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Incidence of staff injury and illness at the Tokyo 2020 and Beijing 2022 Olympic and Paralympic Games

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ABSTRACT

Objective To report epidemiological data regarding injury and illness among the Team USA staff during the Tokyo 2020 Summer Olympic and Paralympic Games and Beijing 2022 Winter Olympic and Paralympic Games.

Methods A retrospective review of all Team USA staff (total staff, N=1703 (62.5% female); total staff days (SD)=34 489) medical encounters during the Tokyo 2020 Games and Beijing 2022 Games was conducted. Details related to injury and illness were evaluated. Incidence with 95% CI per 1000 staff days were calculated.

Results A total of 32 illnesses (incidence [95% CI] 0.9 [0.6, 1.2]) and 23 injuries (incidence 0.7 [0.4, 0.9]) were sustained by the Team USA delegation staff members during the Tokyo 2020 Games and Beijing 2022 Games. Female staff reported more illnesses (illnesses proportion (IP) 2.9%; incidence 1.4 [0.8, 2.0]), while male staff incurred more injuries (IP 1.8%; incidence 0.9 [0.5, 1.3]). When stratified by physiological system, dermatological and infectious were the most common systems involved with illness (IP 0.5%; incidence 0.2 [0.1, 0.4]). Injuries to the upper limb were most common (IP 0.3%; incidence 0.3 [0.1, 0.5]).

Conclusion Injury and illness rates among the Team USA staff during the Tokyo 2020 Games and Beijing 2022 Games were low, but notable. Knowledge of injury and illness risks contributes to staffing decisions and prevention strategies for staff supporting athletes during competition.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ To the authors' knowledge, there is no existing published literature describing the epidemiology of injury and illness of staff members belonging to a single national delegation represented at any Olympic or Paralympic Games.

WHAT THIS STUDY ADDS

⇒ This study demonstrates within the Team USA staff delegation at the Tokyo 2020 and Beijing 2022 Games that there were 32 illnesses and 23 injuries that received medical evaluation.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ These data may be used to more accurately estimate needs for provision of medical care required by a large delegation at future events of such scale.

INTRODUCTION

The Olympic Games are the largest sporting events in the world, with typically around 10 000 athletes competing during Summer Games and 3000 athletes competing during Winter Games.[1] While slightly smaller in scope, the Paralympic Games are also among the largest mass-sporting events in the world, with a total of around 4500 athletes competing between the Summer and Winer Games.[2] Working behind the scenes of these thousands of athletes are tens of thousands of staff and volunteers who work to support the athletes and Games. As an example, while just over 11 000 athletes competed in the Tokyo 2020 Summer Olympic Games, there were reported to be between 70 000 and 80 000 staff, volunteers, and contractors working at the Games.[3 4] During the Olympic and Paralympic Games periods, staff members play an essential role in supporting athletes and are critical in the positive representation of a national delegation overall. Members of a delegation are typically selected based on their skills and ability to support their delegation's athletes and are provided access to necessary resources, such as medical care, when indicated. Epidemiological studies reporting illness and injury rates incurred by athletes at large-scale sporting competitions, such as the Olympic and Paralympic Games, have been extensively reported.[1–13] However, despite prior studies indicating that workforce staff make up a notable portion (5.1% to 61.8%) of those requiring medical care,[14–19] there is presently no research focusing on injuries and illnesses sustained by staff members from a single delegation.

In general, medical coverage goals include the provision of first aid to athletes, advanced medical support and stabilisation for individuals requiring urgent or emergent transfer to a higher level of care, and triage to avoid overwhelming local emergency medical services and facilities.[20–24] There have been multiple studies that have developed various strategies for estimation of medical needs at sporting events that not only have many participants but also draw large volumes of spectators.[23 25–28] Each of these requires knowledge of utilisation needs in previous iterations of such an event.[18 21 23 26–28] However, while these studies have focused on mass-spectator events, none have examined the Olympic and Paralympic Games, the largest mass-spectator events in the world. Also, none have specifically examined healthcare utilisation among the staff supporting the Games. As such, reviewing and reporting healthcare utilisation among staff from the Tokyo 2020 Olympic and Paralympic Games (Tokyo 2020 Games) and Beijing 2022 Olympic and Paralympic Games (Beijing 2022 Games) is critical to successfully prepare for future Games.

