EDITOR'S CHOICE

PRESS RELEASE

Elite athletes travelling to international destinations >5 time zone differences from their home country have a 2–3-fold increased risk of illness

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Accepted 28 June 2012

ABSTRACT

Background Illness accounts for a significant proportion of consultations with a team physician travelling with elite athletes.

Objective To determine if international travel increases the incidence of illness in rugby union players participating in a 16-week tournament.

Setting 2010 Super 14 Rugby Union tournament.

Participants 259 elite rugby players from eight teams were followed daily over the 16-week competition period (22 676 player-days).

Assessment Team physicians completed a logbook detailing the daily squad size and illness in any player (system affected, final diagnosis, type and onset of symptoms, training/match days lost and suspected cause) with 100% compliance. Time periods during the tournament were divided as follows: located and playing in the home country before travelling (baseline), located and playing abroad in countries >5 h time zone difference (travel) and located back in the home country following international travel (return).

Main outcome measurement Incidence of illness (illness per 1000 player-days) during baseline, travel and return.

Results The overall incidence of illness in the cohort was 20.7 (95% CI 18.5 to 23.1). For all teams, the incidence of illness according to location and travelling was significantly higher in the time period following international travel (32.6; 95% CI 19.6 to 53.5) compared with the baseline (15.4; 95% CI 8.7 to 27.0) or after returning to their home country (10.6; 95% CI 6.1 to 18.2).

Conclusions There is a higher incidence of illness in athletes following international travel to a foreign country that is >5 h time difference and this returns to baseline on return to the home country.

INTRODUCTION

In recent years, there has been an increasing focus on not only the prevention of injuries, but also the protection of the health of the athlete. It is particularly relevant to consider medical illness in elite athletes who participate in events and tournaments lasting for days to a few weeks. In recent years, a number of studies have reported on illness in international competitions for football,[1] (and submitted for publication, Theron N, Schwellnus MP, Junge A, *et al*. Incidence of illness and injuries during the FIFA Confederations Cup 2009. *Clin J Sport Med* 2012.) aquatic sport,[2] Winter Olympic Games[3] and athletics.[4] From these published reports, it does appear that medical illness affects elite athletes while travelling to international competitions,[5 6] and that these illnesses most commonly affect the respiratory system and the gastrointestinal tract (GIT) system.[1–6]

Travel medicine is a discipline of medicine that developed in the past two to three decades to study the health consequences resulting from international travel.[7 8] The priorities in travel medicine research have recently been reviewed, and include studying pretravel interventions, safety during travel and posttravel considerations.[9] Prospective cohort studies are particularly important to determine the incidence and risk factors associated with illness as a result of travel.[9–11] Despite considerable interest in this field, there are very few epidemiological studies, in particular prospective cohort studies, to determine the risk of illness during international travel.[11] Published data are limited by a number of factors including selection bias (surveys from individuals who seek assistance at travel clinics), information bias (self-reported data on illness), recall bias (data obtained weeks after return from travel), poor response rates, failure to control for confounders[11] and failure to document exposure (person days or weeks).[12]

In the southern hemisphere, a rugby union tournament with teams from South Africa, New Zealand and Australia is conducted annually over a 16-week period. In the 2010 Super 14 Rugby tournament, 14 international rugby teams competed in the period from February 2010 to May 2010 at different playing venues in South Africa, Australia and New Zealand. Unlike other tournaments, which typically take place in one venue or in one country, this tournament is unique in that players travelled between South Africa, Australia and New Zealand over the 16-week period. Games take place every week, and each team play against every other team—some games are played in the home country and others abroad. Therefore, this tournament is characterised by periods of play in the home country and periods of playing abroad where time zone differences vary from 2 to 11 h. This tournament is also an event that is characterised by very high-intensity international standard rugby games[13] on 15 weekends over the 16-week period, with an addition of 3–5 training sessions per week.

The incidence of medical illness in rugby union players participating in this tournament has recently been reported.[14] In this study, the incidence

of illness was higher than that in similar studies in football (soccer) players where the tournament was shorter and only played in one country.[1] The majority of illnesses affect the respiratory, digestive and skin and subcutaneous system, and were mostly infective in nature.[14] In approximately half the illness cases seen, symptoms were already present the day before they were reported by the player.

