The illness burden of gastrointestinal illness is two times higher if it is associated with systemic symptoms and signs: a cross-sectional study of the super rugby tournament over 5 seasons (102,738 player-days)

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BACKGROUND: Gastrointestinal tract illness (GITill) in rugby players is underreported. The incidence, severity (% time loss illness, days lost per illness) and burden of GITill with/without systemic symptoms and signs in professional South African male rugby players during the Super Rugby tournament (2013-2017) are reported.

METHODS: Team physicians completed daily illness logs of players (N.=537; 1141 player-seasons, 102738 player-days). The incidence (illnesses/1000 player-days, 95% CI), severity (% ≥1-day time-loss; days until return-to-play [DRTP]/single illness [mean: 95% CI]) and illness burden (IB: days lost to illness/1000 player-days) for the subcategories of GITill with/without systemic symptoms and signs (GITill+ss; GITill-ss), and gastroenteritis with/without systemic symptoms and signs (GE+ss; GE-ss) are reported.

RESULTS: The incidence of all GITill was 1.0 (0.8-1.2). Incidence was similar for GITill+ss 0.6 (0.4-0.8) and GITill-ss 0.4 (0.3-0.5; P=0.0603). Incidence of GE+ss 0.6 (0.4-0.7) was higher than GE-ss 0.3 (0.2-0.4; P=0.0045). GITill caused ≥1-day time-loss in 62% of cases (GE+ss 66.7%; GE-ss 53.6%). GITill caused an average of 1.1 DRTP/single GITill, which was similar for subcategories. IB of GITill+ss was higher than GITill-ss (IB Ratio: 2.1 [1.1-3.9; P=0.0253]). IB for GITill+ss is 2 times higher than GITill-ss (IB Ratio: 2.1 [1.1-3.9]; P=0.0253); and GE+ss >3 times higher than GE-ss (IB Ratio: 3.0 [1.6-5.8]; P=0.0007).

CONCLUSIONS: GITill accounted for 21.9% of all illnesses during the Super Rugby tournament, with >60% of GITill resulting in time-loss. The average DRTP/single illness was 1.1. GITill+ss and GE+ss resulted in higher IB. Targeted interventions to reduce the incidence and severity of GITill+ss and GE+ss should be developed.

KEY WORDS: Athletes; Rugby; Signs and symptoms; Return to sport.

Acute illness in athletes affects organ systems in a very consistent pattern.[1, 2] Among a variety of sports codes, more than 20% of acute illness affects the gastrointestinal tract of athletes participating in international contests of short duration (9-18 days). These sports codes include netball,[3] handball,[4] rugby,[5] tennis,[6] foot-

ball,[7, 8] aquatics,[9, 10] athletics,[11, 12] Youth Olympics,[13] Paralympics,[14] Island Games,[15] and both the summer[16, 17] and winter[18] Olympic Games. Although gastrointestinal tract illness (GITill) in athletes is common,[19] only data relating to the broad category of all GITill are generally reported.[8, 9, 11, 18] Few published studies reported the subcategories of GITill in athletes by cause,[5] localized *vs*. systemic symptoms, and severity (training and competition days lost, and illness burden).[5, 20] More specifically, the number of days until return-to-play (DRTP) for the subcategories of GITill has not been reported. The annual Super Rugby tournament is contested at the international level over 16 weeks with matches each weekend. Players travel frequently between the various countries during the tournament period. Super Rugby players are exposed to different continental and environmental conditions including temperature, humidity, atmospheric pollution, aeroallergen exposure, different strains of pathogenic organisms and diet. We previously showed that during the 2012 Super Rugby tournament, the incidence of GITill was the second-highest organ system affected after the respiratory tract.[5] Intercontinental travelling also increased the risk of GITill in these players.[21] In a recent study we showed that a team illness prevention strategy (TIPS) significantly reduced the overall incidence of all GITill in Super Rugby players in a 4-year intervention period compared to a 3-year control period.[20] However, in none of these studies more detailed data of the subcategories of GITill on the number of DRTP and illness burden were reported. It is of clinical importance to report subcategories of GITill associated with or without systemic symptoms, because systemic symptoms of acute illness are indicative of more severe illness.[22, 23] For example, data from two prospective cohort studies showed that ultra-distance runners reporting systemic symptoms and signs of acute prerace illness had a higher risk of not finishing a race.[24, 25] More detailed information on the incidence of illness, the total days of training and gameplay interruptions, and the number of DRTP in acute GITill presenting with or without systemic symptoms, will be of value to team physicians in the management of illness during a tournament, and when planning preventative illness strategies.[26] The main aim of this study wass to describe the incidence, severity (% time loss illness, days lost per illness) and burden of illness in the subcategories of GITill with systemic symptoms (GITill+ss) *vs*. GITill without systemic symptoms (GITill-ss) in the South African teams competing in the Super Rugby tournament over five consecutive seasons.