During large-scale events, it is important to appropriately provide medical care to the highest degree possible so as to not overwhelm local medical systems.[29–31] Within the setting of Olympic and Paralympic Games periods, this requires a nation to be prepared to provide medical care not only to their delegation's athletes but also their staff. Understanding prior healthcare resource utilisation to make informed predictions about a delegation's medical needs is integral to success in that endeavour.[18 21 23 26–28] While data on healthcare utilisation among the entire delegation of staff supporting a Games would be ideal, that data are not currently collected across all national delegations or by the International Olympic Committee (IOC) or International Paralympic Committee (IPC). Therefore, single delegation data on this topic, especially from one of the largest and most diverse athlete/staff delegations (Team USA), serves as an important starting point to determine healthcare utilisation needs during Olympic and Paralympic Game periods. Therefore, the purpose of this study was to report epidemiological data regarding injury and illness among the Team USA staff during the Tokyo 2020 Games and Beijing 2022 Games.

METHODS

This descriptive retrospective study evaluated the findings of the United States Olympic & Paralympic Committee's (USOPC) injury and illness surveillance programme during the Tokyo 2020 Games and Beijing 2022 Games. Due to the COVID-19 pandemic, the Tokyo 2020 Games were postponed to 2021. As Team USA staff typically arrive prior to the start of a Games and stay beyond the end of a Games as part of their various job responsibilities, this retrospective analysis included an 11-day pre-competition period, competition period, and 3-day post-competition period for both the Tokyo 2020 Games (Olympic Games, 13 July–11 August 2021; Paralympic Games, 13 August–8 September 2021) and Beijing 2022 Games (Olympic Games, 24 January–24 February 2022; Paralympic Games, 21 February–16 March 2022). All Team USA staff members provided their consent to be treated by Team USA credentialed healthcare providers during the Tokyo and Beijing Games. Any medical encounter of a staff member were documented by those healthcare providers by within the electronic medical record (EMR) as part of normal clinic operations during each Games period. These data were then retrospectively extracted and deidentified for use in this study, and the Institutional Review Board (IRB) therefore waived the requirement for consent by participants.

Patient and public involvement

Team USA staff delegation members involved in the Tokyo 2020 Games and Beijing 2022 Games were not directly involved in the identification of questions or outcomes of interest for this study. However, the USPOC Research Review Committee provided oversight for this project. This committee is a multidisciplinary group comprised of Team USA athletes, medical clinicians, mental health providers, physiologists, nutritionists, strength and conditioning coaches, representatives from sport national governing bodies and legal representatives. Each member plays an essential role in supporting Team USA athletes.

Equity, diversity and inclusion

The authors of this study are balanced in gender (50% female) and career status, including junior (80%), mid-career (10%) and senior (10%) researchers from a variety of disciplines. The study population included male and female staff from the Tokyo 2020 Games and Beijing 2022 Games, representing various educational and professional backgrounds. Therefore, these findings may not be generalisable to smaller national delegations or those with fewer resources.

Data collection

Clinicians providing care to the Team USA staff delegation during the Tokyo 2020 Games and Beijing 2022 Games documented all encounters in an EMR maintained by the USOPC (GE Centricity, General Electric, Fairfield, Connecticut, USA). For this study, medical encounters were defined as the provision of medical services (ie, evaluation, treatment and delivery of preventative services) by Team USA credentialed healthcare providers across all clinics. Medical providers (n=259) across the four Games periods consisted of physicians (n=78), athletic trainers (n=76), physical therapists (n=48), chiropractors (n=28), massage therapists (n=26) and physician assistants (n=3).

Following the completion of the Tokyo 2020 Games and Beijing 2022 Games, the research team performed a structured quality control process. All medical encounters documented during the four Games periods were individually reviewed for accuracy. All evaluations that involved medical care delivery for a new injury or illness to staff members, as well as management of exacerbations

of pre-existing injury or illness, were extracted for analysis.