The reasons for this observed higher incidence of illness was not clear[14] but could be attributed to a number of different factors including: the prolonged and strenuous nature of the competition, exposure to different environmental conditions (temperature, humidity, atmospheric pollution, aeroallergen exposure) and variation of diet. In addition, players travelling between continents may also be exposed to different strains of pathogenic organisms.

There are no studies on the incidence of medical illness in athletes when they undergo multiple journeys of international air-travel across many time zones in both directions (east to west and west to east). The main aim of this study was therefore to report on the incidence and nature of illness in elite rugby union players when travelling to competitions across multiple time zones and on returning to their home country.

METHODS

Type of study

This was a prospective cohort study conducted over a 16-week period during the 2010 Super 14 Rugby Union tournament.

Selection of participants

The methodology of this study has previously been described in detail.[15] The UCT/MRC Research Unit for Exercise Science and Sports Medicine conducted the study, together with the South African Rugby Football Union and with the co-operation of the team physicians of eight of the participating rugby teams from South Africa and New Zealand. Before the start of the tournament, research ethics approval for the study was obtained from the University of Cape Town Health Sciences Research Ethics committee (REC 008/2010). Detailed information about all the components of the study was provided to the team physicians of the South African (five teams) and some of the New Zealand (three teams) participating teams. All the players (n=259) participating in the eight teams were approached (28–36 players per team) to participate in this prospective study through their team physicians. Each team physician was able to explain the details of the study as well as the potential risks and benefits of the study by providing players with a detailed subject information sheet. Written informed consent was obtained from players to participate in the study.

A system of coding each player and team anonymously was used to ensure anonymity. Each team was allocated a random code (letter of the alphabet) and each player in the team was randomly allocated a number. Only the team and player code were listed on all the documentation. An independent party assigned the codes, and these were kept in sealed envelopes and safe storage until after the competition.

Illness data collection

Data collection took place on a daily basis during the competition. Each team physician was requested to complete a 'daily medical illness log' for each player. This started when the team assembled a few days before the first game and ended after a team played their last game. A booklet was provided that contained daily illness report forms (one page per day).

A medical illness was defined as 'any non-trauma-related symptom or sign presenting in a player who required medical attention from the team physician on a specific day'. The information of every medical illness that was included on the daily report form was the same as that which a team physician would obtain during usual clinical care of an athlete. This information included the following: presenting symptom/s or sign/s, duration of symptoms (days), the specific final clinical diagnosis (a list of common diagnoses was provided for each system) and the predicted number of days lost from practices or matches and the suspected aetiology of illness (a list of common categories of causes was provided). The team physician obtained these data through clinical assessment.

The team physicians kept the booklet of daily illness forms secure and the completed booklets were submitted only to the central research office at the end of the competition. Regular contact between the central research office and the participating team doctors occurred during the competition using either email or telephonic contact. Following the completion of the competition, all daily illness report booklets were analysed. There was 100% compliance in the return of completed booklets.

Calculation of the player-days

The calculation of player-days has previously been described.[15] Briefly, the number of team and player-days was calculated as follows: eight teams (daily squad size varied from 28 to 36 players per team) participated in the study during the tournament over about 16 weeks. On each day, the team physician reported the 'daily squad size' for that day as this could vary (squad sizes were often reduced during times of international travel). The total player-days for each team were therefore calculated as follows: total team tournament days×daily squad size (for each day). The total number of player-days for all the teams was 22 676 (South African teams=14291, New Zealand teams=8385).

Calculation of the incidence of illness

The calculation of illness incidence data (calculated as illness per 1000 player-days) has also been described.[15] For the purposes of this article, the incidence rates will be reported for (a) all illnesses, (b) illnesses in the respiratory system, (c) illness in the gastrointestinal system, and (d) all infective illnesses combined. We previously identified that illness classified as subcategories b–d were common during this tournament.[14]

Incidence of illness in the teams from the two different countries

In this study, there were teams from two different countries and the first analysis was to determine whether the incidence of illness differed in the teams from the two countries.

