The frequency and severity of gastrointestinal symptoms in rugby players

Abstract

Assess self-reported frequency and severity of gastrointestinal symptoms (GIS) at rest and around rugby training and match play in male and female rugby union players. An online questionnaire was sent to registered rugby union players (sevens or fifteens). Thirteen GIS were assessed alongside perceptions of appetite around rugby and rest using Likert and visual analogue scales. Questions investigating a range of medical and dietary factors were included. 325 players (male n=271, female n=54) participated in the study. More frequent GIS (at least one GIS experienced weekly/more often) was reported by players at rest (n=203; 62%) compared to around rugby (n=154; 47%). Overall severity of GIS was low (mild discomfort), but a portion of players (33%) did report symptoms of moderate severity around rugby. Female players reported more frequent and severe symptoms compared to male counterparts ($p<0.001$). Self-reported appetite was significantly lower after matches compared to training. There were no dietary or medical factors associated with GIS severity scores. This study describes GIS characteristics in male and female rugby union players. Half of players experienced some form of GIS which may affect nutrition, training, or performance, thus should be a consideration for practitioners supporting this cohort.

Keywords: rugby, gastrointestinal symptoms, appetite, sport

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Introduction

Depending on the style and duration of the activity, 30-93% of athletes report a range of gastrointestinal symptoms (GIS) around exercise [1]. Different symptoms, often categorised into upper or lower gastrointestinal tract, can impair training, performance, or wellbeing [2]. The aetiology of GIS around exercise can be complex, with no single causal factor. Exercise-associated gastrointestinal syndrome highlights two mechanistic avenues for GIS [3]: the circulatory gastrointestinal and the neuroendocrine gastrointestinal pathways. Exercise intensity, duration, dietary intake, time of day, sleep, medication and the external environment may influence the experience of GIS in athletes [4–9].

Data describing the frequency and severity of GIS in athletes is predominantly from endurance exercise and there is limited research investigating GIS in team sports[10]. Rugby union is a high intensity intermittent team sport that includes specific risk factors which may predispose players to gastrointestinal distress and changes in appetite (e.g. high training volume, collisions, use of pain medication). Repeated training sessions with high intensity efforts and collisions contribute to the physical demands on players and reflect in their recovery and energy demands thus creating a unique team sport environment [11–13]. Food choices, food volume and energy balance may influence GIS [14,15] but gastrointestinal profiles have not been included in any investigations of dietary intakes in rugby players thus far.

Changes in appetite do not appear part of the traditional assessment of gastrointestinal distress around exercise, although loss of appetite may be a barrier to exogenous fuelling. Loss of appetite may be experienced concomitant to other GIS, such as nausea or bloating [14]. Appetite is likely critical in the post-exercise period for team sports when nutrition is prioritised as part of recovery and where high daily calorie intakes are necessary, as is the case in rugby [16]. The continued growth of women's rugby is an important consideration, as female athletes report higher levels of GIS compared to males in endurance athletes but is unknown in team sport athletes [17,18].

Therefore, the aim of this study was to establish self-reported frequency and severity of GIS and appetite responses associated with rugby and rest in rugby union players.

Materials and Methods

Participants

Male and female senior rugby union players, from both fifteens and sevens, were invited to participate in the study. Online anonymous questionnaires were sent via coaches or national governing body. Coaches were recruited through existing rugby networks across different levels of play. Multiple governing bodies were invited to participate. Those who participated distributed the questionnaire via the lead nutritionist, the nutritionist at the club or the players association. The participant information sheet was shared prior to the study and this information and informed consent were included in the online questionnaire (Supplementary material). Informed consent was obtained from all participants. Ethics approval was granted by the Ethics Advisory Committee at an institution affiliated with one of the authors. Additional permissions were obtained from the Irish and South African rugby federations.