Materials and methods

Type of study and participant selection

This cross-sectional study involved professional male rugby union players from the South African teams that competed in the annual 16-week Super Rugby Union tournament, over 5 years (2013-2017). During each year of the study period, at least five rugby teams participated. All the players of the participating teams were eligible for inclusion in the study (in total 1141 player-seasons). Team physicians who accompanied the players during the annual tournament were provided with detailed information on the study. The physicians informed all players of the study details and obtained written informed consent from each player. The Research Ethics Committees of the University of Cape Town (REC 736/2013) and the University of Pretoria (REC 432/2015 and 343/2017) approved the conduction of this study.

Gastrointestinal illness data collection

Each year (2013-2017) we recorded daily illness data for the duration of the competition period. The methodology on gastrointestinal illness (GITill) reporting was in accordance with that described in detail in previous publications for all illness recording during this tournament.[5, 20, 27] Team physicians recorded daily illness data on a custom-designed web-based system[5] and this included the number of players in the squad, the type of day (rest day, training day or match day), location of the squad and medical illness data. The medical illness data included GITill+ss and GITill-ss, specific final clinical diagnosis (a list of common diagnostic categories of causes or main presenting symptoms/sign of the illness was provided, *e.g.*, gastroenteritis [GE] with systemic symptoms and signs [GE+ss], and without systemic symptoms and signs [GE-ss]) and days lost from training or matches. The team physicians logged all GITill based on their clinical diagnosis, including a clinical assessment of systemic symptoms and signs. They estimated the days lost to play, based on their clinical experience. Actual time-loss days was not reported. Some definitions are given below:

- illness – defined as "any physical complaint (not related to injury), symptom or sign presenting in a player that required medical attention from the team physician on a specific day;"[5, 18, 21, 28, 29]
- GITill with systemic symptoms and signs (GITill+ss) – gastrointestinal illness with additional systemic symptoms and signs, *e.g.*, fever, myalgia/arthralgia, palpitations;

• GITill without systemic symptoms and signs (GITill-ss) – gastrointestinal illness without additional systemic symptoms and signs, *e.g.*, fever, myalgia/arthralgia, palpitations;

• gastroenteritis with systemic symptoms and signs (GE+ss) – diagnosed as definite diarrhea and vomiting with additional systemic symptoms and signs, *e.g.*, fever, myalgia/arthralgia, palpitations;

• gastroenteritis without systemic symptoms and signs (GE-ss) – diagnosed as definite diarrhea and vomiting without additional systemic symptoms and signs, *e.g.*, fever, myalgia/arthralgia, palpitations;

• time-loss illness – indicative of the severity of an illness and was defined as: "any medical illness requiring medical intervention resulting in a loss of training or match-play of ≥1-day."[5, 21]

We documented both new and recurrent medical attention illnesses, and time-loss illnesses.

Calculation of player-days

The total player-days per year was calculated as follows: total team days per season × daily squad size (for each day) = total player-days (for each year).[5] The dates the tournament started and finished each year were different for each team. Per year, the first and last match played also depended on team performance and games won in the regular Super Rugby Conference, and if the team were able to advance to the quarter-final, semi-final or final. The daily squad size varied from 28-36 players per team per day, however, was often reduced during times of international travel.

