**Title**: Occurrence and impacts of gastrointestinal symptoms in team-sport athletes: a preliminary survey

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**ABSTRACT**

**Objectives**: Although gastrointestinal (GI) symptoms are prevalent in endurance athletes, scant research has examined GI symptoms in team-sport athletes, their impacts, and explanatory factors. This study aimed to assess the prevalence and severity of GI symptoms in team-sport athletes and identify potential risk factors.

**Design**: An observational anonymous survey.

**Setting**: Online.

**Participants**: 143 athletes (79 men, 64 women) from team-based sports, with soccer, rugby, and American football athletes comprising about 75% of the sample.

**Assessments of Risk Factors**: Age, gender, body mass index, competition experience, trait anxiety, and resting GI symptoms.

**Main Outcomes**: GI symptoms during training and competition.

**Results**:Overall, past-month GI symptoms during training and competition were mild and relatively infrequent. However, 13.9% and 37.5% of males and females, respectively, reported that GI symptoms had ever impacted their performance. In comparison to men, women reported that nausea, bloating, and abdominal cramping were more likely to have affected performance (p<0.05). Women also had higher trait anxiety as well as higher scores for resting GI symptoms, during-training GI symptoms, and during-competition GI symptoms (p<0.001). Resting GI symptoms were the strongest predictor of training and competition GI symptoms (ρ=0.46-0.67), though trait anxiety was also consistently correlated with competition GI symptoms (ρ=0.29-0.38).

**Conclusions**: This study suggests that female team-sport athletes experience a higher burden of GI symptoms than males, and that resting symptoms and anxiety predict competition symptoms. Interventions targeting anxiety could theoretically reduce GI symptoms in some team-sport athletes, but this should be confirmed through experimental designs.

**Keywords**: anxiety; competition; gastrointestinal distress; gender; sport.

**INTRODUCTION**

It is well recognized that gastrointestinal (GI) symptoms are prevalent among individuals partaking in endurance exercise, although estimates vary with factors such as exercise intensity, age, sex, training experience, nutritional intake, supplement use, and psychological state.1-5 Using a prospective design, Wilson found that male and female runners experienced at least one GI symptom on 84% and 78% of their runs, respectively, over a 30-day period, and moderate-to-severe symptoms (≥5 on a 0-to-10-scale) were experienced on 14-22% of runs.6 Competition-related GI symptoms are also commonplace, with ≥90% of ultra-endurance race (100-mile runs, 70.3-mile triathlons, etc.) participants reporting at least one symptom.7,8 Among standard 26.2-mile marathoners, Pugh et al. reported that the occurrence of moderate GI symptoms during competition ranges from 20-30%.9

Although strong evidence points to GI symptoms being common and problematic in endurance athletes, scarce research has examined this subject among team-sport athletes. Studies specific to team sports are needed because these activities are inherently different from endurance activities. Team sports such as soccer, American football, basketball, lacrosse, rugby, etc. involve repeated accelerations-decelerations and high-intensity exercise interspersed, to varying degrees, with rest or low-intensity work.10 Volleyball and basketball involve repeated vertical jumping, a movement that could impact the GI system through changes in intra-abdominal pressure.11 Further, sports like rugby, American football, and hockey involve frequent physical contact between players, which, in theory, could contribute to GI disturbances via mechanical trauma.12 To the authors’ knowledge, there are no published survey studies that have examined the prevalence of GI issues among team-sport athletes exclusively.

Although elucidating the impacts of an individual athlete’s GI symptoms on a team’s overall performance would be a difficult task scientifically, understanding the underlying factors that contribute to GI symptoms in team-sport athletes is nonetheless important for optimizing athlete enjoyment, well-being, and performance. One emerging factor that has been connected to GI symptoms in endurance athletes is anxiety.4 In one study, endurance race participants who had high state anxiety on the morning of races had elevated odds of nausea (odds ratio [OR] = 5.57), regurgitation/reflux (OR = 3.75), fullness (OR = 2.98), and cramping (OR = 3.99) during races.13 A link between general/trait anxiety and GI symptoms among endurance athletes has been shown in other studies.14,15 Numerous anecdotes of team-sport athletes suffering from competition anxiety-related GI symptoms like nausea and vomiting exist,16 yet these relationships need verification through research.