Questionnaire

An online questionnaire (Qualtrics^{XM}), written in the English language, was used for convenience and effective distribution (Supplementary material). Self-reported characteristics (age, body mass, height, playing level, primary position of play, training hours/week) were included to define participants [19]. Modified Likert scales were used to assess the frequency and severity of thirteen GIS [20,21] at rest and around rugby. Rest and around rugby were not pre-defined for participants and left to the participants interpretation. The lack of specific definition to the rugby and rest environments was identified as a limitation after the study. Perceptions of appetite pre and post-training and pre and post-match were included as a separate GIS using visual analogue scales (VAS) [22,23]. Two items relating to constructs of appetite: feelings of hunger and desire to eat were included. A combination of dichotomous and ranking questions were used to assess the various associated risk factors for GIS reported in other studies. Risk factors included antibiotic use, NSAIDs, fibre intakes (via fruit and vegetables), alcohol post-exercise, hydration pre-exercise, probiotics (in supplements), fermented foods and high protein intakes. These risk factors were drawn from a variety of research [24–29].

Statistical analyses

Statistical analyses were conducted using the Statistical Package for the Social Sciences software programme (SPSS, Version 26). Data are presented as median (interquartile range (IQR)). VAS data for perceptions of appetite are reported in arbitrary units (AU) rather than millimetres, due to screen/phone size. All GIS data were non-normally distributed. Wilcoxon rank tests were used to compare differences in GIS frequencies at rest and around rugby (separate GIS), as well as changes in GIS severity scores between rest and rugby conditions in all, male and female groups. Chi-squared tests were used to compare the frequencies of any GIS (weekly or more often) or GIS severity (>4) between rest and rugby conditions. Spearman rank-order correlation was used to analyse the relationship between GIS severity scores and associated risk factors mentioned above. Statistical significance was accepted at a level of $p<0.05$. Graphs were created by the authors using R (version 4.2.0).

Results

Participant characteristics

A total of 325 players (271 male and 54 female) completed the questionnaire. Characteristics of the sample are presented in Table 1. Half the sample were International/National level [19]. None of the characteristics (e.g., body mass, age, training hours/week) had any significant relationship with GIS frequency or severity (p>0.05).

Insert Table 1

Gastrointestinal symptom frequency and severity

At least one GIS (experienced weekly or more often) was reported by 62% (n=203) of players at rest and by 47% (n=154) of players around rugby (Table 2, p<0.001). In a separate question, almost half of the players (48%) reported that they ‘probably’ or ‘definitely’ experienced more severe GIS around matches compared to training (any symptom), however only diarrhoea (p<0.001) and urgent need to defecate (p=0.48) had a higher frequency reported around rugby compared to rest for females, whilst diarrhoea (p=0.05) had a higher frequency around rugby compared to rest for males (Table 2). Other GIS were reported as higher at rest compared to rugby conditions.

Insert Table 2

Median rating of severity of individual symptoms ranged between 1-3 (no discomfort to mild discomfort) (Figure 1). However, 42% and 33% of players reported at least one symptom with moderate discomfort or worse (≥4) at rest or around rugby, respectively (Table 2).

Insert Figure 1

Combined severity scores for upper, lower and total GIS were significantly higher at rest compared to around rugby for the whole group(Table 3, p<0.001, p=0.002, p<0.001 for upper, lower, and total GIS scores respectively).

Insert Table 3

Changes in appetite

Sixty percent of players reported lower feelings of hunger and desire to eat after a match compared with before a match, while 40% reported lower feelings of hunger and desire to eat after training compared with before training (Figure 2). After matches, 39% of all participants reported that their loss of appetite resolved within an hour, while 46% reported they needed one to two hours for their appetite to return to normal.

Insert Figure 2

Sex-based differences

Female participants reported higher frequency and severity of GIS (Table 2, Table 3, Figure 1) and lower feelings of hunger and desire to eat around rugby compared to males (Figure 2). Male players reported lower total severity of GIS around rugby compared to rest (p<0.001), whereas female players reported no difference between severity scores around rugby compared to rest (Table 3). The median scores translate as minor discomfort (rating of 2), apart from diarrhoea (around rugby) which had a median severity of mild discomfort (rating of 3). In male players, median feelings of hunger after matches were lower than after training (35 vs. 45 AU, p=0.54, Figure 2) as was desire to eat (34 vs. 45 AU, p=0.003, Figure 2).which was similar for female players (feelings of hunger; 35 vs 53 AU, p<0.001, desire to eat; 31 vs. 52 AU, p<0.001, Figure 2).

