Elite male Flat jockeys display lower bone density and lower resting metabolic rate than their female counterparts: Implications for athlete-welfare

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Abstract:

To test the hypothesis that daily weight-making is more problematic to health in male compared with female jockeys, we compared the bone-density and resting metabolic rate (RMR) in weight-matched male and female Flat-jockeys. RMR (kcal.kg^{-1} lean mass) was lower in males compared with females as well as lower bone-density Z-scores at the hip and lumbar spine. Data suggest the lifestyle of male jockeys' compromise health more severely than females, possibly due to making-weight more frequently.

Keywords: Jockey, weight-making, metabolism, bone, hydration, injury

Introduction:

Professional jockeys are unique amongst weight-making athletes in so much as they are required to make-weight all-year round and on a daily basis (Wilson et al. 2014). It has been widely reported that in order make-weight jockeys will engage in unhealthy weight-loss practices such as food deprivation and dehydration (Labadarios et al. 1993; Leydon and Wall 2002; Moore et al. 2002; Warrington et al. 2009; Wilson et al. 2013a; Wilson et al. 2015), chronic fluid restriction (Leydon and Wall 2002; Dolan et al. 2011; Wilson et al. 2013b) and self-induced vomiting (Moore et al. 2002; Dolan et al. 2011). Such practices compromise markers of health and well-being particularly relating to bone (Warrington et al. 2009; Waldron-Lynch et al. 2010; Dolan et al. 2012; Wilson et al. 2013a; Wilson et al. 2015) and mood (Leydon and Wall 2002; Caulfield and Karageorghis 2008; Wilson et al. 2012b; Wilson et al. 2013a) Additionally, it has been reported that rapid weight-loss in jockeys compromises their physical strength and riding performance (Wilson et al. 2013b), which may increase the occupational hazards of race-riding (Dolan et al. 2013; Wilson et al. 2013b).

Whereas, previous literature on weight-making and jockey health has by-and-large concentrated on male professional jockeys, there exists little data on female professional jockeys although they too are required to make-weight on a daily basis. We therefore recruited male and female weight-matched professional jockeys to examine effects of daily weight-making on markers of bone health and resting metabolic rate. Given the requirement of males and females to ride at the same weight despite known gender differences in lean body mass we hypothesised that the adverse health consequences observed to date in professional jockeys would be significantly worse in male compared with female jockeys, because of the known gender differences in lean body mass (Buchholz et al. 2001).

Materials and methods:

Sixteen (n=8 male; n=8 female) professional Flat jockeys volunteered for this study (the subject characteristics can be seen in Table 1). At the time of the study, all jockeys were currently race-riding in Great Britain (GB) and therefore were actively making-weight on a daily basis. Jockeys reported to the laboratory at ~ 9.30am, following an overnight fast for the assessment of hydration status, bone density, body composition and resting metabolic rate (RMR). For the most recent year (2014) the male group had an average of 368 (±198) professional race-rides and females had 162 (±123) (Post 2015). Both groups were free of injury at the time of testing and none of the jockeys were smokers, taking medication or nutritional supplements. Jockeys provided a mid-flow urine sample for assessment of osmolality using a handheld refractometer (Atago, USA) which has previously been validated against freezing point depression (Sparks and Close 2013). Jockeys were then measured in minimal clothing (vest and shorts) for height and weight on a dual height/weight stadiometer (Seca, Germany), before having whole body composition and hip and lumbar bone sites analysed using dual-energy X-ray absorptiometery (DXA) scan (Hologic, USA). Finally, jockeys then underwent a 20-min assessment of resting metabolic rate (RMR) in a supine position using indirect calorimetry (Melayser, USA). Resting metabolic rate was calculated by the averaged breath-by-breath VO_2. ($L \cdot min^{-1}$) from the last 15-min of the 20-min collection period (Compher et al. 2006) and multiplied by 60 (representing minutes) and 24 (representing hours), and by the calorific value corresponding to the averaged respiratory quotient value in the Table of Zuntz (Zuntz 1901). All testing took place in the same building with RMR taking place after the DXA scan in an adjacent room to the main laboratory. The jockeys were supine for an additional 15 minutes prior to the commencement of the RMR examination to allow the effects of movement to dissipate.

Statistical analysis:

All data were analysed using SPSS for Windows (Version 22 SPSS Inc. USA). Data were initially checked for normality and then independent T-tests were performed to compare male with female jockeys. All data were reported as means (± SD) with additionally 95% confidence intervals (CI), and statistical significance was set at P≤0.05.

Results:

All data are presented in Table 1.There were no significant difference in total body mass (P=0.78; 57 ± 2.1 vs. 57.3 ± 3.5 kg) or height (P=0.07; 167 (± 4 vs. 163 ± 5) between males and females respectively. Despite greater lean body mass (P=0.01; 5.7 ± 1.2 vs. 42 ± 3.3 kg) and lower percentage body fat (P=0.01; 12.5 ± 2.7 vs. 19.5 ± 2.5 kg) in males compared with females, respectively, no differences in RMR were apparent (P=0.59; 1484 ± 141 vs. 1540 ± 110 $kcal.day^{-1}$). However, there was a significant difference in RMR when expressed as $kcal.kg^{-1}$ lean mass (P=0.01; 33 ± 3 vs. 36 ± 2) in males compared with females respectively. Males had lower bone mineral density (BMD) Z scores at the hip (P=0.03; -1.2 ± 1.0 vs. -0.02 ± 0.8) and lumbar spine (P=0.02; -1.6 ± 1.3 vs. -0.3 ± 0.8) compared with females. There was no significant difference in BMD in $g.cm^2$ at the hip (P=0.21; 0.89 ± 0.1 vs. 0.87 ± 0.15) although there was a trend for a significant difference at the lumbar spine (P=0.09; 0.90 ± 0.14 vs. 1.02 ± 0.13) for males versus females respectively. Morning urine osmolality was significantly greater ($P=0.05$; 773 ± 257 vs 432 ± 231 $mOsmol \cdot L^{-1}$) as was the total number of rides in the 2014 season ($P=0.01$; 368 ±198 vs. 162 ±123 rides) in males compared with females.