Injury and illness definitions

The 2020 International Olympic Committee Consensus Statement for reporting and recording epidemiological data pertaining to illness and injury in sport and the Orchard Sports Injury and Illness Classification System (OSIICS V.10.0) were used to classify and define all illness and injury encounters.[32–34] Injury was defined as 'tissue damage or other derangement of normal physical function' and illness was defined as 'a complaint or disorder not related to injury … (which) may include health-related problems in physical, mental, or social well-being'.[32 33] Encounters relating to the SARS-COV-2 virus were excluded from this analysis due to the low number (<1%) of Team USA staff diagnosed with COVID-19 across the Games and to make our results more generalisable to non-pandemic Games periods.[35] Medical encounters for mental health were also excluded. This was based on the methods by which Team USA psychological service clinicians provided mental health support, the lack of specific diagnostic classifications within the OSIICS coding system on mental health conditions, and the lack of standardised methods to conduct surveillance of mental health conditions at the time of data collection.[34 36]

Staff days, injury proportion and incidence

Flight manifests for members of the Team USA delegation designated the arrival and departure date for all staff. The number of days that each staff member was present in Tokyo or Beijing was calculated and all days were totalled. This value (total staff days) served as the measure of exposure and denominator for calculating injury and illness incidence rates. Injury and illness proportions (IP) were calculated for all injuries and illnesses ((number of staff injured or ill/total number of staff)*100). Incidence was calculated and reported as injuries or illnesses per 1000 staff days (SD) ((total number of injuries or illnesses/total number of SD)*1000).

Statistical analysis

Descriptive analyses included the total number of staff participating across the four Games periods, total number of staff days and the frequency of injuries and illness. Injury and illness proportions and incidence were calculated as described above, with 95% CIs calculated. All analyses were conducted both overall and by sex, job category, anatomic location and body system. Incidence ratios (IRs) with 95% CI were calculated to compare injury and illness rates between male and female staff. All analyses were performed using R statistical software (R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

Overall (all Games periods)

Illness and injury incidence data for the four combined Games periods are presented in tables 1–6. In total, 1703 Olympic staff members (females, n=691; males, n=1012) travelled to the four Games periods, accounting for a total of 34 489 SD. The job categories of the staff members included sport coaches/managers/equipment staff (n=589, 34.6%), sport operations (n=442, 26.0%), sports medicine and performance (n=406, 23.8%), communications and media (n=165, 9.7%), and USOPC/National Governing Body (NGB) Executives and Miscellaneous staff (n=101, 5.9%). A total of 49 staff members presented for evaluation of an injury or illness across the four Games periods.

A total of 32 illnesses occurred (incidence, 0.9 [0.6, 1.2]), with female staff at higher risk of sustaining an illness compared with male staff (IR, 2.3 [1.1, 4.6]). The most common types of illness were dermatological illnesses (IP, 0.5%; incidence, 0.2 [0.1, 0.4]) and infections (IP, 0.5%; incidence, 0.2 [0.1, 0.4]). The highest rate of illness occurred among sports medicine and performance staff (incidence, 1.1 [0.4, 1.8]), followed by sport operations staff (incidence, 1.0 [0.4, 1.5]).

A total of 23 injuries occurred among staff across the four Games periods (incidence, 0.7 [0.4, 0.9]), with a trend towards higher injury rates among male staff compared with female staff (IR, 2.7 [0.9, 7.1]). The most common location of injury was the upper limb (43.5% of all injuries; incidence, 0.3 [0.1, 0.5]), followed by the torso and lower limb (each 21.7% of all injuries; incidence, 0.1 [0.0, 0.3]). The majority of injuries (60.9%) and highest injury rates were sustained by sport coaches/managers/equipment staff (incidence, 1.5 [0.7, 2.3]). Full illness

Table 1 Incidence of illness by sex for staff supporting the Team USA across all combined Games periods (Tokyo 2020 SOG, Tokyo 2020 SPG, Beijing 2022 WOG, Beijing 2022 WPG)

	Total staff	Staff days	Illness frequency	Percentage of staff with and illness	Incidence per 1000 staff days	95% CI	
						Lower limit	Upper limit
Male	1012	19 868	12	1.2	0.6	0.3	0.9
Female	691	14 621	20	2.9	1.4	0.8	2.0
All	1703	34 489	32	1.9	0.9	0.6	1.2

SOG, Summer Olympic Games; SPG, Summer Paralympic Games; WOG, Winter Olympic Games; WPG, Winter Paralympic Games.