Risk Factors for GIS

None of the risk factors assessed (medication or dietary) in the questionnaire were found to be associated to the frequency or severity of GIS scores (Table 4, all p>0.05).

Insert Table 4

Discussion

This is the first study of self-reported GIS characteristics and perceptions of appetite in high level rugby union players. Approximately half of players experienced at least one symptom weekly or more often at rest or around rugby. Players reported more frequent and severe GIS at rest compared to rugby for the majority of symptoms, but the overall severity was low. Female players experienced more frequent and severe GIS compared to their male counterparts. Measures of appetite were lower post-match compared to post-training, with females reporting lower levels of hunger and desire to eat compared to males. There were no associations between the frequency or severity of GIS and any of the external factors assessed. GIS profiles in rugby players should be assessed in order to highlight risk factors and possible intervention options for those who are affected.

The frequency of reported GIS is lower than in a previous mixed sport sample (86%) [30] but aligns with findings from various endurance studies [1,31]. The range of frequencies across individual symptoms (4-48%) in this study mirrors those previously reported where certain GIS (e.g. bloating) are more common than others [30,32]. Diarrhoea and urge to defecate were two GIS that were elevated around rugby compared to rest. This may be as a response to sympathetic activation that may influence specific lower GIS [33]. Rugby may expose players to higher rates of psychological stress due to concerns about performance. Psychological stress has been correlated with GIS during endurance running [34]. Unfortunately, there is no published research on the psychological stress state in rugby players but a ‘nervous tummy’ is supported anecdotally by players and in recent studies in runners [35] and team athletes [10].

The lower overall frequency and severity of GIS around rugby compared to rest (47% vs. 62%) may be influenced by training or dietary adaptations. Players involved in a fulltime rugby programmes (~50% of participants) will participate in a range of training modalities [36]. Rugby training sessions can be 45-60 minutes [36,37]; a duration that may be too short to elicit significant GIS but may still contribute to positive adaptations [38]. Hypothetically, repeated rugby sessions may improve gastrointestinal tolerance over time, via decreasing levels of splanchnic hypoperfusion in response to increasing cardiovascular fitness. Different exercise modalities and different styles of training (fifteens vs. sevens) may also alter the magnitude of the GI response [29,38–40]. In this current study, participants did not report any perceived difference in GIS between different training sessions, including sessions with contact-based drills. Full contact-based drills or collisions in match play increase the metabolic requirements of players [36,41], but seem not to influence the experience of GIS reported here. This may also be in part to the limits placed on contact-based drills during training over time[42]. Further, there may be a secondary improvement mediated via the microbiome [7,43]. Specific symptom frequency, for example flatulence, may be influenced or modulated by certain bacterial species [44]. Athletes have been found to have altered microbiome profiles compared to non-athletes, including rugby players [45–47]. However, the impact of these differences in microbiome on GIS is unknown. A third of players still reported GIS of moderate severity or worse around rugby which may cause discomfort around training or rugby matches, possibly negatively influencing performance [48]. The experience of athletes of GIS in relation to match day performance will be useful to explore further.

Dietary adaptations may include pre-training dietary exclusions [49], or training in a euhydrated, healthy state [50]. Participants in this study at elite/sub-elite level may approach rugby training with specific dietary habits learned through experience, limiting risk of GI distress. This may go alongside adaptations to higher carbohydrate intakes. High volumes of carbohydrate fluid given repeatedly over two weeks has been shown to reduce GIS during exercise [51], while high carbohydrate intakes may also induce an increased content of glucose transporter protein (GLUT4 and GLUT5) in the gastrointestinal tract [52]. Conversely, higher volumes of food eaten to meet higher caloric requirements may aggravate specific GIS such as flatulence and bloating at rest [43,53]. Therefore, dietary exposures aligned with a training programme may minimise GIS around rugby. Monitoring GIS frequency and severity reported over a preseason and during a season may give more insight around possible training and dietary adaptations.