Measures of outcome

Measures of outcome are listed below:

• incidence (I) of illness – calculated as illness episodes per 1000 player-days with 95% confidence intervals (CI)[5, 21] for all GITill, as well as for the subcategories of GITill+ss and GITill-ss;

• severity of illness reported in percentage (%) time-loss illness (the % of GITill that resulted in time-loss [defined as ≥1-day lost from training or match-play]),[5] and days until return-to-play (DRTP) per single illness (the number of days lost before returning to play; the DRTP was estimated for each illness from the time of onset until medical clearance to return to full sports participation and competition);

• illness burden (IB), the number of days lost due to GITill relative to exposure, reported as days lost per 1000 player-days;[30, 31] and illness burden risk matrix, the overall burden of GITill was divided into four quadrants, *i.e.*, Q1 – low incidence, low severity; Q2 – low incidence, high severity; Q3 – high incidence, low severity; and Q4 – high incidence, high severity. An arbitrary cut-off point to define incidence and severity was ≥0.5 illness/1000 player-days, and ≥1-day lost per illness respectively.[32]

Statistical analysis

All recorded data were transferred to an Excel spreadsheet (Microsoft Corp., Redmond, WA, USA). Standard descriptive statistical analyses were conducted, using univariate analysis where appropriate. Frequencies and proportions were used to describe the number and percentage of gastrointestinal illnesses. Illness data were in the form of counts, which represented the number of GITill for each day the team remained in the tournament. Incidence (I) and incidence burden (IB) were estimated using Poisson GEE models with an offset equal to 1/1000 in order to produce estimates expressed as per 1000 player days. Incidence ratios (IR) and illness burden ratios (IBR) were estimated from the models as a measure of association between systemic and non-systemic illness symptoms and signs. To account for within-player and -team correlations due to repeated measurements and clustering within a team, we used a player within team nested correlation as working correlation and robust standard errors were produced using the sandwich estimator. To produce estimates for DRTP, only illness records were included as per the outcome. No correlation was considered for DRTP estimates and ratios between systemic and non-systemic symptoms and signs due to low sample sizes. The case of appendicitis was excluded from all incidence and ratio calculations as it was the only condition causing such a high number of days lost. All analysis was done using SAS 9.4 (SAS Institute, Cary, NC, USA). A 5% level of significance was used.

Results

Player demographics

The demographics of the player population are presented in Table I. The average age, height, weight and BMI of players over the 5-year study period remained similar.

Number of players, player-days and teams

The total number of players, total player-days (all, training, match) and the number of teams per season are shown

TABLE I.—*Player demographics of age, height, weight and BMI (mean, SD and range) for each season 2013-2017 during the Super Rugby tournaments.*

Parameters		Season				
		2013	2014	2015	2016	2017
Age (years)[#]	Mean (SD)	25.1 (3.5)	24.4 (3.3)	24.4 (3.3)	24.1 (3.0)	24.4 (3.2)
	Range	18-35	18-36	19-37	19-34	18-35
Height (m)	Mean (SD)	1.87 (0.07)	1.86 (0.07)	1.87 (0.07)	1.86 (0.08)	1.86 (0.08)
	Range	1.68-2.08	1.69-2.05	1.69-2.09	1.67-2.06	1.63-2.09
Weight (kg)	Mean (SD)	101.9 (12.6)	102.0 (12.8)	101.4 (12.5)	101.3 (13.4)	101.2 (13.1)
	Range	75-127	72-132	77-133	67-136	63-132
BMI (kg/m^2)	Mean (SD)	29.3 (2.9)	29.3 (3.1)	29.1 (3.0)	29.2 (3.2)	29.3 (3.2)
	Range	24.0-38.8	22.1-38.8	23.3-39.4	23.2-39.4	23.4-39.1

Results presented as means with SD, range.
[#]Age: calculated in years, as of January 1 of each season. The squad changed with the annual influx of new younger players.
BMI: Body Mass Index.