Incidence of illness in relation to intercontinental travel

Team physicians were asked to report the geographic location of the team on the daily illness log. The location data were used to calculate the incidence of all illness in relation to time periods before, during and after travelling to other countries. The incidence of illness was calculated for time periods as follows:

1. South African teams: playing at home (baseline), playing after travelling from west to east (to Australia and New Zealand) (time zone differences between 6 and 11 h from their home country) and travelling from east to west (from Australia or New Zealand) back to their home country (time zone differences between 6 and 11 h from their home country).

2. New Zealand teams: playing at home (baseline), playing after travelling from east to west (to Australia) (time zone differences between 2 and 5 h from their home country), playing after travelling from east to west (to South Africa) (time zone difference of 11 h from their home country), travelling from west to east (from Australia) back to their home country (time zone differences between 2 and 5 h from their home country) and finally travelling from west to east (from South Africa) back to their home country (time zone difference of 11 h from their home country).

Incidence of illness during the 4 months of the tournament

The incidence of illness was calculated during the months of the tournament (from February to May). This was conducted to determine if the incidence of illness was related to a change in seasons (from autumn to winter). Because the tournament only started in mid-February, team-days in February and March were combined. The total number of team-days in each month was therefore as follows: February/March (385), April (240) and May (163).

Incidence of illness over time after travel to different locations

An analysis was conducted to determine if the incidence of illness varied during the time periods (from the first to the fourth week after arrival in a new location). The incidence of illness was calculated over the 1st, 2nd, 3rd and 4th weeks after starting the tournament (baseline period), international travel (travel period) and following return to the home country. The clinical importance of this analysis was to identify 'higher risk' periods after arrival in a new location.

Statistical analysis of data

All the data from the booklets were recorded and transferred to an Excel spread sheet. Standard descriptive statistical analyses were conducted, using uni- and bi-variate analysis where appropriate. These data were a series of measurements of incidence of illness observed for the teams over time (days over the 2010 Super 14 rugby tournament). These incidences of illness over time were taken at the team level, making the observations clustered within teams. Generalised linear mixed-effects models were used to model the data with a binary response (positive/negative response to an illness) and explanatory predictors/covariates considered were as follows: home country for the teams, month/season of play, indicators of intercontinental travel and duration (number of days) in a specific travel stage of the tournament. The model fits a random intercept and slope on time (day of tournament). In the initial stage of the analysis, various methodologies for measuring intercontinental travelling were considered. Once this was finalised, covariates were included in the model to obtain the final parameter estimates.

RESULTS

Overall incidence of all illness

The overall incidence and nature of illness during this tournament has been reported previously.[14] In summary, a total number of 469 illnesses were reported in 187 of the 259 players (72.2% of players) during the 16-week study period. The overall incidence of illness was 20.7 per 1000 player-days (95% CI 18.5 to 23.1), and the most common system affected by illness was the respiratory system (30.9%), followed by the digestive system (27.5%) and the skin and subcutaneous tissue (22.5%). Infections accounted for the majority of illness.

Table 1 The incidence (per 1000 player-days) (95% CI in brackets) of all illness, respiratory tract illness, gastrointestinal tract illness and all infective illness in the teams from the two different countries (South Africa, New Zealand)

	South Africa	New Zealand
All illness (n=469)	11.0 (6.0 to 20.3)	26.6 (12.5 to 55.8)
Respiratory tract illness (n=144)	6.0 (4.0 to 10.0)	4.0 (2.0 to 8.0)
Gastrointestinal illness (n=128)	2.2 (1.2 to 4.3)	7.1 (3.5 to 14.5)[a]
All Infective illness (n=254)	5.1 (2.8 to 9.4)	15.8 (7.6 to 32.6)[b]

[a]p=0.016, significantly different between countries.
[b]p=0.019, significantly different between countries.

Incidence of illness in the teams from the two different countries

The incidence of illness in the teams from the two different countries is reported in table 1. Incidence data are reported for all illness, respiratory tract illness, GIT illness and all infections.

There was a significantly higher incidence of GIT illness and all infective illness in the teams from New Zealand compared to the teams from South Africa ($p<0.05$). The incidence of all illness and respiratory tract illness was not different between the teams from the two countries.