This study showed GIS to be more common in female compared to males, with sex-based changes in colonic transit time and visceral hypersensitivity being proposed amongst the possible mechanisms [17,18,48]. Menstrual phase may affect female rugby players, who previously reported abdominal pain, nausea or cramping as common GIS that negatively affect training during their menstrual cycle [54]. Unfortunately, neither menstrual phase nor contraceptive use were assessed in this study in the female players. As there appears to be no sex-based difference seen in the gastrointestinal endothelial response to exercise [55], an endocrine related mechanism may be more likely. Female players may need screening for GIS and changes in relation to their menstrual cycle phase. Female participants in this study, although from national representative teams, may train and compete in part-time environments and have less nutrition support compared to males, as well as lower training ages. This may also differentiate any training and dietary associated adaptations mentioned above.

Self-reported measures of appetite (feelings of hunger, desire to eat) were lower post-match compared to post-training and most players reported this took an hour or more to resolve. This coincides with the clearance time for markers of gut endothelial damage, splanchnic reperfusion [56,57] and metabolites such as lactate [58,59]. The reported suppression of appetite seen here with rugby is concordant with appetite responses after continuous [60,61]; and intermittent high-intensity exercise in laboratory studies of non-athletic populations [62,63]. Previous data has not demonstrated any differences in appetite responses to exercise in male and female athletes [64,65]. These data may reflect both the physiological intensity and psychological stress of match scenarios as mentioned previously. More investigation into the differences between sevens and fifteens players would be useful, but were not within the scope of this study. Appetite, as a GIS, requires practical nutrition support; however, validated nutritional strategies for increasing appetite and promoting feeding post-exercise have yet to be established.

Based on the current literature, this is the first study to describe self-reported rates of NSAIDs use in rugby players. Acute NSAID use has been shown to increase gut cell damage with and without exercise [66–68]. Chronic NSAID use has been associated to higher levels of GIS in non-athletes [69], but there is limited consensus on the impact of chronic NSAID use on GIS and performance in athletes [70]. Rates of reported NSAID use were lower than studies in endurance runners (57-60% of race finishers) [2,71] and collegiate American football players (~50% players during the season) [72]. Lower levels seen here may reflect improved awareness in players and stricter protocols around NSAID prescription due to publicised reports of now-retired rugby players describing high NSAID use for pain management and consequent GIS. Continued education to players of all levels around appropriate NSAID use will only benefit future gastrointestinal outcomes. A third of players reported antibiotics in the previous year, but this is difficult to contextualise with limited data on antibiotic use in team sport outside of major competitions [73]. Antibiotics have been shown to disrupt host microbiome, aggravate GIS (antibiotic associated diarrhoea) and recurrent use may impact long term gastrointestinal outcomes [74] and performance [75]. It would be important for future research to elucidate microbiome recovery in athletes post-antibiotics, or any concomitant strategies (e.g. probiotics) that may limit any detrimental effects of antibiotics on gastrointestinal health [76].

Dietary factors may influence GIS. Fruit and vegetable, alcohol, probiotic, and prebiotic intakes and pre-match hydration status were included in the questionnaire as these have been implicated in general gastrointestinal health and GIS around exercise [25,77–79]. Although there were no relationships found with GIS in this study, practitioners can still consider that these factors may play a role in GIS in individual cases. Investigation of dietary strategies used in endurance athletes to proactively manage GIS has been published [80] which may give some insight into other dietary interactions.

Limitations

Using an online questionnaire has limitations. Although efforts were made to be comprehensive, superficial questions make some of the application of these data challenging. While rest and rugby were chosen to establish the change in environment, there may be differences in interpretation around when a player would transition from one to the other. More in depth studies should consider the differences between sevens and fifteens environments. There is currently no consensus on what frequency (e.g., weekly) or severity (e.g., moderate) of GIS is meaningful to athletes for wellbeing or performance. This is especially relevant for GIS like burping compared to diarrhoea, where performance associated impact may not be equivalent. This questionnaire was cross-sectional and some form of season-wide surveillance from a baseline would give more insight into the ability for the gut to adapt in contact-based, highly demanding sports. Ensuring that the current GIS questionnaires available is validated for team sports, as they have been done for endurance exercise, may be useful as there are limited data from team sports [48,81,82].