TABLE II.—*Number of players and total player-days per season in the study period (2013-2017).*

Parameters	Season					
	2013	2014	2015	2016	2017	Total
Number of players	180	196	218	272	275	1141[#]
Total player-days	16,715	16,118	21,406	23,817	24,682	102,738
Number of teams per season	5	5	5	6	6	27

[#]Several players participated in multiple years. In total 537 individual rugby players participated in the study, *i.e.*, the same players are counted multiple times in more than one season.

in Table II. In this study, 537 individual rugby players participated. Several players were selected for multiple seasons. The player influx over the 5 consecutive seasons in the study period (2013-2017) has previously been described.[27]

Incidence of all illnesses

A total of 456 illnesses in all organ systems were reported during this 5-year study period (2013-2017). The unadjusted incidence (per 1000 player-days: 95% CI) of illness in all organ systems was 4.3 (3.9-4.8). A total of 359 illnesses with systemic symptoms (78.7% of all illnesses) in all organ systems were recorded, with an unadjusted incidence of 3.4 (3.1-3.8).

Incidence of GITill

In the 5-year period, 101 GITill were reported. A single case of acute appendicitis in the 5-year study period that required surgery was excluded from all further incidence and severity calculations or comparisons of GITill due to the high time-loss and skewing the data. The overall incidence of all GITill reported was 1.0 (0.8-1.2) (N.=100; 21.9% of all illness). The incidence of GITill+ss 0.6 (0.4-0.8) (N.=60, 13.2% of all illnesses) was not significantly higher compared to GITill-ss 0.4 (0.3-0.5) (N.=40, 8.8% of all illness) (IR=1.5; 1.0-2.4; P=0.0603). In the subcategories of GITill diagnosed, the incidence of GE+ss 0.6 (0.4-0.7) (N.=57, 12.5% of all illnesses) was significantly higher compared to GE-ss 0.3 (0.2-0.4) (N.=28, 6.1% of all illnesses) (IR=2.0; 1.2-3.4; P=0.0045) (Table III).

TABLE III.—*The number, percentage (% of all illness) and incidence (illness per 1000 player-day; 95% CI) of all GITill with and without systemic symptoms and signs, and the subcategories of GITill during the 2013-2017 Super Rugby tournaments.*

Subcategories of GITill	N.	% of all GITill illness	Incidence/1000 player-days (95% CI)[$]
GITill+ss	60	13.2	0.6 (0.4-0.8)
GE+ss	57	12.5	0.6 (0.4-0.7)*
Appendicitis (Surgery)[#]	1	0.2	–
Other GITill+ss	3	0.7	–
GITill-ss	40	8.8	0.4 (0.3-0.5)
GE-ss	28	6.1	0.3 (0.2-0.4)
Upper GITill-ss	7	1.5	–
Abdominal pain (non-specific)	3	0.7	–
Other GITill-ss	2	0.4	–

Upper GITill-ss: includes dyspepsia, gastro-esophageal reflux and vomiting (non-specific, no diarrhea); %: percentage of all illness.
[$]Number too small to calculate incidence accurately; *significantly different from GE-ss; [#]acute appendicitis (N.=1) not considered in the incidence calculations or comparisons of GITill+ss.
GITill: gastrointestinal tract illness; GITill+ss: gastrointestinal tract illness with systemic symptoms and signs; GITill-ss: gastrointestinal tract illness without systemic symptoms and signs; GE+ss: gastroenteritis with systemic symptoms and signs; GE-ss: gastroenteritis without systemic symptoms and signs; N.: number of illnesses.

TABLE IV.—*The % time-loss illness (≥1-day), the days until return-to-play per single illness (DRTP: mean; 95% CI) and illness burden (IB per 1000 player-days: 95% CI) of all GITill with and without systemic symptoms and signs, and the subcategories of GITill during the 2013-2017 Super Rugby tournaments.*

Subcategories of GITill	N.	Total days lost	≥1-day time-loss GITill N. (% of GITill)[§]	DRTP /single illness (mean[†]) (95% CI)[§]	IB /1000 player-days (95% CI)[§]
GITill+ss	60	76	41 (68.3)	1.3 (1.0-1.6)*	0.8 (0.5-1.1)*
GE+ss	57	70	38 (66.7)	1.2 (1.0-1.6)	0.7 (0.5-1.0)*
Appendicitis (surgery)[#]	1	42	1 (100)	–	–
Other GITill+ss	3	6	3 (100)	–	–
GITill-ss	40	37	21 (52.5)	0.9 (0.7-1.3)	0.4 (0.2-0.6)
GE-ss	28	23	15 (53.6)	0.8 (0.6-1.2)	0.2 (0.1-0.4)
Upper GITill-ss	7	9	3 (42.9)	–	–
Abdominal pain (non-specific)	3	2	2 (66.7)	–	–
Other GITill-ss	2	3	1 (50.0)	–	–