Given the paucity of data within team sports, the primary aim of this investigation was to examine the prevalence and impact of GI symptoms in a sample of team-sport athletes. A secondary aim was to evaluate whether reported anxiety levels are associated with GI symptoms during training and competition.

**METHODS**

***General Design***

This observational investigation utilized an anonymous web-based survey for data collection. The survey was administered using Qualtrics software (Qualtrics, Provo, UT, USA). Information about the study’s purpose, a statement about its voluntary nature, investigator contact information, and a consent statement were provided at the beginning of the survey. The study protocol outlining the survey, recruitment procedures, etc. was submitted to the Human Subjects Review Committee of the Darden College of Education and Professional Studies at Old Dominion University and was exempted from full review.

***Participants***

Recruitment was carried out by emailing team and league contact persons and posting on social media. A hyperlink to the anonymous survey was included in these communications/postings. Individuals were eligible if they responded ‘yes’ to three screening questions: 1) “Are you currently age 18 years or older?”; 2) “Do you currently participate in a team-based sport (football, soccer, basketball, rugby, baseball, lacrosse, hockey, volleyball, etc.)?”; and 3) “Have you competed in at least one competitive game or match over the past month?”

A total of 143 individuals (79 men, 64 women) met the eligibility criteria and provided complete data for analysis. Descriptive information on the participants is provided in **Table 1**. The sample was predominantly compromised of young (<30 years old) athletes who competed at the recreational, collegiate, or club levels. The most heavily represented sports were soccer and rugby, each making up more than 25% of the total sample.

***Survey Contents***

The survey had a target completion time of approximately 10 minutes. After completing the three screening questions, eligible individuals were allowed to proceed with taking the remainder of the survey. Background information solicited in the initial section of the survey included age, gender, race/ethnicity, weight, height, primary sport, years of competition experience, and competitive level (recreational/amateur, collegiate, club, semi-professional, professional). Next, respondents reported if they had disorders or medical conditions (e.g., inflammatory bowel disease or gastroesophageal reflux disease) that caused frequent GI symptoms. They then rated the severity of seven GI symptoms (nausea, regurgitation/reflux, stomach fullness, bloating, abdominal cramps, gas/flatulence, urge to defecate) over the past month on a 0-to-10-scale (0 = no discomfort; 5 = moderate discomfort; 10 = unbearable discomfort). These symptoms were chosen due to being used in previous research that had shown associations between GI issues and anxiety in endurance athletes.13-15 Survey respondents were provided specific definitions for each symptom, as described in a previous paper.15 Separate ratings were solicited for rest, during training sessions, and during competition. Scores for individual GI symptoms were summed to create total GI-symptom scores (0 to 70) for rest, training, and competition settings separately.

For during-training and during-competition GI symptoms, participants also indicated the percentages of sessions and games/matches over the past month that they experienced each symptom. The percentages for individual symptoms were averaged across all seven symptoms for both during-training and during-competition GI symptoms. In addition, participants reported the frequency of observing blood in their stool after hard exercise (never, rarely, sometimes, frequently). Participants were also asked whether GI symptoms had ever negatively impacted their performance during competition. If they indicated ‘yes’, they were then asked to select which symptom(s) had impacted their performance and to estimate the percentage of games/matches that are negatively impacted by GI symptoms.

The final portion of the survey consisted of the State-Trait Inventory for Cognitive and Somatic Anxiety (STICSA).17 Scores on the STICSA have been shown to correlate with GI symptoms in endurance athletes.13,15 The STICSA-trait includes 21 statements in reference to cognitive and somatic manifestations of anxiety. Respondents rate how often, in general, each of the 21 statements is true (1=almost never, 2=occasionally, 3=often, 4=almost always), with total possible scores ranging from 21-84.