This study highlights self-reported GIS in high level male and female rugby players. Low severity GIS are common, but more so at rest. With limited data in team sport, these data may assist with the awareness for practitioners and development of interventions for the individuals who are affected. Future research focusing on the chronic impact of rugby training, NSAID use, collisions and dietary changes on the GIS profile over time (a season) would be useful to promote gastrointestinal health for wellbeing and performance.

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Figure legends:

Figure 1: Median (IQR) gastrointestinal symptom severity scores by symptom between female (grey) and male (dark grey) players; at rest (A) and around rugby (B); Hburn, Heartburn; Burp, Burping; U.abp, Upper abdominal pain; Naus, Nausea; Vomit, Vomiting; Cramp, Cramping; Bloat, Bloating; L. abp, Lower abdominal pain; Flat, Flatulence; Const, Constipation; Defec, , Urgent need to defecate; Stool, change in stool consistency; * denotes a significant difference between male and female players ($p<0.05$) Gastrointestinal symptom severity; 1. No discomfort 2. Minor discomfort 3. Mild discomfort 4. Moderate discomfort 5. Moderately severe discomfort 6. Severe discomfort 7. Very severe discomfort

Figure 2: Median (IQR) and range of ratings of perceived feelings of hunger and desire to eat after training and matches using a Visual analogue scale (Hunger training; feeling of hunger post training Hunger match, feelings of hunger post match, Desire training, desire to eat post training, Desire match, desire to eat post match) in male (A) and female (B) and players; * denotes a significant difference between pre and post training or pre and post match, $p<0.01$

Table titles and legends

Table 1. Characteristics of participants

Data are presented as percentage (number) of players; kg, kilograms; cm, centimetres; [#]denotes a significant difference between males and females; * denotes a significant difference between forwards and backs of the same sex, $p<0.05$

Table 2. Self-reported frequency and severity of gastrointestinal symptoms reported at rest and around rugby

Data are presented as the percentage (number) of players who reported any gastrointestinal symptom experienced weekly or more often (weekly, more than once a week or daily); GIS, gastrointestinal symptom, [a] denotes a significant difference the frequencies reported between rest and rugby, ($p<0.05$), [b] denotes a significant difference between male and female players for the reported frequency of an individual GIS ($p<0.05$), *denotes a significance between rest and rugby for any GIS reported as a severity of ≥ 4, ($p<0.05$)

Table 3 Severity scores of self-reported gastrointestinal symptoms reported by rugby players at rest and around rugby

Data is reported as median [interquartile range] of the GIS severity scores, * denotes a significant difference between female and male players for the comparative score, ($p<0.05$), [a] denotes a significant difference between rest and rugby environments, ($p<0.05$)

Table 4. Frequency of participants reporting different non-exercise associated risk factors for gastrointestinal symptoms (all) and in relation to reported GIS at rest or around rugby (n=329)

NSAIDs, Non-steroidal anti-inflammation medication, GIS represents players who reports one of more gastrointestinal symptom with a frequency of weekly or more often at rest or around rugby

Table 1. Characteristics of participants

Characteristics	Male (n=271)	Female (n=54)

Country of origin	*Ireland*	42% (115)	63% (34)
	England	32% (86)	2% (1)
	South Africa	24% (64)	17% (9)
	Scotland	1% (3)	18% (10)
	Australia	1% (2)	
Rugby union format	*Fifteens*	84% (226)	52% (28)
	Sevens	4% (11)	22% (12)
	Both	12% (32)	14% (14)
Level of play	*Elite/International*	21% (58)	
	Highly trained/ National level	59% (158)	100% (54)
	Trained / Amateur divisions	20% (54)	
Age (years)	*18-24*	63% (171)	48% (26)
	25-35	35% (96)	50% (27)
	>35	1% (3)	2% (1)
Primary playing position	*Forwards*	53% (143)	40% (22)
	Backs	43% (118)	52% (28)
	n/a	4% (9)	8% (4)
Hours of training/week	*3-<5*	3% (8)	
	5-<7	15% (40)	2% (1)
	7-10	27% (74)	30% (16)
	>10	49% (132)	63% (34)
Self-reported body mass (kg)	*All*	100.0 ±12.9#	72.2 ± 9.9
	Forwards	108.1 ± 8.8*	78.7 ± 9.8*
	Backs	89.1 ± 8.4	66.3 ± 5.9
Self-reported stature (cm)	*All*	185.2 ± 7.5#	167.7 ± 6.5
	Forwards	188.2 ± 7.0*	170.4 ± 5.6
	Backs	181.6 ± 6.5	165.9 ± 6.9