Table 2 Incidence of illness by body system for staff supporting the Team USA across all combined Games periods (Tokyo 2020 SOG, Tokyo 2020 SPG, Beijing 2022 WOG, Beijing 2022 WPG)

Body system	Total number of illnesses	Number of staff with an illness	Percentage of staff with an illness	Incidence per 1000 staff days	95% CI	
					Lower limit	Upper limit
All	32	32	1.9	0.9	0.6	1.2
Respiratory	3	3	0.2	0.1	0.0	0.2
Dermatological	8	8	0.5	0.2	0.1	0.4
Eye and ocular adnexa	3	3	0.2	0.1	0.0	0.2
Genitourinary	1	1	0.1	0.0	0.0	0.1
Neurological	3	3	0.2	0.1	0.0	0.2
Infection	8	8	0.5	0.2	0.1	0.4
Gastrointestinal	1	1	0.1	0.0	0.0	0.1
Rheumatological	1	1	0.1	0.0	0.0	0.1
Ear, nose and throat	1	1	0.1	0.0	0.0	0.1
Undiagnosed	3	3	0.2	0.1	0.0	0.2

SOG, Summer Olympic Games; SPG, Summer Paralympic Games; WOG, Winter Olympic Games; WPG, Winter Paralympic Games.

and injury incidence data for individual Games period are presented within the online supplemental materials.

Tokyo 2020 Games

Eight hundred and eighty-five staff (females, n=343; males, n=542) travelled to Tokyo for the 2020 Olympic Games, accounting for 16893 SD. Of those, 23 staff members presented for medical evaluation (2.6% of all staff), with a total of 17 illnesses (incidence, 1.0 [0.5, 1.5]) and 6 injuries (incidence, 0.4 [0.1, 0.6]) sustained during the Games period. There were no differences in illness or injury incidence between male and female staff members. The most common types of illness were infections (IP, 0.7%; incidence, 0.4 [0.1, 0.6]) and dermatological illnesses (IP, 0.6%; incidence, 0.3 [0.0. 0.6]). The most common location of injury was to the lower limb (IP, 0.5%; incidence, 0.2 [0.0, 0.5]). Illnesses were most common among sport operations staff (41.2% of all illnesses; incidence, 1.6 [0.4, 2.7]) and injuries were most common among sport coaches/managers/equipment staff (50.0% of all injuries; incidence, 0.5 [0.0, 1.1]).

Two hundred eighty-three staff (females, n=140; males, n=143) travelled to Tokyo for the Tokyo 2020 Paralympic Games, accounting for a total of 5549 SD. Of those, three staff members presented for medical evaluation for an illness (1.1% of all staff), all of whom were female (incidence, 1.1 [0.0, 2.3]). The three illness encounters were dermatological, infections and rheumatological illnesses (IP, 0.4% each; incidence, 0.2 [0.0, 0.5]). Similarly, the three illness encounters occurred in three separate staff categories: sport coaches/managers/equipment staff, sports medicine and performance staff, and sport operations staff (1 illness each). No staff presented for medical evaluation of injury during the Games period.

Beijing 2022 Games

Four hundred and fifteen staff (females, n=152; males, n=263) travelled to Beijing for the 2022 Winter Olympic

Table 3 Incidence of illness by job category for staff supporting the Team USA across all combined Games periods (Tokyo 2020 SOG, Tokyo 2020 SPG, Beijing 2022 WOG, Beijing 2022 WPG)

	Total staff	Staff days	Illness frequency	Percentage of staff with an illness	Incidence per 1000 staff days	95% CI	
						Lower limit	Upper limit
Sport coaches, managers, equipment staff	589	9292	9	1.5	1.0	0.3	1.6
Sports medicine and performance	406	8281	9	2.2	1.1	0.4	1.8
Sport operations	442	11519	11	2.5	1.0	0.4	1.5
Communications and media	165	3397	2	1.2	0.6	0.0	1.4
USOPC/NGB executive and miscellaneous	101	2000	1	1.0	0.5	0.0	1.5

NGB, National Governing Body; SOG, Summer Olympic Games; SPG, Summer Paralympic Games; USOPC, United States Olympic and Paralympic Committee; WOG, Winter Olympic Games; WPG, Winter Paralympic Games.