***Statistics***

Distributions of data were evaluated for normality through the inspection of histograms and Q-Q plots. Given that several variables (GI-symptom scores, percentage of training sessions and competitions with GI symptoms, competition experience, body mass index [BMI]) showed non-normal distributions, median (interquartile range [IQR]) values are presented as descriptive statistics.

In order to evaluate whether differences existed between men and women for GI-related variables and anxiety levels, the Mann-Whitney U test was used. Other variables, such as age, BMI, competition experience, etc., were not compared between men and women given that gender differences for these variables were not a focus of this study. Pearson chi-square tests were used to examine whether the prevalence of medical conditions associated with GI symptoms differed between men and women, as well as whether men and women had a different prevalence of performance-altering GI symptoms.

For correlational analyses, several predictor variables (age, BMI, experience, resting GI symptoms, STICSA-Trait) were correlated against the 0-70 scores for during-training and during-competition GI symptoms as well as the percentages of training sessions and competitions with GI symptoms. Also, during-training GI symptoms were correlated against competition-related GI-symptom variables. Due to non-normal distributions of GI-symptom variables, Spearman’s rank-order correlations were utilized. In addition, gender-specific correlations were carried out due to the noted differences between genders with respect to GI-symptom occurrence2 and anxiety.18

Lastly, Mann-Whitney U tests were used to evaluate whether GI-symptom variables and other variables (age, BMI, experience, STICSA-Trait) differed between athletes whose performance had been negatively impacted by GI symptoms versus those who reported no performance impacts. These comparisons were done in a gender-specific manner.

SPSS version 28 was used for the analyses, and a threshold of p < 0.05 was set as the criteria for statistical significance.

**RESULTS**

***GI Symptom Severity and Prevalence***

In both men and women combined, median (IQR) GI symptom scores at rest, during training, and during competition were 5 (0-11), 2 (0-7), and 1 (0-6), respectively. The percentage of training sessions with GI symptoms (average across seven symptoms) was 2.7% (0.0-10.0%), while the percentage of competitions with GI symptoms (average across all symptoms) was 0.7% (0.0-8.1%).

As presented in **Table 1**, participants reported that blood in the stool after hard exercise was an infrequent event (median = 1 [never]). Across both men and women, the prevalence of medical conditions that caused GI symptoms was 11.2%. Specific conditions reported included the following: IBS (4 cases); gastroesophageal reflux or heartburn (4 cases); gastritis (2 cases); and hiatal hernia, colitis, systemic lupus erythematosus, Crohn’s disease, and lactose intolerance (1 case each). One participant reported a medical condition but labelled it as “not diagnosed.”

 Of 143 athletes, 35 (24.5%) reported that GI symptoms had negatively impacted their performance. Among these 35 participants, they estimated that 15% (10-25%) of their competitions are negatively impacted by GI symptoms.

***Gender Differences***

In comparison to men, women had higher STICSA-Trait scores, higher resting GI symptoms, higher during-training GI symptoms, higher during-competition GI symptoms, and greater percentages of training sessions and competitions with GI symptoms (all p < 0.001; **Table 1**). Further, women were more likely to report having had their performance impacted by GI symptoms (p = 0.001).

In **Table 2**, data are presented showing the prevalence of symptoms that had ever impacted performance in men and women. Nausea, bloating, and abdominal cramps were more likely to have affected performance among women than men (all p < 0.05).

***Correlates of During-Training and During-Competition GI Symptoms***

Among both men (**Table 3**) and women (**Table 4**), resting GI symptoms were consistently, positively correlated with during-training and during-competition GI symptoms, as well as the percentages of training sessions and competitions with GI symptoms. The during-training GI symptom variable was the strongest correlate of during-competition GI symptom variables in men and women (ρ values ≥ 0.66).