Incidence of illness in relation to intercontinental travel

An initial analysis was performed to determine the incidence of illness in the South African and New Zealand teams following international travel to foreign countries compared to the incidence of illness during the baseline period and when returning to their respective home countries (table 2A).

For the South African teams, there were no significant differences in the incidence of illness when located in Australia compared with New Zealand. Of note is that there is a maximum of 5 h time zone difference between cities in Australia and New Zealand. Similarly, for the New Zealand teams, there was no significant difference in the incidence of illness when located in Australia compared with their home country.

Therefore, a further analysis was conducted to calculate the incidence of illness during the baseline period, and following travelling to locations >5 h time zone differences (any travel between South Africa and Australia and/or New Zealand) (east to west and west to east) for the New Zealand and the South African teams (table 2B). For the New Zealand teams, 11 of the 24 team-days that were classified as travel to Australia in table 2A (*) were re-classified as baseline because teams returned to New Zealand. The other 13 team-days (*) were re-classified as international west to east travel, as these days

Table 2A The incidence of all illness (per 1000 player-days) (95% CI in brackets) in the South African and New Zealand teams following travel to international locations (n=team-days)

	South African teams		New Zealand teams	
	n	Incidence	n	Incidence
Baseline (home country)	156	10.0 (5.0 to 19.7)	134	27.6 (12.1 to 59.6)
Travel to Australia	74**	24.3 (12.5 to 46.6)[a]	24*	24.1 (10.0 to 25.7)
Travel to New Zealand	72**	19.9 (10.2 to 38.8)[a]		–
Travel to South Africa		–	64	51.1 (23.6 to 11.0)[a]
Return (home country)	195	5.8 (2.9 to 11.5)[b]	69	17.1 (7.4 to 39.0)[b]

[a]p<0.002 vs baseline.
[b]p<0.001 vs a, but p>0.01 vs baseline.
* and ** refer to team-days and is discussed in the text.

Table 2B The incidence of all illness (per 1000 player-days) (95% CI in brackets) in the South African and New Zealand teams following travel (>5 h time zone difference) in an east to west and west to east direction (n=team-days)

	Baseline		East to west		West to east	
	n	Incidence	n	Incidence	n	Incidence
New Zealand teams	145	28.7 (12.7 to 63.6)	64	51.1 (23.6 to 11.0)[a]	82	16.4 (7.0 to 37.8)
South African teams	156	10.0 (5.0 to 19.9)	146	5.8 (2.9 to 11.6)	195	22.1 (11.5 to 42.0)[b]

[a]p<0.02 vs baseline.
[b]p<0.006 vs baseline.

were spent in Australia after returning from South Africa (>5 time zone difference). For the South African teams, team-days spent in New Zealand and Australia (**) were combined and re-classified as international west to east travel (table 2B).

This analysis confirmed that there was a significant increase in the incidence of illness (from baseline) when teams travelled to foreign locations that were >5 h time zone difference away from their home country (east to west for New Zealand teams, and west to east for South African teams), but not when they returned to their home country (west to east for the New Zealand teams, and east to west for the South African teams). Therefore, for teams from both countries, the direction of travelling itself (east to west, or west to east) was not a determining factor for the incidence of illness but rather the travelling to a location away from the home country that was >5 h time zone difference.

For further analysis and modelling of the incidence data, three time periods were therefore identified during the tournament as follows: before travelling while located in their home country (Baseline period), travelling internationally to destinations >5 h time zone difference (Travel period), period after returning to their home country following international travel (Return period). Of the 788 team-days that were followed during the tournament, there were 301 baseline period team-days, 210 travel period team-days and 277 return period team-days (table 2B).

All subsequent illness incidence data (all illness, respiratory tract illness, GIT illness and all infective illness) were calculated during these three periods. The overall incidence of illness (all illness, respiratory tract illness, GIT illness and all infections), based on international travel (>5 time zones), is reported in table 3.

There was a significantly higher incidence of all illness, respiratory tract illness, GIT illness and all infective illness in the travel time period compared with baseline or return (p=0.0001). The incidence of illness on returning home was not different to that of the baseline.