Upper GITill-ss: includes dyspepsia, gastro-esophageal reflux and vomiting (non-specific, no diarrhea); % of all GITill: percentage ≥1-day time-loss of all in the subcategory (N.≥1-day time-loss/total N.).
[§]Number too small to calculate DRTP and IB accurately; [†]mean of those with the relevant illness; *significantly different: comparing GITill+ss *vs*. GITill-ss and GE+ss *vs*. GE-ss; [#]acute appendicitis (N.=42 days lost) not considered in the incidence calculations or comparisons of GITill+ss.
GITill: gastrointestinal tract illness; GITill+ss: gastrointestinal tract illness with systemic symptoms and signs; GITill-ss: gastrointestinal tract illness without systemic symptoms and signs; GE+ss: gastroenteritis with systemic symptoms and signs; GE-ss: gastroenteritis without systemic symptoms and signs; N.: number of illnesses.

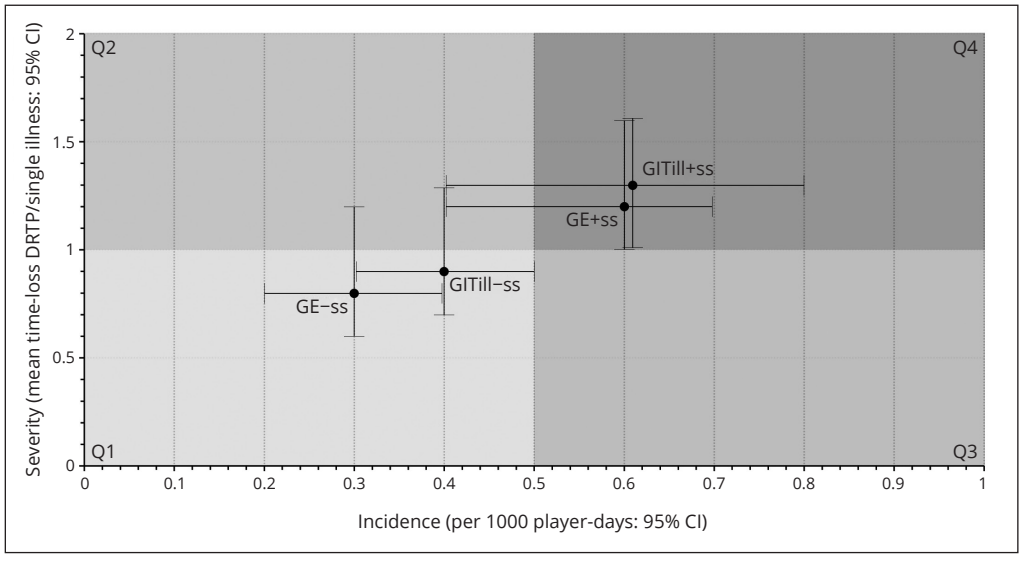

Figure 1.—Risk matrix illustrating the overall burden for all GITill with and without systemic symptoms and signs, and the subcategories of GE+ss and GE-ss during the study period (2013-2017).
The overall burden of GITill is divided into four quadrants: Q1 – low incidence, low severity; Q2 – low incidence, high severity; Q3 – high incidence, low severity; Q4 – high incidence, high severity. Arbitrary cut-off points: incidence ≥0.5 illness/1000 player-days; severity ≥1-days lost per illness.
[#]Acute appendicitis (N.=1) not considered in the incidence calculations or comparisons of GITill+ss.

Severity of GITill

Percentage (%) ≥1-day time-loss GITill

Of the 100 GITill, 62% (N.=62) resulted in ≥1-day time-loss. GITill+ss accounted for 68.3% (41/60) time-loss illness from tournament play, compared to 52.5% due to GITill-ss (21/40). GE+ss resulted in the greatest % of time-loss illness (66.7%) (Table IV).

