Title: Prevalence and severity of gastrointestinal symptoms in recreational and elite Equestrian athletes in training and competition: an exploratory analysis

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Abstract

Equestrian sports present a unique challenge to the rider's GI tract and health, as they meet nutritional requirements for performance, execute riding-discipline specific skills, and coordinate their hip and abdominal movements with their equine movement pattern. Additional gastro-intestinal challenges may result through the known gut-brain axis, as previous research reports a high rate of anxiety in equestrian athletes. A survey was administered to assess gastro-intestinal symptom prevalence and severity in recreational and elite equestrian athletes, across a range of disciplines. Participants reported prevalence of 12 symptoms on a 0-10 point scale, and stool consistency using a modified validated questionnaire. Total symptom score, symptom perception and symptom region (Upper GI tract, Lower GI tract and Other) were assessed. A sub-set of elite riders repeated the questionnaire post-competition.

Elite riders had a higher average total GI symptom score but did not differ significantly to the recreational sample (W = 438.50; $p = 0.13$; $r_B = 0.19$; *Small*). There were no regional symptom differences between groups. Prevalence of all abnormal stool consistencies were higher in the elite sample, when compared to the recreational sample. Five elite athletes (25%) reported blood in stool. Symptoms are not correlated with nor predicted by rider age, or number of competitions performed per year (all $p > 0.05$; $R^2 = 0.10 – 0.59$). Symptoms were not significantly different in competition.

The majority of equestrians present with some GI symptoms, with a small proportion of elite and recreational riders showing symptoms that impair exercise performance. The questionnaire provides a useful starting point for athletes, coaches and support personnel to understand symptom prevalence and severity in equestrians.

Keywords

Horse riding; Gut health; Show-jumping; Eventing; Dressage; Elite Athletes; Recreational Activity

Introduction

Equestrian sports are under-researched across the sport sciences (Millet et al., 2021) and are uniquely complicated as the only Olympic discipline requiring co-operative partnership between human and non-human (equine) athletes to compete. Equestrian athletes must satisfy the additional performance and welfare management requirements of equine athlete(s) alongside their own personal and training needs. These additional requirements can place significant financial costs and psychological stress upon equestrian athletes (Best et al., 2023; Lamperd et al., 2016).

The ability to manage psychological stressors is a pre-requisite for elite sport achievement and performance (Hardcastle et al., 2015; Meyers & Sterling, 2000). Equestrian sport psychology has focussed upon rider anxiety (Schütz et al., 2023; Williams & Tabor, 2017; Wolframm & Micklewright, 2010a, 2011), and how a rider's psychological state may impact rider and horse physiology and performance (Best et al., 2023; Lewinski et al., 2013; Williams, 2013; Wolframm & Micklewright, 2010b, 2011). Appropriate sports nutrition support may enhance athletes' psychological state and optimise performance (Best et al., 2023). There is a growing understanding of how the gastrointestinal (GI) tract and brain interact in response to physiological stress or exercise and modify GI and psychological function(s) (Clark & Mach, 2016; Eisenstein, 2016; Luger et al., 1987). For athletes, this may manifest in potential performance disrupting GI symptoms such as a stitch, or the urge to defecate or vomit, potentially increasing rider error. This bidirectional communication is referred to as the gut-brain axis and comprises the autonomic nervous system and enteric nervous system in the GI tract (Clark & Mach, 2016; Eisenstein, 2016). The gut-brain axis is primarily governed by the Vagus nerve, running from the brainstem to the digestive tract, and is responsible for the control of digested materials (Eisenstein, 2016). Secondary mediating factors are gut hormones (e.g. 5-hydroxyptamine, noradrenaline) and gut microbiota (e.g. Turicibacter spp, Ruminococcus gnavus) (Clark & Mach, 2016; Rhee et al., 2009). Inappropriate nutritional choices and a lack of gut training or familiarity may also increase GI distress. Gut-brain axis stressors of particular concern for athletes are anxiety, exercise-induced hyperthermia, exercise duration and intensity and nutrition circa-exercise (Berger et al., 2024; Hughes & Holscher, 2021; Luger et al., 1987; Racinais et al., 2015; Schütz et al., 2023; Wilson, 2020; Wilson, Ferguson, et al., 2023). Each of the named stressors have been shown to influence prevalence and severity of GI symptoms during exercise, and may respond to training or intervention.

GI symptoms during exercise have traditionally been considered within an (ultra-)endurance context (Berger et al., 2024; Hoogervorst et al., 2019; Pugh et al., 2018) and from a broad perspective (Wilson, 2019). There is an increased focus on location of symptoms within the GI tract (Gaskell et al., 2019; Wilson, 2019) and breadth of contexts (e.g. (Wilson, Fearn, et al., 2023)). GI symptoms in sport are typically assessed in relatively fixed (cycling) or vertically oscillating (running) torso movement patterns. Equestrian sports require the rider to oscillate their lower abdomen and pelvis in all three axes while coordinating and accommodating for the horse's gait and unique/individualized movement patterns (Baillet et al., 2017; Cocq et al., 2013; Engell et al., 2016). Each discipline requires additional consideration depending on saddle design, movement patterns (e.g., jumping), and rider position (Bye & Lewis, 2019; Deckers et al., 2020; Wilkins et al., 2022, 2023). Potential links to pathology should also be considered, and how we best support athletes in equestrian contexts with nutritional and psychological coaching warrants further investigation (Best et al., 2023; Wolframm & Micklewright, 2011), once baseline GI symptom prevalence and severity are understood.