Table 3 The incidence (per 1000 player-days) (95% CI in brackets) of all illness, respiratory tract illness, gastrointestinal tract illness and all infective illness during the three time periods (baseline, travel, return)

	Baseline	Travel	Return
All illness (n=469)	15.4 (8.7 to 27.0)	32.6 (19.6 to 53.5)[a]	10.6 (6.1 to 18.2)
Respiratory tract illness (n=144)	2.7 (1.4 to 5.1)	7.8 (4.9 to 12.5)[a]	4.2 (2.5 to 7.2)
Gastrointestinal illness (n=128)	3.6 (1.7 to 7.7)	11.0 (6.8 to 18.9)[a]	1.5 (0.7 to 3.2)
All infective illness (n=254)	9.0 (4.9 to 16.4)	15.8 (9.5 to 26.0)[a]	5.2 (2.9 to 9.1)

[a]p=0.0001, significantly different from baseline and return.

Table 4 The incidence of all illness (per 1000 player-days) (95% CI in brackets) in all teams during the months of the tournament

	February/March	April	May
All illness (n=469)	19.5 (11.6 to 32.5)	14.1 (8.4 to 23.5)[a]	18.4 (10.6 to 31.8)
Respiratory tract illness (n=144)	7.6 (4.7 to 12.5)	2.6 (1.5 to 4.4)[b]	4.5 (2.4 to 8.4)
Gastrointestinal illness (n=128)	4.0 (2.2 to 7.4)	4.6 (2.6 to 8.1)	3.4 (1.7 to 7.1)
All infective illness (n=254)	10.9 (6.4 to 18.5)	6.6 (3.8 to 11.3)[c]	10.2 (5.6 to 18.4)

[a]p=0.09, marginally different from other months.
[b]p=0.07, marginally different from other months.
[c]p<0.05, significantly different from other months.

Incidence of illness by month of the tournament

The incidence of illness during the months of the tournament (from autumn to winter) is reported in table 4. Incidence data are reported for all illness, respiratory tract illness, GIT illness and all infections during the months of February/March, April and May.

There was a marginal (p<0.01) lower incidence of all illness and respiratory tract illness during the month of April, compared with the other months. However, the incidence of all infective illness was significantly lower in April compared with the other months (p<0.05). The incidence of GIT illness was not different between the months.

Incidence of illness over time during different periods (baseline, travel and return)

The incidence of illness over time (weekly time periods following arrival in a new location) during the three periods (baseline, travel and return) for all illness, respiratory illness, GIT illness and infective illness was determined. This analysis was done to identify possible 'high-risk' periods for illness on arrival following travel (to foreign countries and following return to the home country) (table 5).

At baseline there were no significant differences in the incidence of illness between days 1 and 7, 8 and 14 and 15and 28 for all illness, respiratory tract illness and GIT illness. However, at baseline, the incidence of all infective illness was significantly higher in the period days 8–14 compared with days 1–7 (p=0.02). Following international travel, and on returning to the home country, there were no significant differences in the incidence of illness between days 1–7, 8–14 and 15–28 for all illness, respiratory tract illness, GIT illness and all infective illness.

DISCUSSION

In this study, the effects of international travel across multiple time zones (in both an easterly and westerly direction), on the incidence of illness in elite rugby players participating in the 2010 Super 14 Rugby Union tournament was documented. The main findings of this study are as follows: (1) international travel to a foreign location greater than 5 h time zone difference from the home country was associated with a significant increase (2–3 times) in the incidence of all illness, respiratory tract illness, GIT illness and all infective illness, (2) the incidence of illness was not affected by the direction of

Table 5 The incidence (per 1000 player-days) (95% CI in brackets) of all illness, respiratory tract illness, gastrointestinal tract illness and all infective illness over time (days 1–7, 8–14 and 15–28) during the three time periods (baseline, travel, return)

