.5 | 424.5 |
| England (n=1233) | Present study | 72.6 (+12%) | 97.3 (+20%) | 253.5 (+11%) | 345.0 (-4%) | 427.4 (+1%) |
| KY (n=700) | Pagan (1996) | 76.1-77.7 | . | 250.7-255.9 | 335.2-349.2 | 418.0-427.8 |
| KY (n=6783) | Present study | 74.6-76.7 | 99.7-101.4 | 249.3-254.8 | 339.4-354.7 | 423.2-438.2 |

At 12 months of age, American Thoroughbreds were taller but not heavier than English Thoroughbreds. However, at 18 months of age, American Thoroughbreds were significantly heavier than English Thoroughbreds, but there was no significant difference in height. A similar trend was observed between Thoroughbreds raised in Australasia compared with those raised in America. At 12 months of age, Australasian Thoroughbreds were heavier and taller than those in all other countries. Between 15 and 18 months, Australasian Thoroughbreds were significantly heavier than those in all other countries; however, there were no significant differences in height between Australasian and American Thoroughbreds. This is most likely representative of the difference in management of yearlings prepared for sale. Australasian yearlings tend to be sold in a well-rounded condition with higher condition scores compared with American yearlings which are presented as leaner, more athletic and fit. This trend is beginning to change as breeders and buyers realize the potential musculoskeletal problems associated with over-conditioned yearlings.

These observations may further be attributed to the management of growing horses for different racing industries under different growing conditions. In general, the American racing industry has significantly more short-distance dirt races than the industries of England, Australia, and New Zealand, and as a result, American Thoroughbreds are raised to be precocious sprinting horses ready to race at two years old. In contrast, the English racing industry holds turf races commonly of distances greater than 1 mile, and as a result England has traditionally produced slower-maturing Thoroughbreds bred to run on turf. Australia and New Zealand are also known to produce turf-racing Thoroughbreds; however, these southern hemisphere horses are traditionally known for their size, which may be attributed to genetics, even though shuttle stallions have had a significant impact on evening out the genetic pool between hemispheres.

Thoroughbreds in all countries except for India showed low ADGs around 10 to 11 months and increases in ADGs between 13 and 16 months. As these horses were all born in the spring and early summer, the decline in growth rate around 10 and 11 months of age coincides with the winter months of decreased pasture quality and availability. The increase in ADG after 11 months of age in these horses could be attributed to the onset of spring pasture growth.

The ADGs of Indian Thoroughbreds declined steadily between 1 and 18 months, did not increase between 10 and 14 months of age, and were significantly less than those of horses in the rest of the world at 13-15 months of age ($P < 0.05$). This significant result could be attributed to differences in nutritional management of Indian Thoroughbreds as well as climatic conditions in that country. Horse farms in India rely heavily on grain and harvested forage, predominantly alfalfa, as sources of nutrition for their growing horses (Peter Huntington, personal communication). In contrast to the other countries in this study, Indian horses have restricted or no access to pasture. The climate in India ranges from a dry, cool winter (December - February) to a dry, hot summer (March - May) and heavy monsoon conditions (June - September) (National Geographic, 2003). It is therefore understandable that horses growing in these tropical monsoon conditions will not exhibit an increase in ADG between 10 and 14 months of age associated with seasonal increase in pasture growth in temperate climates. Furthermore, the effect of demanding climatic conditions on managing growing horses could contribute to the overall smaller size of the Indian Thoroughbreds compared with those raised in temperate climates under different management conditions. Indian horses are reported to spend a significant amount of time indoors due to extreme heat in the summer and monsoon season in the fall. This restricted access to pasture and exercise may hinder growth potential of these horses. Indian bloodstock is sourced predominantly from North America and most foals arrive in India in-situ with their dams following a November or January broodmare sale. Anecdotal evidence suggests these pregnant mares may experience a difficult journey from the US to India and this stress is reported to act negatively on the size and health of their foals, which is evident in their significantly lower birth weights compared with other countries. Thoroughbreds in India begin their racing career at 3-4 years of age and it is thought that by 2 to 2 1/2 years of age, these horses have caught up in size with the world population. Data from Indian yearlings were not analysed after 18 months, so this observation cannot be verified.

The considerable differences in the patterns of growth between Thoroughbreds in different geographical regions indicate that reference growth curves created specifically for each country would be beneficial.

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