This research aims to capture the prevalence and severity of GI symptoms in equestrian athletes. It is hypothesised that prevalence of symptoms may exceed that of the general population and other athletic groups due to the previous interest in anxiety and competition practices within equestrian sport. We also hypothesise that severity will vary between individuals, and symptoms will be higher in competition than in training.

Methods

Ethical approval for this project was provided by the Waikato Institute of Technology's Human Ethics in Research Group (Approval number: WTLR16010523) and supported by Equestrian Sports New Zealand (ESNZ).

Questionnaire design

Questionnaires were developed and hosted using the lead author's institute's preferred software to facilitate distribution (Qualtrics, Utah, USA). Paper copies were not used. IP address and captcha data were gathered to ensure responses were performed by humans and any repeat responses could be queried or removed. The training questionnaire design was adapted from previously published work on equestrian participation demographics (Keener et al., 2023) and gastrointestinal symptoms in endurance athletes (Gaskell et al., 2019). Demographic factors included respondent age, sex, years of riding experience, preferred discipline, competitive level and annual competition participation (an average number in a typical year). Gaskell et al's questionnaire (Gaskell et al., 2019) was modified to assess athlete perception of GI symptoms (Overall gut discomfort), total, upper and lower GI symptoms using a 0 – 10 point Likert scale and defecation behaviours as Yes/No responses. A rating of 0 indicated no symptoms for that particular factor. Ratings of 1 – 4 indicated a sensation of GI symptoms but no interference with exercise performance, 5 – 9 indicated GI symptoms potentially impacted or inhibited exercise performance and a rating of 10 indicated either severely impacted exercise performance or cessation (Gaskell et al., 2019).

Practitioner engagement was assessed in questionnaires that were distributed to both recreational and elite groups. In the recreational group athletes were asked whether they had ever visited a doctor or other medical practitioner for symptoms related to GI symptoms, or anxiety – with available response options of Yes, No, Unsure and Prefer not to say. Elite athletes were asked the same questions as the recreational group, and were also asked about sports psychology and dietetic engagement. More specifically, whether they had sought support from a sports psychologist or related practitioner for anxiety or mental aspects of performance and whether they had sought support from a sports dietitian or related practitioner for support related to GI symptoms, or nutrition as it related to sports performance. No distinction was made between whether this advice from support personnel was sought for clinical or performance reasons either exclusively or congruently.

The training and competition questionnaires are available as supplementary materials.

Questionnaire distribution

Distribution took place via introductory articles that contained both a direct link and QR code, published online and in lay publications in New Zealand; distribution was supported by social media. Data were collected over three months online (Recreational: May – August 2023; Elite: July – September 2023). A known elite sample was recruited through direct contact via national governing body performance pathways (ESNZ, Wellington, New Zealand). Given the relative novelty and potential sensitivity of the topic, we anticipated a low uptake relative to potential sample size within each group. To assess competition symptoms, elite participants were requested to provide the date of their next competition and a condensed version of the training questionnaire focussing upon symptoms experienced by the athlete and the extent to which preparation and nutritional intake were habitual was distributed via email on the Monday morning following competition. Athletes had 24 hours to complete their competition survey.

Within competition data are only reported for the Elite group, due to being able to validate participation via ESNZ.

Statistical analyses

Demographic data and responses to binary questions are reported using a comprehensive range of descriptive statistics and percentages, respectively. One sample t-tests were used to assess the prevalence and severity of symptoms, using participants' perception of overall symptoms, against pre-determined thresholds of a rating of ≥1 (awareness of non-zero symptoms) and rating of ≥5 (symptoms may inhibit performance) for each group. Differences between groups were assessed via independent samples Mann-Whitney t-tests, due to differences in sample sizes between groups. Differences between training and competition data were assessed via Wilcoxon signed rank tests, with the direction and hypothesis of comparison being training < competition. For defecation symptoms, differences between groups were assessed using contingency tables and chi-square (χ^2) statistics for independence. Relationships between demographic data and symptom severity are assessed via linear regression(s), with years riding and numbers of competitions per year as co-variates; checks for residuals, normality and linearity performed using appropriate plots (Best & Standing, 2019).

All analyses are accompanied by effect sizes. In the case of the independent samples t-tests, rank biserial correlation which are interpreted as per descriptors for Spearman correlation coefficients: <0.1 *trivial,* 0.1 – 0.3 *small,* 0.3 – 0.5 *moderate,* ≥0.5 *large*. For paired and one-sample tests, standardised mean differences (Hedge's *g*) are considered *trivial, small, moderate, large* and *very large* at thresholds of <0.2, 0.2 – 0.6, 0.6 – 1.2, 1.2 – 2.0 and ≥ 2.0 standard deviations (Hopkins et al., 2009). Thresholds for statistical significance across all analyses were $p<0.05$.

Results

A total of 84 surveys were returned with 57 complete surveys included for analysis forming the recreational sample. In the elite sample, 20 complete surveys were obtained from 31 responses, from a possible 80 athletes, Only complete surveys were included for analyses and reporting to ensure consistency of interpretation. Data were analysed in two sub-groups of recreational riders and Elite with national and international riders, as per ESNZ.

