Estimation of growth rates in UK thoroughbreds

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Introduction

Growth rate data for Thoroughbreds (TB) in the UK is limited. Body mass is an important tool in evaluating nutritional requirements and drug dosage. TB raised in Kentucky have different growth rates compared with Canadian TB, with both sex of the foal and month of its birth being reported to influence birth mass and growth rate (*Pagan* et al 1996). It may therefore be inappropriate to apply either USA or Canadian growth rate data to UK TB. The objectives of this study were to determine body mass as a function of age and investigate the effect of sex of foal and month of its birth on birth mass and subsequent growth in UK TB.

Materials and methods

Birth mass (measured using a weigh bridge), sex and date of birth were recorded for 200 individuals born in 2003-2004. Body mass was subsequently measured twice monthly during the first month of age and then at monthly intervals, until the individuals were 540 days of age. The hypothesis that birth mass was different for colts and fillies was tested using an unpaired Student's t-test. The effect of birth month on birth mass was investigated using a one-way ANOVA followed by post-hoc tests. Growth rate was modelled using the Gompertz curve* (Genstat**):

$$Y=A+Ce^{-b(x-m)}$$

Results

There were differences, although not statistically significant ($p>0.05$), between the birth mass of colts (52.90kg±6.05kg) and fillies (51.45kg±6.08kg). Significant differences ($p<0.05$) were found between the birth mass of all foals born in January and foals born in March and April (Table 1).

Table 1 Effect of month of birth on birth mass.

	January	February	March	April	May
Birth mass(kg) ± sd	47.7±6.7 ^{a}	51.3±5.9	52.4±6.0 ^{b}	54.3±5.6.0 ^{b}	52.0±5.7

Different superscripts=significant ($p<0.05$) differences between columns.
*Where A=lower asymptote, b=fractional growth rate, C=upper asymptote, m=time to maximum growth, x=age in days and Y=live weight.
**Genstat for windows, 6th Edition, Version 6.1.0.2000

Sex did not affect growth rate up to 100 days of age, however after 100 days of age colts had significantly ($p=0.005$) higher rates of mass gain compared with fillies, and these differences persisted at 540 days of age (Figure 1). Month of birth did not significantly affect growth rate up to 200 days of age. After 200 days of age January born foals had significantly ($p=0.05$) lower rates of mass gain than foals born in other months and these differences persisted at 540 days of age (Figure 2).

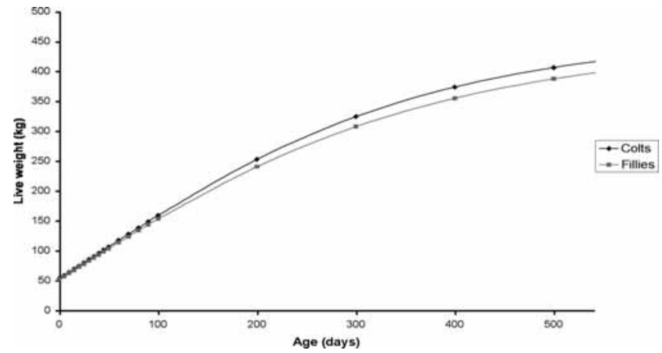

Fig 1 Effect of sex on growth rate.

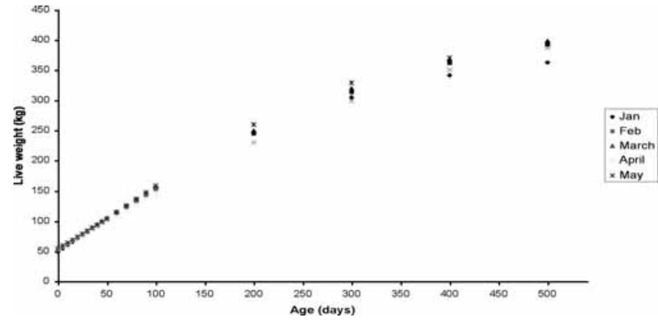

Fig 2 Effect of month of birth on growth rate.

Discussion

Effect of sex on birth mass

In agreement with the findings of another UK study (*Green* 1969), no significant ($p>0.05$) difference in birth mass was found between colts and fillies. This is contrary to the findings of American studies, which reported the birth mass of colts to be significantly ($p<0.05$) greater than fillies (*Green* 1969, *Hintz* et al. 1979). In humans, the greater birth mass of boys compared with girls has been attributed to androgen action (*De Zegher* et al. 1999) and serum insulin-like growth factor-1 (*Catalano* et al. 2001).