Days until return-to-play per single GITill

In total over the 5 years, the days until return-to-play (DRTP: mean; 95% CI) per single illness is reported. An average of 1.1 days (1.0-1.4) per single GITill were lost from tournament play. The DRTP per single illness was not significantly higher for GITill+ss 1.3 days (1.0-1.6) compared to GITill-ss 0.9 days (0.7-1.3; P=0.1169) (DRTP Ratio =1.4; 0.9-2.0). The DRTP per single illness for GE+ss compared to GE-ss was similar (P=0.0943) (Table IV).

Illness burden of GITill

Illness burden

A total of 113 days was lost due to GITill in this study period. The overall illness burden (IB per 1000 player-

days: 95% CI), of GITill was 1.1 (0.8-1.5). The IB of GITill+ss 0.8 (0.5-1.1) was significantly higher compared to GITill-ss 0.4 (0.2-0.6) (IBR=2.1; 1.1-3.9; P=0.0253). The IB for GE+ss 0.7 (0.5-1.0) was significantly higher compared to GE-ss 0.2 (0.1-0.4) (IBR=3.0; 1.6-5.8; P=0.0007) (Table IV).

Illness burden risk matrix

The risk matrix (by incidence and severity) of GITill is depicted in Figure 1. The GITill that had the highest incidence and severity was GITill+ss, followed by the subcategory GE+ss.

Discussion

This is the first study reporting the incidence and severity of the subcategories of GITill in rugby players participating in an international Super Rugby tournament over a period of 5 years. The main findings are: 1) the most common GITill was GE+ss (12% of all illness); 2) 62% of all GITill resulted in time-loss and this was highest for GE+ss (67%); 3) the average DTRP was 1.1 days (1.0-1.4) and was similar for all subgroups; 4) the illness burden of GITill+ss 0.8 (0.5-1.1) is 2 times higher compared to GITill-ss 0.4 (0.2-0.6); and 5) in the subcategories of GITill the illness burden was highest for GE+ss 0.7 (0.5-1.0) and was significantly higher for GE+ss *vs*. GE-ss. In other GITill subcategories, the incidence and severity of illness were generally low. The exception was a single case of acute appendicitis that resulted in DRTP of 42 days. The incidence of all GITill across the 5 years of this study was 1.0 (0.8-1.2; 21.9% of all illnesses). This is higher compared to a study on professional football teams in Europe (UEFA Champions League) over a 4-year multiple season period (2011-2014). The UEFA Study, using the same methods of illness diagnosis and exposure recording, reported an incidence of all GITill of 0.41 (0.38-0.45; 28% of all illnesses).[33] Published data of both South African and New Zealand rugby teams during the single season of the 2010 Super Rugby tournament also reported a considerably higher incidence of all GITill in players at 5.6 (4.9-6.6).[5] In the TIPS 3-year control *vs*. 4-year intervention study, the incidence of gastrointestinal illness decreased significantly by 58% and the incidence after an intervention was introduced (1.1; 0.8-1.4).[20] This is similar to the incidence of all GITill we report in the current study. Most studies from other tournaments on single sports, only report incidence proportion (IP) and during one season;[9, 11, 13, 18, 34, 35] therefore, a comparison to the incidence (per 1000 player-day exposure) of all GITill data in our study could not be drawn. Over the 5-year period of our study, the incidence of GITill+ss 0.6 (0.5-0.8) was not significantly higher than GITill-ss 0.4 (0.3-0.5; P=0.0603). In most sports codes, including rugby,[5] athletics,[11] aquatics,[9, 10] tennis,[6] football[7, 8] and both the summer[17] and winter[18] Olympic Games, the subcategories of GITill+ss were not reported and therefore we cannot compare our data to these studies. GITill+ss is likely to be a result of more severe infective illness. In our study, we report that the incidence of subcategories of GE+ss was 2-times higher than GE-ss (IR=2.0; 1.2-3.4; P=0.0045). Previously reported illness data from both South African and New Zealand teams during the 2010 Super Rugby tournament, and other studies of GITill in the literature do not report subcategories of GE+ss and GE-ss and we cannot compare our data to these studies.[5, 20] Overall, in our study >60% of players with a GITill experienced training and gameplay interruptions of ≥1-day. This specifically includes the subcategories of GE+ss (66.7%) and GE-ss (53.6%) of GITill resulting in training or game play interruptions of ≥1-day. As mentioned previously, we cannot compare our data to those from a previous study during the 2010 Super Rugby season, as GE+ss and GE-ss subcategories were not reported.[5] We could also not compare our results to other studies since the % time-loss illness for the subcategories of GITill is not reported. We show that on average, players diagnosed with a GITill will lose approximately 1.1 DRTP/single illness. This is similar for all subcategories of GITill. A risk matrix is a powerful tool to assess risk and to report the actual impact of illness in sport. In the risk matrix, the relationship between incidence and severity for the most relevant illness types are illustrated. The IB of GITill+ss 0.8 (0.5-1.1) is 2-times higher when associated with systemic symptoms and signs. In the subcategories of GITill the IB was highest for GE+ss (0.7; 0.5-1.0), and >3-times higher compared to all GE-ss. GITill+ss and GE+ss represented the greatest health burden in our cohort. From this study, the maximum impact of a GITill prevention program will be to reduce the incidence and the severity of GE+ss. The main strength of this study is that it is the largest study of its kind conducted to date on GITill and includes data over 5 Super Rugby seasons in 102,738 player-days. The findings can be used in the future strategic design of GITill prevention programmes. It is the first study reporting the incidence of the subcategories of GITill, based on the presence or absence of systemic signs and symptoms, in any sport, and specifically in rugby players competing in the Super Rugby tournament. Furthermore, the team physicians col-