Demographics

Demographic data for recreational and elite samples are provided in Table 1, for age, sex, years riding experience, level of competition and number of competitions participated in per year. Recreational included athletes from a wide variety of equestrian events while Elite encompassed those riders who were part of the national high performance system and included international representation (eventing, showjumping and dressage). Event preference for the recreational sample is presented in Figure 1 panel A, and Figure 1 panel B for the elite sample. Due to specialisation, elite athletes only selected one response whereas the recreational sample were free to select multiple responses hence response numbers exceed sample size (Figure 1 panel A). Response selection decreased as number of disciplines selected increased i.e. 27 respondents selected a second discipline, 19 respondents selected a third discipline and two respondents selected a fourth discipline (see supplementary materials). Wide age range and participation in year in equestrian are illustrated from under 18 y to over 60+ y and 4 y to 42 y of riding experience.

Table 1: Demographics of Recreational and Elite riding populations

			Characteristic				
Age range	*Under 18*	*18 - 19*	*20 - 29*	*30 - 39*	*40 - 49*	*50 - 59*	*60 or over*
Recreational	0	2	10	5	11	5	4
Elite	3	4	9	1	1	2	0
Gender	*Female*	*Male*					
Recreational	35	2					
Elite	19	1					
Years of riding^	*Mean ± SD*	*Median ± Range*	*Minimum*	*Maximum*			
Recreational	27 ± 13	28 ± 46	4	50			
Elite	17 ± 9	14 ± 37	5	42			
Competition level	*Recreational*	*Local*	*Regional*	*National*	*International*		
Recreational	4	8	11	13	1		
Elite	0	0	0	11	9		
Competitions per year^	*Mean ± SD*	*Median*	*Range*				
Recreational	12 ± 7	10	0 – 40				
Elite	17 ± 6	15	6 – 30				

Significant differences between groups are denoted using*. ^Values are rounded to the nearest whole year

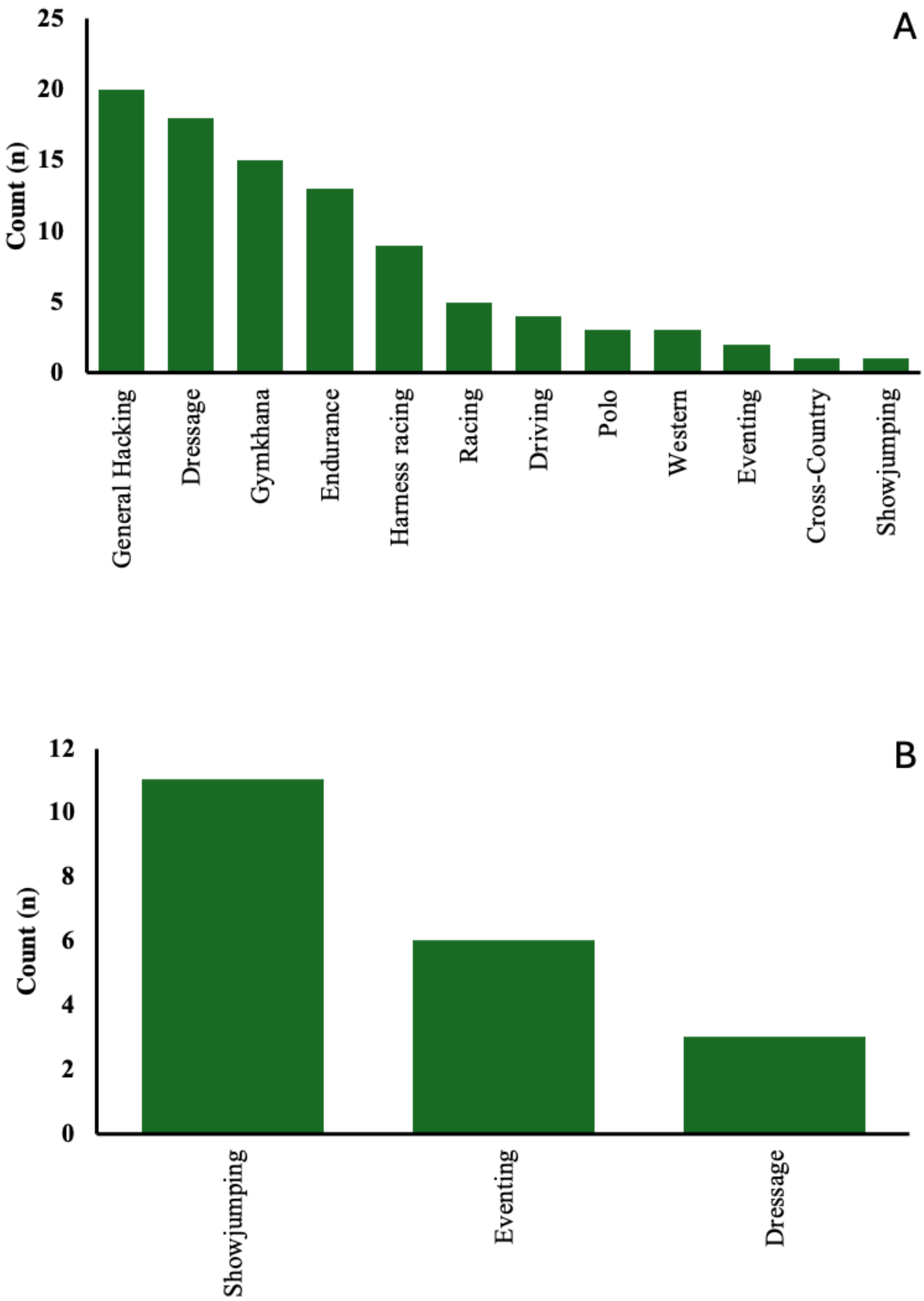

Figure 1 – Preferred discipline for Recreational (n = 57; Panel A) and Elite (n = 20; Panel B) samples. Recreational participants could select up to three disciplines. Elite athletes were asked to select the discipline in which they competed that aligned to their governing body performance pathway selection.