Among men, STICSA-Trait scores were consistently associated with training- and competition-related measures of GI symptoms (ρ values = 0.35-0.43), while in women, significant correlations (ρ values = 0.29-0.32) were only observed with competition-related measures of GI symptoms. Age, BMI, and experience showed some modest-sized, occasionally significant correlations with GI-symptom measures in men; among women, these variables were not associated with GI-symptom variables (except for experience and percentage of training sessions with GI symptoms).

***Comparisons based on the Presence of Performance-Impacting GI Symptoms***

In comparison to men whose performance was not affected by GI symptoms (n=68), men whose performances were affected (n=11) had higher STICSA-Trait scores, resting GI symptoms, during-training GI symptoms, during-competition GI symptoms, and percentages of training sessions and competitions with GI symptoms (**Table 5**). In contrast, age, BMI, and experience did not differ between groups. Similar patterns were found in women, except STICSA-Trait scores did not differ between women who did (n=24) and who did not (n=40) report having their performance affected by GI symptoms.

**DISCUSSION**

This preliminary investigation on GI symptoms in team-sport athletes has several notable results. One of the most prominent findings is that the majority of team-sport athletes experienced either no GI symptoms, or only minor GI symptoms, during most training sessions and competitions. In addition, blood in the stool after hard exercise, which is often considered a more severe indicator of GI dysfunction, was very infrequent in this sample, which is in good agreement with past research on endurance athletes.19 Even so, 13.9-37.5% reported having had their performance ever affected by GI symptoms. Notably, female athletes were more likely to report these negative performance effects than men.

The gender differences observed in this study may be partly because certain GI symptoms are, generally speaking, more common in women than men. As discussed in a review by Pugh et al.,2 several studies have found a greater incidence of GI symptoms in female athletes at rest, but data regarding symptoms during exercise have been inconclusive. There are a variety of factors that would explain a higher incidence of certain symptoms in women, including GI motility differences and a higher incidence of nausea, bloating, and abdominal cramping that women experience during menstruation.2 This notion aligns with the results of the current study, which found that women were more likely than men to report that nausea, bloating, and abdominal cramping had affected their performance. In addition, some research has shown women to have superior episodic memory and to be more willing to report pain and discomfort than men.20,21 In other words, the observed gender difference could be partly due a greater willingness among women to report, as well as a better ability to recall, recent episodes of GI symptoms. Regardless of the specific reasons, this study seems to confirm that, much like female endurance athletes, female team-sport athletes are at an elevated risk for reporting GI symptoms with training and competition, and this may translate to a substantial impact on performance and training.22 Yet, further research is clearly needed as to how GI symptoms may vary throughout the menstrual cycle and what strategies can be implemented to mitigate the negative effects of such symptoms on training quality and competition performance.

 Another notable finding of this investigation is that anxiety, as measured by the STICSA-Trait, is modestly associated with the severity and frequency of exercise-related GI symptoms in team-sport athletes. The associations were present in both men and women, although they were more consistent among the former. Several prior investigations have found that anxiety correlates with GI symptoms in individuals partaking in endurance training and competition.13-15 In general, the size of the associations observed in the present study are in line with what has been seen in past work. Wilson, for example, found that scores on the Beck Anxiety Inventory were modestly correlated (ρ = 0.27) with the proportion of runs over one month in which runners reported at least one notable GI symptom.14 Likewise, another study by Wilson found that scores on the STICSA-Trait were modestly positively associated with in-race upper GI (ρ = 0.33) and in-race lower GI (ρ = 0.23) symptoms among 87 running race and duathlon/triathlon participants.15 While the correlations between anxiety and GI-symptom variables are modest in size, it is important to recognize that most other predictors of exercise GI symptoms (age, experience, exercise intensity, nutrient intake, etc.) show similarly sized correlations.14,23,24 Given that most GI symptoms have several causes, it is to be expected that no single variable can explain a large proportion of the variability in GI symptomology.