Table 4 Incidence of injury by sex for staff supporting the Team USA across all combined Games periods (Tokyo 2020 SOG, Tokyo 2020 SPG, Beijing 2022 WOG, Beijing 2022 WPG)

	Total staff	Staff days	Injury frequency	Percentage of staff with an injury	Incidence per 1000 staff days	95% CI	
						Lower limit	Upper limit
Male	1012	19 868	18	1.8	0.9	0.5	1.3
Female	691	14 621	5	0.7	0.3	0.0	0.6
All	1703	34 489	23	1.4	0.7	0.4	0.9

SOG, Summer Olympic Games; SPG, Summer Paralympic Games; WOG, Winter Olympic Games; WPG, Winter Paralympic Games.

Games, with a total of 9280 SD during the Games period. In total, 15 staff members presented for medical evaluation (3.6% of all staff), with 8 illnesses (incidence, 0.9 [0.3, 1.5]) and 12 injuries (incidence, 1.3 [0.6, 2.0]) sustained. There were no differences in illness or injury incidence between male and female staff members. The most common types of illness were eye/ocular (IP, 0.5%; incidence, 0.2 [0.0, 0.5]) and neurological (IP, 0.5%; incidence, 0.2 [0.0 0.5]) illnesses. Most injuries were sustained to the upper limb (IP, 1.2%; incidence, 1.1 [0.4, 1.7]). Illnesses were most common among sports medicine and performance staff (50.0% of all illnesses; incidence, 1.8 [0.0, 3.6]) and injuries were most common among sport coaches/managers/

Table 5 Incidence of injury by anatomic location for staff supporting the Team USA across all combined Games periods (Tokyo 2020 SOG, Tokyo 2020 SPG, Beijing 2022 WOG, Beijing 2022 WPG)

	Total number of injuries	Number of staff with an injury	Percentage of staff with an injury	Incidence per 1000 staff days	95% CI	
					Lower limit	Upper limit
All	23	17	1.0	0.7	0.4	0.9
Head/face/neck	3	2	0.1	0.1	0.0	0.2
Head/face	1	1	0.1	0.0	0.0	0.1
Neck	2	1	0.1	0.1	0.0	0.1
Upper limb	10	5	0.3	0.3	0.1	0.5
Shoulder	6	1	0.1	0.2	0.0	0.3
Upper arm	0	0	0.0	0.0	0.0	0.0
Elbow	1	1	0.1	0.0	0.0	0.1
Forearm	0	0	0.0	0.0	0.0	0.0
Wrist/hand	3	3	0.2	0.1	0.0	0.2
Torso	5	5	0.3	0.1	0.0	0.3
Chest	1	1	0.1	0.0	0.0	0.1
Trunk/abdomen	0	0	0.0	0.0	0.0	0.0
Thoracic spine	0	0	0.0	0.0	0.0	0.0
Lumbar spine	3	3	0.2	0.1	0.0	0.2
Pelvis/buttocks	1	1	0.1	0.0	0.0	0.1
Hip/groin	0	0	0.0	0.0	0.0	0.0
Lower limb	5	5	0.3	0.1	0.0	0.3
Thigh	0	0	0.0	0.0	0.0	0.0
Knee	0	0	0.0	0.0	0.0	0.0
Lower leg	1	1	0.1	0.0	0.0	0.1
Ankle	2	2	0.1	0.1	0.0	0.1
Foot	2	2	0.1	0.1	0.0	0.1
Unspecified	0	0	0.0	0.0	0.0	0.0

SOG, Summer Olympic Games; SPG, Summer Paralympic Games; WOG, Winter Olympic Games; WPG, Winter Paralympic Games.

Table 6 Incidence of injury by job category for staff supporting the Team USA across all combined Games periods (Tokyo 2020 SOG, Tokyo 2020 SPG, Beijing 2022 WOG, Beijing 2022 WPG)

	Total staff	Staff days	Injury frequency	Percentage of staff with an injury	Incidence per 1000 staff days	95% CI	
						Lower limit	Upper limit
Sport coaches, managers, equipment staff	589	9292	14	2.4	1.5	0.7	2.3
Sports medicine and performance	406	8281	2	0.5	0.2	0.0	0.6
Sport operations	442	11519	5	1.1	0.4	0.1	0.8
Communications and media	165	3397	0	0.0	0.0	0.0	0.0
USOPC/NGB executive and miscellaneous	101	2000	2	2.0	1.0	0.0	2.4

NGB, National Governing Body; SOG, Summer Olympic Games; SPG, Summer Paralympic Games; USOPC, United States Olympic and Paralympic Committee; WOG, Winter Olympoic Games; WPG, Winter Paralympic Games.

equipment staff (66.7% of all injuries; incidence, 4.0 [1.2, 6.7]).