Practitioner engagement

Recreational

The recreational participation group reported low practitioner (support services including medical, psychological and nutrition) engagement due to GI symptoms within the last year. Thirty two (56%) respondents reported not having visited a doctor, 1 stated they were unsure and 4 visited a doctor for GI symptoms. For anxiety related symptoms practitioner engagement within the last year was higher and more evenly distributed. Twenty one (37%) respondents reported not having visited a doctor, with the remaining 16 respondents having visited a doctor for anxiety related symptoms. There was no correlation between having visited a doctor for GI symptoms and anxiety (r = -0.02; *Trivial*).

Elite

The Elite group reported low practitioner support engagement due to GI symptoms within the last year. Fifteen (75%) respondents reported not visiting a doctor, 1 was unsure and 4 visited a doctor for GI symptoms. Similar values were reported for anxiety, 14 respondents had not visited a doctor, and 6 visited a doctor for anxiety related symptoms. Due to wider availability of specialist support staff, elite athletes were also asked about psychologist and dietitian engagement. Eight (40%) reported not having consulted with a psychologist within the last year, 1 was unsure, and 11 had or were actively being supported by a psychologist. No dietitian engagement was indicated by 12 riders, with 1 was unsure and 7 had or were actively being supported by a dietitian.

Prevalence and severity of symptoms

Prevalence and severity of symptoms are reported in training for both groups.

Training

Data in the recreational sample were non-normally distributed as assessed against previously stated criteria (Best & Standing, 2019), Shapiro Wilk values and visual inspection of Q-Q plots. The elite sample appeared to be normally distributed for all variables except lower GI symptoms. However, due to the relatively small sample size of the elite group, and the uneven sample sizes between groups we have opted to perform and report non-parametric equivalents. Comparisons between recreational and elite groups by region are outlined in Figure 2.

Total GI symptom scores and Overall perception of GI symptoms

Total GI symptom scores comprise the total of upper, lower and other GI symptom scores. Median total score for the recreational sample was 19 and ranged from 0 to 63 (mean ± SD = 20.00 ± 16.60). Median total score for the elite sample was 24 and ranged from 0 to 54.5 (mean ± SD = 24.05 ± 14.95). Whilst the elite sample had a higher average total GI symptom score they did not differ significantly to the recreational sample (W = 438.50; p = 0.13; r_B = 0.19; *Small*).

Overall perception is an athlete reported measure of GI symptom experience, scored from 0 – 10. The median overall value from the recreational sample was 2, ranging from 0 to 8 (mean ± SD = 2.27 ± 2.03). Median overall value for the elite sample was 2 and ranged from 0 to 7 (mean ± SD = 2.42 ± 2.02). Differences between samples in overall GI symptom perception were *trivial* (W = 390.50; p = 0.37; r_B = 0.06).

Upper GI symptom scores

Upper GI symptoms comprised belching, heartburn, bloating, urge to regurgitate and vomiting. Symptoms experienced by the recreational sample ranged from 0 to 29, with a median value of 6, from a possible maximum score of 50 (mean ± SD = 7.70 ± 7.31). In the elite sample, the median value was 8 with a range of 0 to 23 (mean ± SD = 9.68 ± 7.42). Differences in upper GI symptoms between samples were not significant (W = 432.50; $p = 0.15$; $r_B = 0.17$; *Small*).

Lower GI symptom scores

Lower GI symptoms comprised flatulence, lower bloating, left intestinal pain and right intestinal pain. Symptoms experienced by the recreational sample had a median value of 4 and ranged from 0 to 26, from a possible maximum of 40 (mean ± SD = 7.45 ± 7.27). The elite sample had a median value of 7.5 and ranged from 0 to 20 (mean ± SD = 8.55 ± 6.62). Differences in lower GI symptoms between samples were not significant (W = 425.00; $p = 0.18$; $r_B = 0.15$; *Small*).

Other GI symptom scores and defecation

Other GI symptoms incorporated nausea, dizziness and stitch. The recreational sample had a median value of 3 and ranged from 0 to 23 (mean ± SD = 4.85 ± 5.61), from a possible maximum of 30. The elite sample had a median of 5.5 and ranged from 0 to 13.5 (mean ± SD = 5.83 ± 3.70). Differences in other GI symptoms between samples were not significant (W = 460.00; $p = 0.07$; $r_B = 0.24$; *Small*).

Defecation responses for recreational and elite groups are provided below in Table 2. Prevalence of normal stool consistency was significantly lower in the elite sample compared to the recreational sample (χ^2 (1) = 8.51; $p < 0.001$). Prevalence of all abnormal stool consistencies were higher in the elite sample, when compared to the recreational sample; however, only values for bloody stool differed significantly (χ^2 (1) = 6.84; $p < 0.001$).

Table 2: Reported defecation consistency prevalence of recreational (n = 57) and elite equestrian athletes (n = 20) experienced during training.