	Days 1–7	Days 8–14	Days 15–28
Baseline			
All illness	22.1 (11.6 to 41.7)	30.0 (14.5 to 60.8)	19.7 (9.3 to 41.2)
Respiratory tract illness	2.9 (1.2 to 7.2)	6.9 (2.7 to 17.7)	4.1 (1.5 to 11.3)
Gastrointestinal illness	4.9 (2.0 to 11.9)	3.5 (1.0 to 11.8)	3.9 (1.4 to 10.9)
All infective illness	8.9 (4.2 to 18.9)	19.9 (8.7 to 44.9)[a]	16.3 (7.0 to 37.8)
Travel			
All illness	37.9 (21.3 to 66.6)	40.1 (22.5 to 70.4)	26.9 (14.8 to 48.2)
Respiratory tract illness	7.9 (4.1 to 15.2)	10.8 (5.9 to 19.8)	6.1 (3.2 to 11.5)
Gastrointestinal illness	14.4 (8.0 to 25.6)	15.7 (8.8 to 28.0)	10.3 (5.5 to 19.3)
All infective illness	16.6 (8.8 to 31.0)	24.0 (13.0 to 43.9)	11.7 (6.0 to 22.7)
Return			
All illness	14.1 (7.3 to 26.9)	12.7 (6.3 to 25.4)	7.1 (3.4 to 14.7)
Respiratory tract illness	4.7 (2.2 to 10.1)	4.0 (1.6 to 10.1)	3.6 (1.5 to 8.4)
Gastrointestinal illness	2.2 (0.7 to 6.4)	3.0 (1.0 to 8.9)	1.6 (0.5 to 5.0)
All infective illness	5.3 (2.4 to 11.9)	5.7 (2.4 to 13.4)	4.2 (1.8 to 9.9)

[a]p=0.02, significantly different from days 1–7.

international travel (easterly or westerly direction), (3) travelling back to the home country was not associated with a increased incidence of illness compared with baseline (before travelling) and (4) the weekly incidence of illness was similar over the 4 weeks following international travel to a destination >5 time zones difference, or return international travel back to the home country.

This study, to our knowledge, is the first prospective cohort study to determine the effect of international travel on the incidence of illness in elite athletes participating in a prolonged tournament. Apart from the prolonged duration (16 weeks), intense weekly training sessions (2–3 per week) and weekly matches, the Super Rugby Union tournament is also characterised by periods where teams travel between South Africa, New Zealand and Australia (with time zone differences that vary between 2 and 11 h) to compete. We have previously shown that there is a high overall incidence of illness during this competition, mostly affecting the respiratory and the GIT systems. Infections accounted for most illnesses.[14]

There are no published studies in travelling athletes, and indeed few prospective studies in the travel medicine literature for comparison. In one study, the illness rate (per 100 person-weeks) was reported for adults and children travelling from Europe to subtropical and tropical regions and then returning home.[13] On the assumption that a 100 person-weeks is equivalent to 700 person-days, the incidence of all illness reported in this study during travel (33.9/100 person-weeks) can be expressed as 48.4/1000 person-days. Similarly, the incidence of illness in the 4-week period following return home was 5.7/100 person-weeks and can be expressed as 8.14/1000 person-days. It is of interest to note that these data are quite similar to our reported incidence of 32.6/1000 player-days during travel, and 10.6/1000 players days on return. However, this comparison should be made with caution as the definition and classification of illness, populations studied, time zone documentation, nature of travel and physiological systems were different between studies. Thus, the paucity of data in this area is clear, and more research is needed to determine the precise incidence of illness in travelling athletes from other sporting codes, other tournaments, different travel durations, travel destinations and travel direction (eg, north–south compared with east–west).

In our study we did not find a difference in the incidence of illness across the months of the study, with the exception of a marginal decrease in the incidence of illness during the month of April. Furthermore, there was no significant difference in the incidence of illness in teams travelling to a foreign destination in an easterly or westerly direction across multiple time zones (>5 time zones). However, the principal finding of this study was that any travel >5 time zones away from the home country was associated with a 2–3-fold increase in the incidence of all illness, respiratory illness, GIT illness and all infections. If factors during air travel (including drying of respiratory epithelium, close contact with fellow air travellers, and exposure to re-circulated air) predispose to illness, we would have also expected a high incidence of respiratory illness following return travel to the home country.