One hundred and twenty staff (females, n=56; males, n=64) travelled to Beijing for the 2022 Winter Paralympic Games, totaling 2767 SD. A total of 9 staff members presented for medical evaluation (7.5% of all staff), with a total of 4 illnesses (incidence, 1.4 [0.0, 2.9]) and 5 injuries (incidence, 1.8 [0.2, 3.4]). There were no differences in illness rates between male and female staff, but all five injuries occurred in male staff members (incidence, 3.2 [0.4, 6.0]). The four illness encounters were split evenly between respiratory, dermatological, gastrointestinal and ENT illnesses (IP, 0.8% each; incidence, 0.4 [0.0, 1.1]). Similarly, the four illness encounters were split evenly between sport coaches/managers/equipment, sports medicine and performance, sport operations, and communications and media staff (one illness encounter each). The most common injury locations were to the torso (IP, 2.5%; incidence, 1.1 [0.0, 2.3]), followed by the head/face/neck (IP, 0.8%; IR,0.7 [0.0, 1.7]). Most injuries were sustained by sport coaches/managers/equipment staff (60.0% of all injuries; incidence, 9.9 [0.0, 21.1]).

DISCUSSION

To the authors' knowledge, this is the first study to report the incidence of illness and injury sustained by staff members from a single national delegation supporting athletes during a Summer or Winter Olympic or Paralympic Games. Each delegation's respective staff members are critical contributors towards the delegation's success and the success of the Games overall. Of the 1703 Team USA staff members supporting athletes during the Tokyo 2020 and Beijing 2022 Games, 49 (2.9%) presented for medical evaluation for either an injury or illness. Furthermore, we observed some variability in injuries and illness occurring across Games periods based on sex, staff member role and specific Games period, including either Tokyo 2020 or Beijing 2022.

Patterns of staff member illnesses

When evaluated by staff member sex, 20 of the 32 (62.5%) illness encounters during the combined Games period involved female staff, with female staff contracting an illness at approximately twice the rate of male staff (IRR 2.3 [1.1, 4.6]). Interestingly, this phenomenon has also been observed in studies reporting illness incidence among athletes at prior Games.[2 6 7 9–11] This finding is also consistent with medical resource utilisation in general.[37–39] Our findings demonstrated that infections and illnesses involving the dermatological systems comprised most evaluations (n=16; 1.0% of all staff; IR, 0.5 [0.3, 0.8]). Sports operations staff (eg, travel and transport personnel, information technology support personnel, athlete village housing staff) members accounted for 11 of the 32 (34.4%) illness encounters during the combined Games period (IR, 1.0 [0.4, 1.5]). This was followed closely by sport coaches/managers/equipment staff and sports medicine and performance staff with 9 illnesses each (28.1% of all illness encounters) with IR of 1.0 [0.3, 1.6] and 1.1 [0.4, 1.8], respectively.

Sports operations staff, coaches/managers/equipment staff, and sports medicine and performance staff account for 26%, 35% and 24% of the entire staff delegation, respectively. Few studies comment on rates of illness, but do not offer investigation into reasoning behind the observed rates.[14–19] However, it is likely that each of these groups have a greater density of face-to-face interactions simply by nature of their roles. These interactions thereby lead to inherent risk for developing an infection or dermatological illness, as these are commonly spread via contact or close proximity with others. However, more in-depth analysis is needed to truly determine whether these interactions are the driving factor behind illness rates within these types of staff positions, or whether local environmental factors play a larger role. In their recent article, McElheny *et al*[40] described the implications of illness on the entirety of sports teams, including non-athlete members, and detail important illness mitigation strategies.[40] In a manner similar to an athlete missing

from his/her team, staff member illness results in a gap in the functioning of the delegation as a whole. Therefore, limiting illness risk among all delegation members is of utmost importance.