	Stool Consistency				
Group/ response	*Normal*	*Abnormally loose*	*Diarrhoea*	*Bloody Stool*	*Constipation*
Recreational					
Yes	18	21	10	0	--
No	19	14	25	35	--
Blank	0	2	2	2	--
Elite					
Yes	2	14	8	5	2
No	18	6	12	15	18
Blank	0	0	0	0	0

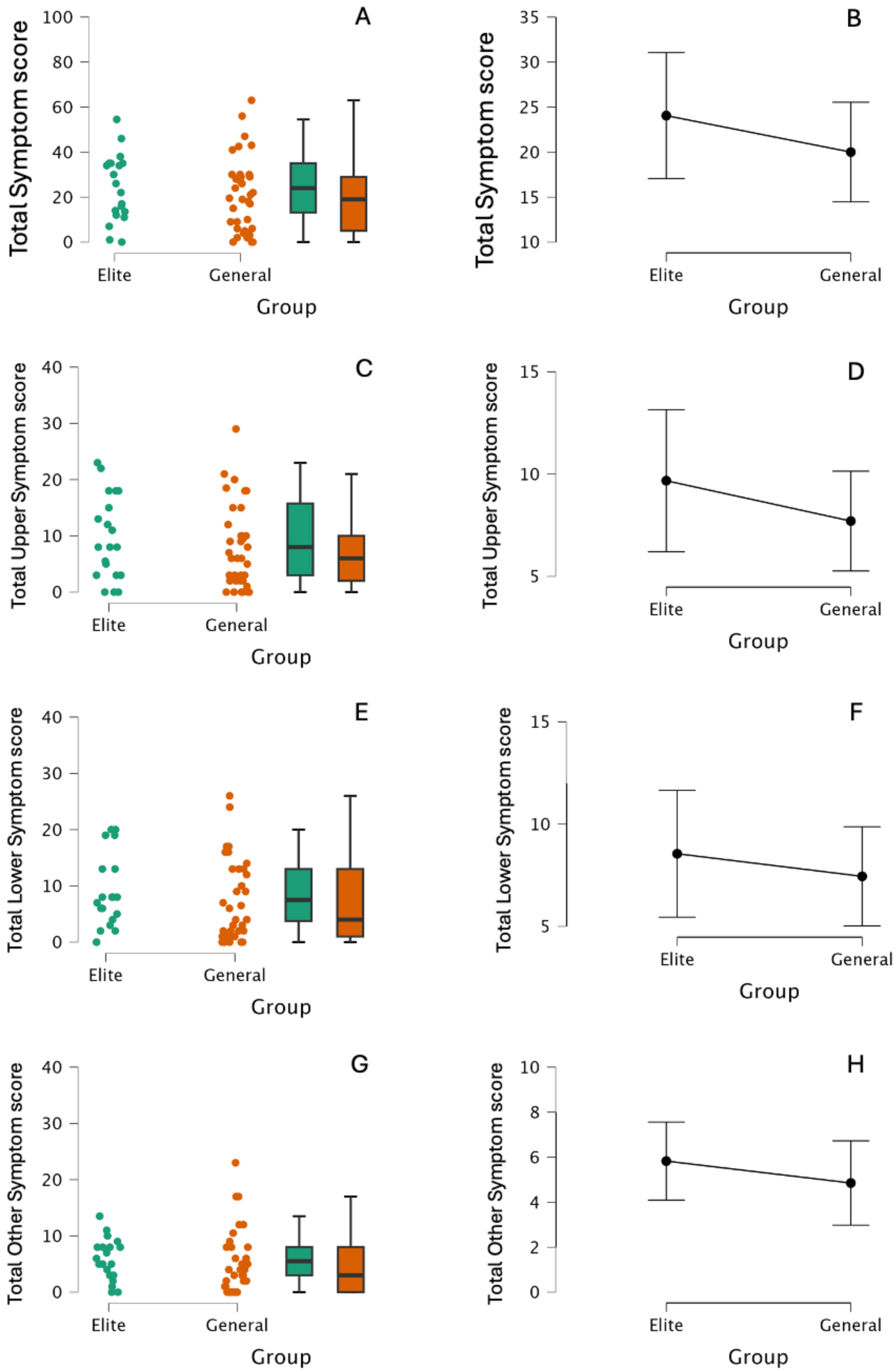
A
B
C
D
E
F
G
H
Total Symptom score
Total Upper Symptom score
Total Lower Symptom score
Total Other Symptom score
Elite
General
Group

Figure 2 – Symptom location within and between recreational and elite equestrian groups for Total (Panels A and B), Upper (Panels C and D), Lower (Panels E and F) and Other (Panels G and H) GI symptom scores.

Competition

Overall symptom perception did not differ significantly between training and competition (W = 2.50; p = 0.50; r_B = -0.17; *Small*). Similarly, total sample score did not differ between training and competition (W = 12.00; p = 0.91; r_B = 0.60; *Large*). Neither upper (W = 9.00; p = 0.95; r_B = 0.80; *Very Large*), nor lower (W = 9.50; p = 0.75; r_B = 0.27; *Small*), nor other GI symptoms (W = 4.00; p = 0.22; r_B = -0.47; *Moderate*) were significantly worse during competition, however effect sizes indicate a range of responses across participants. That is to say, if GI symptoms are prevalent in training they are likely to remain in competition but not necessarily worsen (Figure 3).

Similarly, for defecation symptoms there were no differences in Normal (W = 0.00; p = 0.50; r_B = -1.00; *Very Large*) or Loose stools (W = 4.00; p = 0.81; r_B = 0.33; *Moderate*); or for diarrhoea (W = 1.00; p = 0.98; r_B = 1.00; *Very Large*) or constipation (W = 1.50; p = 0.68; r_B = 0.00; *Null*). No participants for whom competition data were available reported bloody stools in either training or competition.