A variety of mechanisms could explain the links between anxiety and GI symptoms in team-sport athletes. Corticotropin-releasing factor, a 41-amino acid polypeptide produced in the hypothalamus, is released in response to stressors and is known to impact GI system motility and secretion through multiple pathways, including autonomic nervous system modulation.4,25 Exposure to chronic stressors and elevations in anxiety can also lead to increased visceral sensitivity,26 which is marked by an elevated perception to stimuli (a standardized feeding, balloon distension, etc.) in the gut. To date, however, literature examining the effects of general and competition anxiety on exercise-associated GI symptom occurrence is largely observational in nature and has not incorporated the measurement of physiological biomarkers of stress and anxiety,4 making it difficult to say whether the observed links are causal. Experimental work in both laboratory and field settings will be important for confirming or refuting the role of competition anxiety in the pathophysiology of exercise-associated GI symptoms.

Future research on the topic of GI symptoms in team sports may benefit from focusing in several different areas. Studies of the general population show that GI symptoms are prevalent and are associated with psychological co-morbidities.27 Even though this is the case, little is known about the chronic GI symptoms experienced by athletes, particularly team-sport athletes, and how this might affect their quality of life and/or exercise performance. Equally, little data are available on the prevalence of more severe GI pathologies, for which some of these symptoms may be the first warning signs of. Thus, longitudinal studies of athletes that utilize validated and standardized methods of measuring GI symptoms and pathologies are sorely needed. Future research may also explore how GI symptoms and anxiety change together over time during the lead up to competition. For example, Urwin et al.28 recently reported that the correlations between anxiety/stress and GI symptoms tended to be larger on the day before or morning of a 56-km ultramarathon than two or three days beforehand. Whether these temporal patterns also occur in team-sport athletes before competition should be investigated.

Although this study provides novel information on the prevalence of GI symptoms and whether it impacts team-sport athletes, it is not without limitations. Sampling was done via convenience, so it is unclear how well the sample represents team-sport athletes at large. The sample was also more heavily represented by certain sports (soccer, rugby, American football) than others. Moreover, there were not enough athletes from each sport to provide valid estimates of outcome variables within individual sports. As a result, the authors recognize that estimates of GI-symptom severity and frequency could differ if other sports were more heavily represented in the sample. Likewise, relatively few professional athletes (none among women) completed the survey, so it remains uncertain how well the results generalize to elite athletes who often deal with extreme pressures of performing. In addition, the questionnaires used in this survey asked athletes to recall GI symptoms from the past, which may be prone to inaccuracy and recall biases. That said, a study by Wilson did show relatively good agreement between prospective GI-symptom ratings and retrospective GI-symptom reports in runners.6 Our study did not inquire about a variety of other factors that are known to impact GI symptoms, including nutritional intake, non-steroidal anti-inflammatory drug use, environmental conditions, etc. Although these data would have been beneficial to collect, surveys that go beyond 10-15 minutes of completion time tend to have poor response rates.29 Given the current paucity of data on the topic, the authors felt it was reasonable to limit the extent of data collection.

**CONCLUSIONS**

In a sample that was largely comprised of male and female team-sport athletes from soccer, rugby, and American football, the frequency and severity of GI symptoms were found to be occasional and mild. Even so, a notable percentage of respondents (13.9-37.5%) reported that GI symptoms had negatively impacted their performance at some point in the past. In addition, female athletes were more likely than male athletes to report performance-altering GI symptoms, particularly nausea, bloating, and abdominal cramping. As has been seen in endurance athletes, anxiety was modestly positively associated with during-training and during-competition GI symptoms, which suggests that interventions targeting anxiety could be a fruitful approach for reducing GI symptoms in some team-sport athletes. However, this suggestion requires further confirmation through experimental designs.

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