Indeed, as the incidence of illness following arrival back at home was similar to that of baseline, the results from our study indicate that the illness risk is not directly related to the travel itself, but rather the arrival and location of the team at a distant destination. We can thus conclude that various factors associated with the distant destination, rather than travel per se, are associated with the increased incidence of illness. These factors were not investigated in our study. However, it could be speculated that various possible stressors including environmental conditions (temperature, humidity, climate, altitude, pollution, and pollens), food and exposure to different cultures, populations and pathogens could all play a role. Further studies are needed to determine the role of these factors.

Finally, there is also a possibility that access to the team physician was more likely during travel and therefore it is easier to document illness. However, most teams are also accommodated and travel together during the periods when they are located at home. During these times, it is also a requirement that all illness is reported to the team physician, as they are responsible for the health of the players. Therefore, underreporting of illness during the baseline and return periods is very unlikely.

In an attempt to investigate if there are any 'high-risk' periods of illness following travel (abroad and returning home), we also determined the incidence of illness at weekly intervals (weekly for 2 weeks) and in a 2–4-week period following travel. These results show that there is no increased risk of illness in the first compared with the 2nd to the 4th week after travel (abroad or returning home). The incidence of infective illness was however higher in the 2–4-week period during baseline. The reasons for this are not clear, but may be related to the transmissions of pathogens are possible when players that get together for the first time in the season. Many pathogens have an incubation period that would result in manifestations of illness after 7 days. This finding needs to be confirmed but team physicians can take note of this higher risk period at the onset of the tournament and institute measures to reduce the risk of illness.

The strengths of the present study are that it represents the largest prospective cohort study on the effects of international

travel on the incidence of illness in elite athletes. Furthermore, team physicians accurately reported the incidence of clearly defined illness on a daily basis, with a very high compliance rate.

The main limitations of this study are that the results cannot necessarily be applied to other sporting codes and tournaments, to the recreational or business traveller, or to long-distance travel that does not cross multiple time zones such as north–south travel. Furthermore, we cannot account for any possible confounders such as possible illness prevention measures that team physicians employed in their teams.

The clinical relevance of the findings from this study is important to team physicians. While we have previously documented that players generally present to the team physician with illness 24 h or more after the onset of symptoms,[14] the data from the current study allow the team physician to identify a period before and during travel where athletes are at higher risk and can allow for increased vigilance.

Although specific risk factors associated with the increased incidence of illness during travel away from home require further research, team physicians can adopt certain strategies to reduce the risk of illness based on (1) some known risk factors from studies in the travel medicine literature[11] and (2) an one report of successful reduction in illness in athletes.[15] General risk factors for illness during travel in non-athletes are age (increased risk in the third decade), female sex, inexperienced travellers, summer season and large climatic contrast from the home country.[12] However, further studies should be planned to determine risk factors (intrinsic and extrinsic) for illness in athletes following travel to international destinations.

In summary, the modern-day elite athlete is increasingly required to travel across multiple time zones in order to participate in international tournaments. The team physician is responsible for protection of the health of the athlete during these periods of travel and competition. This study shows for the first time that elite athletes travelling to international destinations >5 time zone differences from their home country is associated with a 2–3 times increased risk of all illness, respiratory tract illness, GIT illness and all infective illness. Identification of this period where athletes are at higher risk allows the team physician to plan certain preventative measures and have increased vigilance during this time.

What are the new findings

- There is a 2–3-fold increased higher incidence of illness in athletes following international travel to compete in a foreign country that is >5 h time difference.
- This incidence decreases returns to baseline on return to the home country despite following the same duration of travel.

How might it impact on clinical practice in the near future?

Team physicians can explore options to reduce the higher incidence of illness in athletes when they travel with a team away from their home country to destinations >5 time zone differences.

Acknowledgements The authors appreciate the cooperation of the team physicians and their medical staff who gave their time to collect the data for this project on a daily basis: Dr Rob Collins, Dr Stephen Kara, Dr Ryan Kohler, Dr Ian Morris, Dr Tony Page, Dr Craig Roberts, Dr Org Strauss and Dr Sandra Webb. We also would like to thank the players and the administrators for their support with the project.

Funding IOC Research Center: 2009-09-07, partial support.

Competing interest None.

Patient consent Obtained.

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