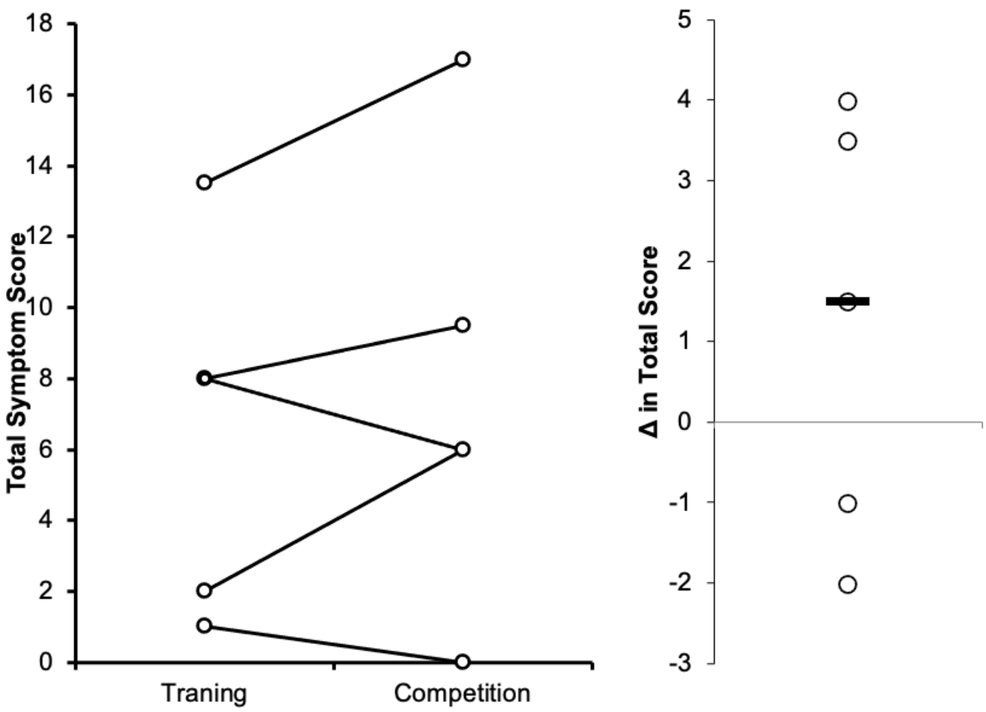

Figure 3 – Individual scores in training and competition for GI symptoms by region in five elite riders who completed both questionnaires. Black line indicates the median difference in total GI symptom scores between training and competition. Figures are produced via sheets available from Weissgerber et al., (2015).

Within group comparisons against symptomatic reference values

Figure 4 shows athlete perception of symptoms against symptomatic reference values for prevalence and severity with respect to performance impairment in elite and recreational samples.

Athlete perceptions of symptoms in the recreational group showed a significant prevalence of GI symptoms compared to the predefined symptomatic value (W = 442.50; p = 3.33 x 10^{-4}; r_B = 0.68; *Large*), however symptom severity was significantly lower than the value considered to impair performance (W = 25.50; p = 9.66 x 10^{-7}; r_B = 0.76; *Large*).

Athlete perceptions of symptoms in the elite group showed a significant prevalence of GI symptoms compared to the predefined symptomatic value (W = 120.00; p = 3.55 x 10^{-3}; r_B = 0.76; *Large*), however symptom severity was not considered to significantly impair performance (W = 7.50; p = 1.00; r_B = -0.92; *Large*) being lower than the threshold value in the majority of the population.

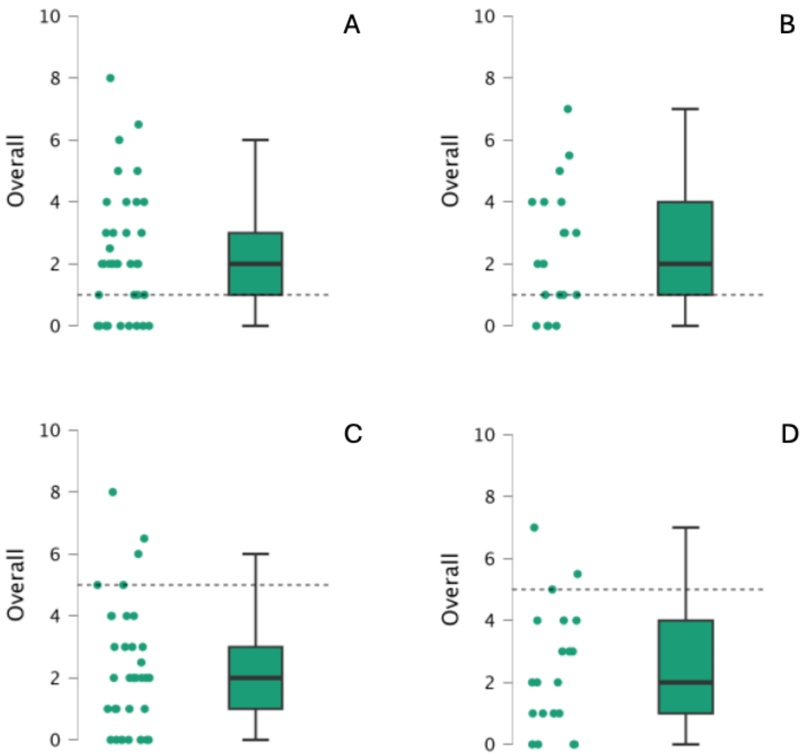

Figure 4 - Athlete perception of symptoms against symptomatic reference values (dashed line) for prevalence (≥1) and severity (≥5) with respect to performance impairment in elite (panels B and D) and recreational (panels A and C) samples.