Data are presented as percentage (number) of players; kg, kilograms; cm, centimetres; #denotes a significant difference between males and females; * denotes a significant difference between forwards and backs of the same sex, $p<0.05$

Table 2. Self-reported frequency and severity of gastrointestinal symptoms reported at rest and around rugby

	All (n=325)	***Male (n=271)***	***Female (n=54)***

	At rest	Around rugby	At rest	Around rugby	At rest	Around rugby
			Upper GIS % (n)			
Heartburn	6% (22)[a]	4% (14)	7% (21)[a]	4% (13)	1% (1)	1% (1)
Burping	27% (88)[a]	11% (35)	27% (74)[a]	9% (24)	25% (14)[a]	16% (9)
Upper abdominal pain	4% (12)	4% (13)	2% (5)	2% (6)	13% (7)	13% (7)
Nausea	7% (23)	7% (24)	6% (18)	7% (19)	7% (4)	9% (5)
Vomiting	1% (4)	1% (4)	1% (2)[a]	1% (4)	3% (2)	0% (0)
Stomach cramps/ gurgling	14% (45)	15% (48)	11% (29)	13% (34)	30% (16)	26% (14)
			Lower GIS % (n)			
Bloating	20% (65)	15% (48)	15% (41)[a]	11% (30)	44% (24)[a]	33% (18)
Lower abdominal pain	6% (20)	6% (20)	4% (10)	4% (10)	19% (10)	19% (10)
Flatulence	48% (156)	28% (92)	48% (129)[a]	27% (73)	50% (27)[a]	37% (20)
Constipation	5% (15)	5% (17)	4% (10)	4% (10)	9% (5)	13% (7)
Diarrhoea	8% (27)	19% (61)	7% (20)[a]	15% (42)	13% (7)[a]	35% (19)
Urgent need to defecate	11% (35)	13% (43)	11% (29)	13% (35)	11% (6)[a]	15% (8)
Change in stool consistency	25% (80)	22% (71)	25% (68)[a]	18% (46)	22% (12)	28% (15)
Any upper GIS ≥ once a week	37% (120)	28% (93)	34% (92)[a]	26% (71)	52% (28)	41% (22)
Any lower GIS ≥ once a week	59% (189)	42% (137)	57% (153)	39% (104)	67% (36)	61% (33)
Any GIS ≥ once a week	62% (203)	47% (164)[a]	60% (164)	43% (118)[a]	72% (39)[b]	67% (36)
Players reporting any GIS severity ≥4	42% (138)	33% (106)*	40% (108)	29% (75)*	64% (35)	57% (31)

Data are presented as the percentage (number) of players who reported any gastrointestinal symptom experienced weekly or more often (weekly, more than once a week or daily); GIS, gastrointestinal symptom, [a] denotes a significant difference the frequencies reported between rest and rugby, (p<0.05), [b] denotes a significant difference between male and female players for the reported frequency of an individual GIS (p<0.05), *denotes a significance between rest and rugby for GIS severity, reported as a severity of ≥ 4, (p<0.05)

Table 3: Severity scores of self-reported gastrointestinal symptoms reported by rugby players at rest and around rugby

	All (n=325)	***Male (n=271)***	***Female (n=54)***

	At rest	Around rugby	At rest	Around rugby	At rest	Around rugby
GIS severity score: upper	9 [7-13]	8 [6-11][a]	9 [7-12]	7 [6-11][a]	12 [8-15]	9 [7–13]*
GIS severity score: lower	11 [8-16]	11 [7-16][a]	11 [8-15]	10 [7-14][a]	15 [11 – 21]	17 [11–22]*
Total GIS severity score	21 [16-29]	19 [14-27][a]	20 [15-27]	18 [13-26][a]	26 [20 – 38]	26 [19–36]*