Discussion:

The main aim of the present study was to compare the RMR and bone density of weight-matched adult elite male and female professional Flat jockeys to test the hypothesis that daily weight-making is more problematic to health in male compared with female jockeys. We report for the first time that despite the male jockeys demonstrating significantly greater lean muscle mass, there was no difference in absolute RMR, which is in contrast to that seen in healthy active people (Arciero et al. 1993; Buchholz et al. 2001). Importantly, when RMR was expressed relative to lean mass, females had a significantly greater RMR. Moreover, female jockeys had significantly higher bone density Z and T scores at the hip and lumbar spine as well as a trend for higher BMD ($g.cm^2$) at the lumbar spine. These data confirm the hypothesis that RMR and bone density of male jockeys are compromised compared to their female counterparts that may be due to reduced lean mass making weight-making easier, and/or the fact that the female jockeys have less race-rides in a given season.

Our data concur with previous research that professional male jockeys have sub-optimal bone health (Leydon and Wall 2002; Warrington et al. 2009; Waldron-Lynch et al. 2010; Dolan et al. 2012; Wilson et al. 2013a). A likely explanation is that male jockeys have inadequate energy availability (Wilson et al. 2014) for normal physiological function (Loucks 2004), given energy availability has been reported as low as ~19 kcal kg^{-1} lean mass (Wilson et al. 2013a), that is considerably lower than the consensus value 45 kcal kg^{-1} lean mass (Loucks et al. 2011). Interestingly, despite having to ride at the same weight the BMD of the female jockeys did not present as problematic using the International Society for Clinical Densitometry (ISCD) guidelines.

In the one previous study to measure bone density of senior female jockeys using DXA (Leydon and Wall 2002) it was reported that 2 of the senior female cohort (n=5) were classed as having osteopenia (T-score < -1 at two sites), which did not apply to any of the 8 female jockeys in our study. Whereas the female jockeys in the present study displayed lower bone density in comparison with other female weight-making athletes (Trutschnigg et al. 2008), their bone density Z and T-scores were significantly higher at both sites compared with the males. Previous work on the bone density of female weight-making athletes from other sports appears limited to one study on female boxers, who demonstrated that the boxers had greater bone density compared with physically active female non-boxers (Trutschnigg et al. 2008). Taken together these data suggest it is not weight-making *per se* that is the driver of reduced bone density in jockeys but rather a combination of weight-making and limited weight-bearing activity, combined with being required to make-weight daily. It is possible that the greater bone density in female compared with male jockeys in this study could be due to females possessing lower lean mass and being shorter in stature resulting in a reduced need for these jockeys to engage in severe weight-making regimes such as food deprivation and sweating (Dolan et al. 2011; Wilson et al. 2013*b*). This suggestion is supported by the fact that the urine osmolality data suggested that male jockeys in this study were dehydrated, whereas female jockeys presented euhydrated (Shirreffs and Maughan 1998). Moreover, it was observed that the females competed in significantly less race-rides than the male jockeys thus subjecting them to less frequent weight-making days. Although the precise reason for the poorer bone density in the male jockeys is unclear this study suggests that specific guidance should be given to the male jockeys in regards to strategies to improve bone health although weight-making advice for both groups are still clearly required.

Of particular interest was the lack of significant difference in RMR between the two genders. This observation is in direct contrast with data from non-weight- making athletic groups (Thompson et al. 1996) and healthy active subjects (Arciero et al. 1993; Buchholz et al. 2001) that have all consistently reported greater RMR in males compared with females. It should however be stressed that to the authors knowledge this is the first data to compare RMR between males and female athletes engaged in a weight-making sport. Given that lean body mass is widely accepted as the single predictor variable for assessing RMR (Cunningham 1980) the observation that there was no difference in RMR despite significantly greater lean body mass in the males was somewhat unexpected. Although the present study was not designed to answer this question we postulate that this could be due to more severe weight-making practices employed by male jockeys including food deprivation and fasting to make-weight (Labadarios et al. 1993; Moore et al. 2002; Dolan et al. 2011; Wilson et al. 2013b), despite recent data from our laboratory suggesting that such practices are unnecessary (Wilson et al. 2012a; Wilson et al. 2015). Indeed, we have recently demonstrated that by increasing food frequency, adding structured exercise and changing the macronutrient composition, the RMR in 10 professional jockeys significantly increased whilst the jockeys concomitantly reduced their body fat (Wilson et al. 2015).

In conclusion, the male elite professional Flat jockeys in this study demonstrated reduced bone density and a compromised RMR compared with female jockeys, which is likely due to greater stresses of making-weight. The reduced bone density in the male jockeys increase the risk of injury in the event of a fall. It appears that male jockeys particularly require alternatives to food deprivation and fasting, as a tool to make-weight, such as those demonstrated previously by our group (Wilson et al. 2012a; Wilson et al. 2015) and further highlights the need for targeted education in these athletes.

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