Relationships between demographic factors and total symptoms

Three linear regressions were performed with a view to predicting total GI symptoms: participant age group (F(8,43) = 1.46, p = 0.20, R^2 = 0.21), preferred discipline (F(25,26) = 1.51, p = 0.15, R^2 = 0.59) and level of competition (F(5,46) = 1.00, p = 0.43, R^2 = 0.10), none of which were statistically significant predictors of total GI symptoms. Participant sex was not considered, due to the under-representation of males within the sample(s). This suggests that GI symptoms are non-discriminatory, and prevalence cannot be readily predicted when accounting for years of riding experience and number of competitions per year. Neither years of riding experience (-0.09; p = 0.53; *Trivial*), nor number of competitions per year (-0.16; p = 0.26; *Trivial*) were significantly correlated to total GI symptom score. While it appears more riders sought advice for anxiety related to GI symptoms it is unclear the number who sought additional nutrition advice to compliment the bidirectional impact of the brain gut axis and achieved relief or improvement in symptoms.

Discussion

The current study assessed the prevalence and severity of GI symptoms in equestrian athletes. We hypothesised that severity would vary between individuals, but symptoms would be higher in competition than in training; this was not the case. We also hypothesised that prevalence of symptoms may exceed that of the general population and other athletic groups due to the previous sport psychology research within equestrian sport highlighting a role of anxiety, and its known impact upon GI symptoms (Clark & Mach, 2016; Wilson, Ferguson, et al., 2023). Whilst symptom prevalence exceeded that of the general population (≤60% (Palsson et al., 2024), it was comparable to other sports, with 92% of athletes reporting symptoms of some symptoms/ non-zero values. This is comparable to ultra-endurance runners whom have reported symptom prevalence of up to 96% (Berger et al., 2024).

Gastro-intestinal symptoms are prevalent in recreational and elite equestrians. Despite differences in how symptoms are distributed between groups, upper GI symptoms are more prevalent than lower GI symptoms, irrespective of sample. Differences between groups are statistically *small* ($p = 0.13$; $r_B = 0.19$), but the higher mean/median values in the elite sample suggest that factors which contribute to GI symptom severity may differ between elite and recreational equestrians, or be a product of different training and working practices between these groups e.g. prolonged reduction in gastrointestinal blood flow due to increased ridden exercise volume (Berger et al., 2024; Oliveira et al., 2014).

Years of riding experience has no effect on symptom prevalence or severity. It could be assumed equestrian riders are accepting of GI symptoms and these behaviours have become normalised. Values do peak sooner in the elite sample (10–15 years) compared to later in recreational riders (15–20 years), indicating a possible link to ridden volume or variety in horses ridden and GI distress. This may occur if either riding professionally, producing horses for income, or riding someone else’s horses as a form of income increases ridden volume. GI symptom prevalence and severity may increase through alterations in blood flow away from the GI tract, biomechanical factors, reduced eating opportunities and inadequate hydration status (Costa et al., 2019; Oliveira et al., 2014). These findings warrant continued research into differences between elite and recreational equestrian groups, concomitantly capturing symptom prevalence and possible physiological mechanisms. Similar relationships are seen in equestrian injury, where ridden volume and participation in larger volumes of seemingly low risk activities impart a greater rate of injury (Glace et al., 2023; Marlin & Williams, 2024), due to increased baseline exposure to risk factors.

Bloating and flatulence were the most commonly reported symptoms in both groups, with the elite group also reporting these symptoms as impacting performance in the competition questionnaire responses. Biomechanical issues, posture, and breathing warrant consideration in both groups alongside gut training and pre-training/pre-event nutritional/food selection. These symptoms may also be a product of eating differently or what is perceived to be more healthily (and often higher in fibre) in the build-up to competition, or due to low quality and possibly a more limited food provision at competition venues. Further information is required to confirm these hypotheses. Regardless, education is required to support general nutrition habits and competition specific nutrition and hydration practices, where total, timing and type of food intake may differ to training/recreational riding (Best et al., 2023) to minimise GI disturbance and maximise performance.

Perceived GI symptom severity is low (Median = 2/10), but frequent in both groups (23/37 recreational sample; 13/20 in elite sample), with ~15% in each group perceiving symptoms to be severe enough to impact their ridden performance (≥5/10 perceived symptom rating reported). This does not appear to change or does so only minorly (e.g. 0.5 to 1.0 units) as a result of competition in the elite sample. These values strongly indicate that athletes are aware of their GI symptoms and their severity, but are unaware of their potential adverse impact(s) on health and performance. Athletes may either consider GI symptoms an accepted part of equestrian participation or are not aware of the availability of support from medical or dietetic practitioners. This is further evidenced by low reporting of doctor's visits due to GI symptoms in both groups, and only 35% of elite riders consulting with a dietitian, despite *moderate* to *large* correlations between symptom perception and total symptom score in both groups (r = 0.73 to 0.81).