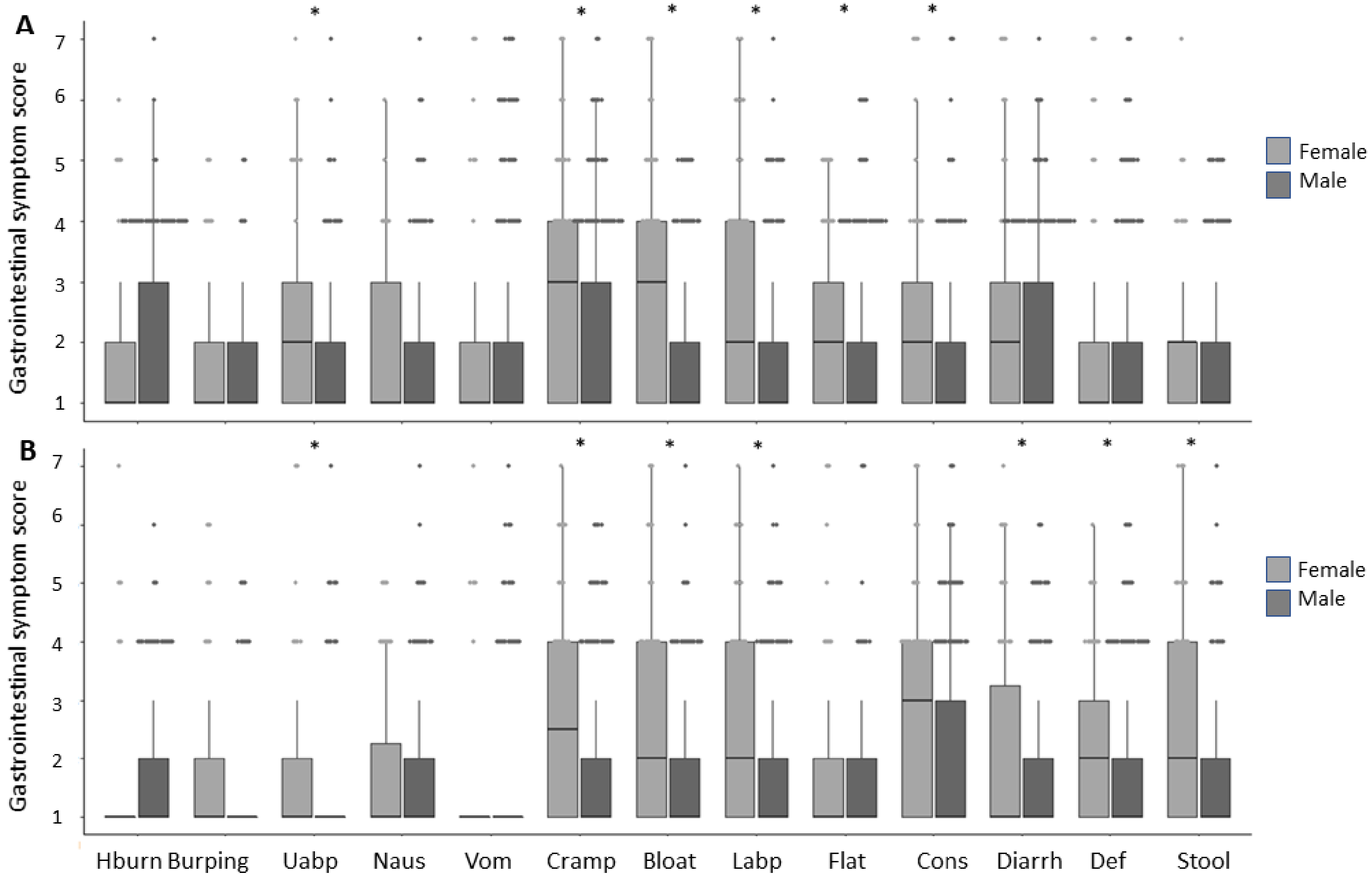
Data is reported as median [interquartile range] of the GIS severity scores, *denotes a significant difference between female and male players for the comparative score, (p<0.05), [a] denotes a significant difference between rest and rugby environments, (p<0.05)