Effect of month of birth on birth mass

Although the age of the dam was not studied, this may have had a confounding effect on the data in this study. It has been reported that the offspring of younger dams (<7 years) have significantly ($p<0.01$) lower birth masses than those from dams aged between 7 to 11 years (*Hintz* et al. 1979). American studies have reported foals born in January to have lower birth masses than foals born in March and April, similar differences were reported in this study (*Pagan* et al. 1996, *Hintz* et al. 1979). Primaparous mares, which typically are less than 6 years of age and give birth earlier in the season, produce offspring with lower birth masses as a result of differences in the physiology of the placenta (Pool-Anderson et al. 1994, Wilsher and Allen 2003). In addition foals from primaparous mares have been reported to have significantly ($p<0.065$) lower levels of serum insulin-like growth factor-1 than foals born to multiparous mares (*Cymbaluk* and *Laarveld* 1996). Low levels of serum insulin-like growth factor-1 has been reported to decrease foetal and post natal growth (*Wang* et al. 1991). The dam's mature size and placental size have also been reported to influence birth mass (*Walton* and *Hammon* 1938, Wilsher and Allen 2003). It is likely that age and parity of the dam have a confounding effect on the data.

Effect of sex on growth rate

Colts have been reported to have higher rates of mass gain with age compared with fillies (*Pagan* et al. 1996) and these differences increased with age (*Hintz* et al. 1979). In this study colts had significantly ($p=0.005$) higher rates of mass gain compared with fillies after 100 days of age and these differences persisted at 540 days of age. The differences between colts (252.4kg) and fillies (240.1kg) became greater (>12kg) at 200 days of age. This coincided with the onset of puberty, which has been reported to occur between 212-408 days of age when body masses range from 277kg to 409kg (*Nogueira* et al. 1997, *Brown-Douglas* et al. 2004). Weight gain increases dramatically in the months following puberty due to increasing levels of sex hormones (*Nogueira* et al. 1997). In addition, studies in other species have reported differences in muscle distribution between males and females (*Gallagher* and *Heymsfield* 1998) and males have been observed to have greater muscle weights compared with females (*Baeza* et al. 1999). It is unknown if these factors occur in equines, but they may account for the higher body masses found in colts compared with fillies. Additionally, colts and fillies are typically segregated at an early age and differences in energy intake from pasture and supplementary feed may explain the differences found in this study.

Effect of month of birth on growth rate

Studies have reported that foals born in January had lower body masses with age compared with foals born in March and April (*Pagan* et al. 1996), and these differences persisted at 510 days (*Hintz* et al. 1979). Assuming body mass is dependent on energy intake, the lack of differences found in this study between the rate of mass gain of foals up to 200 days of age born in either January or later in the season may be explained by similar calorie intakes when suckling their dams. Mares foaling early in the season are provided with higher levels of supplementary feed, thereby compensating for the lower nutritional value of grazing during January and February. After 200 days of age January born foals had significantly ($p=0.05$) lower rates of mass gain compared with foals born in February-May. Foals will typically be weaned at around 200 days of age, thus January born foals are usually weaned in July whereas foals born later in the season are weaned during the autumn flush of grass growth (Aug-Oct). In this study, due to an observed low DM availability of grass as a result of a prolonged period of dry weather, the 2003 cohort of January foals may have had lower energy intakes than later born foals in the season.

Comparison of UK and USA growth rate data

The results of this study show differences in body mass, at specific ages, between UK and USA TB (Table 2). Using

Table 2 Body mass comparison between UK and USA TB.

	Age (days)	14	32	183	350	490
Mean body mass (kg)	UK (n=200)	64.2	78.9	224.4	358.5	424.5
	USA (n=700,[1] n=1,992[4])	76.1-77.7[1]	97-98[4]	250.7-255.9[1]	335.2-349.5[1]	418.0-427.8[1]

growth curves to predict body mass at specific ages allows breeders to monitor the growth of an individual compared with a population mean. Subsequently energy intake can be adjusted to achieve desired body mass and avoid fluctuations in the growth rate, which may increase the risk of developmental problems.15 It is suggested that USA growth curve data is not appropriate to use UK TB, as USA TB are heavier than UK TB at specific ages. Most TB in the UK and USA are sold as either foals (210-330 days of age) or yearlings (450-630 days of age) and body mass has been reported to influence potential value (*Pagan* et al. 2005). It may be that USA TB have an advantage over UK TB as they are heavier when sold as foals. However, UK breeders attempting to achieve similar body mass may increase the risk of developmental problems. A number of factors such as climatic conditions, genetics, management and feeding regimes may account for these differences.

Conclusion

Growth curves provide a prediction of body mass at a specific age, allowing more accurate nutritional support to achieve the requisite growth rate. Although commonly used in practise, USA growth rate data or models may not appropriate for defining the growth rate of foals in the UK and attempting to achieve USA growth rates may increase the risk of developmental problems. Such problems have severe economic impacts; it is estimated that 46% of TB do not achieve their expected sale value as yearlings because of such problems (*O'Donuhue* et al. 1992). The aetiology of developmental problems in horses is certainly multifactorial. The effect of growth rate and changes in body mass are unclear, as periods of rapid growth do not always coincide with the greatest incidences of developmental problems (*Frape* 1998). Future work to monitor growth rate and the incidences of developmental problems in individuals and populations is essential in order to ascertain optimal growth rate in the UK. Growth rate is affected by sex of the foal and month of birth but additional information such as body height is required to distinguish a TB gaining body mass without a corresponding increase in body height as this may increase the risk of developmental problems. Further investigation is required to determine the relationships between diet, body mass, growth rate and the onset of developmental problems.

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