Conversely, 16 (43%) recreational riders reporting seeking medical attention for anxiety. Relatively fewer elite riders sought support for anxiety (30%), but more than half (11/20) reported currently or having previously consulted with a psychologist. This is a possible corollary to the lower prevalence of anxiety in elite athletes. Likewise, whilst only 7 elite athletes had previously or were actively being supported by a dietitian, four athletes perceived their symptoms as a 0, and only 1 athlete had a total score of 0, indicating a need for nutritional support in this group, especially for GI symptom management. We recommend adopting a more inter-disciplinary approach to supporting GI issues within all equestrian populations due to the potential role of the gut-brain axis and how it can be impacted by diet and exercise (Clark & Mach, 2016; Hughes & Holscher, 2021). Evidence for the use of psychological and nutrition co-intervention in supporting GI conditions in clinical populations shows beneficial effects (Colomier et al., 2022; Cox et al., 2022), as both elements of the gut-brain axis are addressed congruently. However, it should be acknowledged that much of the work that takes an interdisciplinary approach and shows larger effect sizes is in palliative populations (Lu et al., 2021; Temel et al., 2016). Ideally, an integrated approach would provide a greater breadth and depth of education and strategies for athletes, and builds upon the existing acceptance and knowledge base of psychological support in equestrian sport to date, whilst increasing uptake of nutrition counselling. Further work on clinical aspects of GI function is also required at the gut and microbiome levels, exploring how these may differ in equestrians compared to other groups and sports e.g. animal ownership, lifestyle and hygiene factors compared to other sports may predispose equestrians to certain risk factors or microflora populations, as per other domestic animals (Abdolghanizadeh et al., 2024; Hernandez et al., 2022; Yang et al., 2023).

Loose/diarrhoea in elite group was reported by 14 riders, with 2 reporting constipation in training. More concerning was the 5 riders reporting blood in stool which is a significant concern. The majority of riders reported normal or loose in competition sample. With the higher microbial load of the equestrian environment riders need to take great attention to hygiene practices (eating in the stable environment, hand to face contact, equine to human contact, cleaning stables) and gut health (consider probiotic use, hand sanitising, and hand washing prior to handling food), especially when in a new environment just as these actions are taken with the equine athlete.

The survey was the first of its kind in equestrian sport, and so carries some limitations and considerations for future research. Given the novelty and potential sensitivity of the topic, we anticipated a low uptake relative to potential sample size. There is a need to break down any perceived barriers and provide quality information for athletes, especially where athlete health may be compromised due to lack of awareness or inaction (e.g. blood in stool). We intend to repeat the survey at a later date, as athlete awareness and access increases. Male athletes are frequently underrepresented in equestrian data, and this was also the case in these participant sets (n = 3/57 pooled; ~5%). Interestingly, male recreational athletes reported total GI scores approximating that of the mean/median for their group, but the elite male exceeded the average values of the elite group. Upper GI symptoms were most prevalent in males, with belching and bloating the most highly rated symptoms. We anticipate that GI symptom and wider research in equestrian sport will progress similarly to relative energy deficiency in sport (REDS (Ackerman et al., 2020; Mountjoy et al., 2014, 2023)). REDS links energy availability to wider systemic acute and chronic athlete health effects, well-being and performance; whereas previous frameworks focussed almost exclusively on symptoms related to female athletes (low energy availability, late onset or lack of menstruation and poor bone density outcomes (Souza et al., 2017; Temm et al., 2022)), REDS accounts for the breadth of symptoms and their ability to affect both male and female health and performance (Ackerman et al., 2020; Heikura et al., 2024; Mountjoy et al., 2014, 2023). There is a definite need for future research targeting male equestrian athletes to maximise our understanding of equestrian sport. However, participation demographic data consistently highlight that equestrian sports are a fantastic opportunity to undertake wider female sport science research and should not be ignored due to perceived complexity (Best, 2022).

The questionnaire itself is a useful screening tool for GI symptoms and possible routes of referral need to considered. We caution that although the questionnaire is useful for screening GI symptom prevalence and severity, and their potential for performance impact, there are populations who may ride AND display adverse gut health/GI symptoms. This could be due to co-pathology and or sustained impairment e.g. Paralympic riders (Hobbs et al., 2023; Stockley et al., 2022), or other disability riders who may experience a predisposition to GI conditions e.g. Down Syndrome (Tsou et al., 2020). We welcome open discussion of GI symptoms in equestrian communities, but encourage referral and 'zooming out', to consider potential causes and explanations for GI symptoms. We do not intend this work to empower coaches or support personnel to diagnose or treat GI or associated symptoms in their riders, unless appropriately qualified to do so.

In conclusion, GI symptoms are prevalent and of sufficient severity in equestrian athletes, irrespective of participation level, to be considered a modifiable factor with respect to riding performance. Symptoms do not appear to significantly worsen in competition, nor are they predicated by age, event or level of participation. More simply, athletes may enjoy or improve their riding when GI symptoms are addressed; they do not have to be an accepted part of equestrian sport and may point to greater underlying health risks. Appropriate support from medical and dietetic practitioners should be sought where symptoms persist and certainly if they impact ridden performance.

Declarations

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Conflicts of interest

The authors have no conflicts of interest to declare

Ethical approval

As outlined in **Methods**, the study received appropriate ethical approval and was conducted in accordance with the declaration of Helsinki

Data Availability

Data are available as supplementary materials, and will be made available via the corresponding author's institutional repository (researcharchive.wintec.ac.nz) and Researchgate profile (www.researchgate.net/profile/Russ-Best)

Authors' contributions

RB and JP contributed to the manuscript equally, both taking account for participant recruitment, data collection, analyses and manuscript preparation and revisions.

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