lected the data, thereby significantly adding to the quality of the data collection.

Limitations of the study

This study has certain limitations. The final clinical diagnosis of GITill was based on the clinical picture of the player and relied on the substantive clinical experience of the team physician, *i.e.*, the diagnosis was not confirmed by special investigations. Time-loss was estimated by the team physician at the time of diagnosis and was not the final actual DRTP. Reporting the actual time-loss days or the specific day of return-to-play, was not feasible in the early version of our data capturing system. In later years, there was an option for team physicians to reurn to the electronic platform and revise the days lost, but compliance was poor. There is also increasing recognition that return-to-sport after injury or illness is a process and not a specific day or time point.[36] Therefore, the actual day of return-to-play may also underestimate or overestimate the absolute severity of the illness when athletes return to training before or long after an illness has clinically resolved. The background medical history of the players, as well as the numbers of players that had to leave the field of play due to GIT symptoms, are not available, and therefore no inference could be made concerning the effect of risk markers for GITill including strenuous exercise. Due to the low number of GITill reported, the seasonal or year effects were not modelled and outbreaks in player groups were therefore not obtained. The incidence of illness is reported per 1000 player-days, and our data can only be compared with studies that used a similar methodology. Our findings in male players from one sport cannot be generalized. This paper was not designed to establish the risk factors associated with GITill. These will be explored in future studies. Confirming infectious diseases by using special investigations would be important in future research. Also, including the pattern of illness in players over years may be important.

Practical implications

- Gastroenteritis with systemic symptoms and signs was the most commonly diagnosed GITill (12.5% of all illnesses).
- In the Super Rugby tournament, 62% of all GITill resulted in time-loss.
- The highest time-loss (66.7%) resulted from gastroenteritis with systemic symptoms and signs.
- Players presenting with gastroenteritis with systemic symptoms and signs documented the most days (1.2 days) until return to play per single illness.
- Gastroenteritis with systemic symptoms and signs represents a substantial burden of illness (0.7 days lost).

Conclusions

This is the first study reporting the incidence and severity of the subcategories of GITill in rugby players participating in an international Super Rugby tournament across 5 seasons (2013-2017). More than 60% of all diagnosed GITill resulted in time-loss illnesses, and this was highest for GE+ss. On average, any player diagnosed with GE+ss will lose 1.2 DRTP/single illness. GITill+ss and the subcategory GE+ss are the most common specific GITills, with the highest IB. For the majority of GITill subcategories, the incidence and severity of illness were generally low. To enable team physicians to plan more precise medical care, the detailed illness incidence and severity in the clinical subcategories of GITill needs to be reported. More targeted interventions to specifically reduce the incidence of GE+ss should be developed.

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