Patterns of staff member injuries

There was a trend towards higher rates of injuries among male staff members when compared with females with an incidence rate ratio of 2.7 [0.9, 7.1]. Given that this is the first time epidemiological data for delegation staff have been reported, we cannot draw direct comparisons to previously published injury rates among athletes at various Games.[1 5–11] However, we do know that non-fatal traumatic injury rates within the USA are known to occur at higher incidence in the general population among males when compared with females.[41 42]

Stratification of our data by anatomical location demonstrates the upper limb (43.5%) being the most commonly injured, followed by the torso (21.7%) and lower limb (21.7%). While limited, there are some data on reporting of work-related injury rates among staff within the sports industry, specifically relating to equestrian racing.[43 44] In contrast to our data, Cowley *et al*[44] identified a greater number of lower limb injuries within their staff population with an IP of 37%, while back plus chest and abdomen included 24% and upper limb were 21% of reported injuries.[44] While our study reports data from staff supporting all sports represented at the four Games, further studies could investigate if there are differences in the injury rates sustained by staff members depending on other factors, such as the local work environment at each particular Games location or the specific context and norms in delegations from other nations.

Finally, in the combined Games injury data, the majority of all injuries (60.9%) and highest injury rates were sustained by sport coaches/managers/equipment staff (IR, 1.5 [0.7, 2.3]). To date, there are no studies describing injury epidemiology in these populations. By nature of their jobs, this subgroup of staff members involves those performing activities and working in conditions most like those of our athletes, perhaps supporting an inherently greater risk for injury. Until further investigation of injury epidemiology in these specific populations and across other national delegations is reported, we cannot provide more interpretation beyond reporting the rates that we identified in our cohort.

Clinical implications

The responsibility of providing medical care to the entirety of a large national delegation at a setting such as the Olympic or Paralympic Games is substantial. While athletes' amazing displays of athleticism rightfully gain the most attention, 'the team behind the team' is no less important or less deserving of medical attention for illness and injury when needed. Understanding the risks of illness and injury sustained by all members of a national delegation is essential to effective planning efforts. This study highlights incidence rates for both illness and injury among multiple venues, representing delegations from the Olympic and Paralympic teams in both a summer and winter Games experience. Caring for all Team USA delegation members promotes responsible resource utilisation and limits unnecessary burden on the local healthcare infrastructure, necessitating reliance on such systems only for more severe cases. While there is no way to precisely predict the provision of medical care at such large-scale events, prior illness and injury rates provides a reference point for preparatory efforts for other large national delegations can use an evidence-based approach at approximating the expected health burden.

Strengths and limitations

There are multiple strengths of this study beyond its novelty to the literature. Notably, it is the first study the authors are aware of that specifically examines the medical needs of staff members representing a large national delegation. From a data collection and analysis perspective, the authors have developed a multi-phase review process to ensure data accuracy built on the definitions provided by the IOC consensus statements.[32 33] Further, access to flight manifest information provided knowledge of exact exposure data which contributed to performance of subgroup analysis. As a result, this study allows for presentation of the study populations who are at greatest risk. However, there are also multiple limitations that should be noted. All medical encounters underwent a post hoc evaluation by study authors to ensure agreement with the involved body system/location with the selected diagnosis code. However, this ultimately was reliant on accurate and thorough documentation from the medical providers performing the evaluations during the Games periods. Unlike the documentation for athlete encounters, the setting for which a staff member incurred an injury, duration of time away from work and extent of which a staff member was unable to complete the duties of his/her job as a result of injury or illness was not mentioned. Thus, determination of time loss, monetary loss or the impact of the incurred illness or injury on the roles of other delegation staff members cannot be reported. Additional details regarding the specific types of injuries sustained (such as traumatic or non-traumatic injuries, or whether injuries occurred related to certain sport coverage) was not captured as part of this study, but would be valuable to collect and analyse in the future in order to determine the most effective prevention strategies for staff.

CONCLUSIONS

Overall, injury and illness rates among the Team USA staff during the Tokyo 2020 Games and Beijing 2022 Games were relatively low. There were 32 illnesses and 23 injuries that were evaluated by the medical team, demonstrating an overall illness rate of 0.9 per 1000 staff days and injury rate of 0.7 per 1000 staff days. Knowledge of injury and illness risks provides guidance for appropriate

staffing decisions and implementation of prevention measures for staff supporting the delegation over Games period.

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