Table 4. Frequency of participants reporting different non-exercise associated risk factors for gastrointestinal symptoms (all) and in relation to reported GIS at rest or around rugby (n=329)

Non-exercise risk factors	Overall frequency	GIS at rest	GIS around rugby
Take oral probiotics regularly (>70% of the time)	23%	14% (47)	14% (44)
Include prebiotic or fermented food at least once a week	22%	12% (39)	10% (31)
Eat 5 or more servings of vegetables per day	32%	21% (69)	17% (53)
Include an alcoholic drink once a week or more after rugby	34%	24% (78)	16% (51)
Take NSAIDs 2-3 times a month or more often	22%	14% (44)	12% (39)
Take antibiotics once or more over the last 12 months	33%	7% (24)	20% (64)

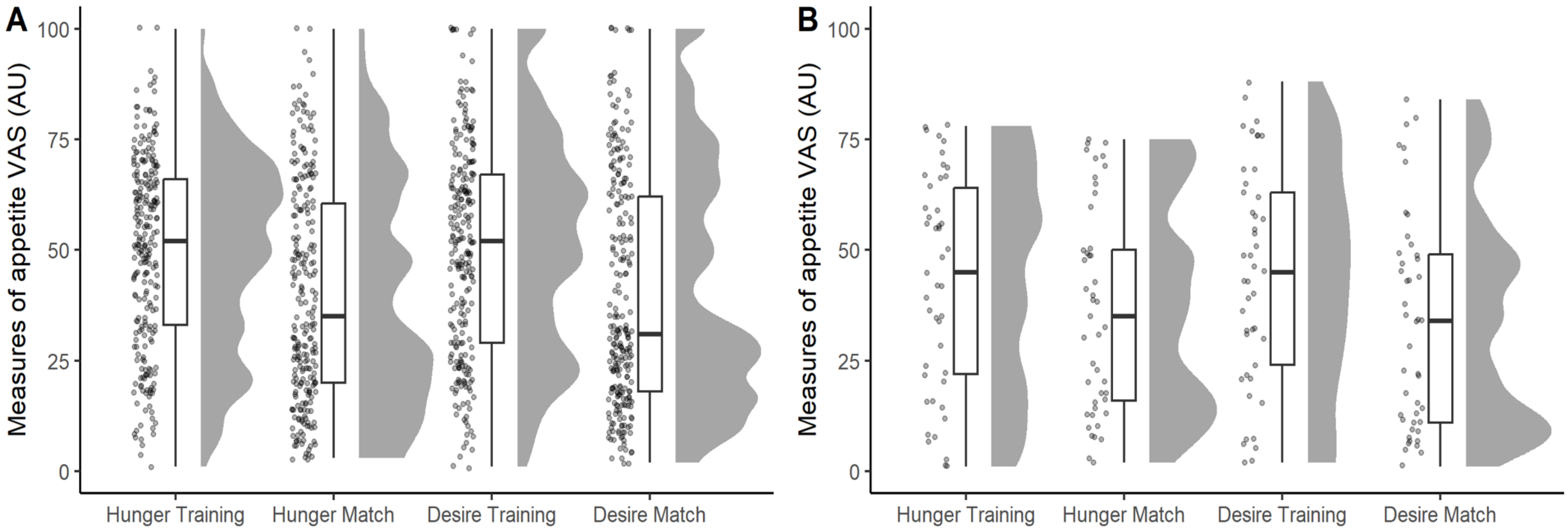
NSAIDs, Non-steroidal anti-inflammation medication, GIS represents players who reports one of more gastrointestinal symptom with a frequency of weekly or more often at rest or around rugby

Figure 1



A
B
Gastrointestinal symptom score
1
2
3
4
5
6
7
Female
Male
Hburn
Burping
Uabp
Naus
Vom
Cramp
Bloat
Labp
Flat
Cons
Diarrh
Def
Stool

Figure 2


A
B
Measures of appetite VAS (AU)
100
75
50
25
0
Hunger Training
Hunger Match
Desire Training
Desire Match