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Clinical and other Case Studies

Health problem surveillance at the 17/U & 19/U Australian national netball championships

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ABSTRACT

Objective: Surveillance of health problems at the 2019 17/U & 19/U Australian Netball National Championships (ANNC) and compare this data with the 2018 17/U & 19/U ANNC. Determine the rate for risk of low energy availability and poor sleep quality in athletes competing at the 2019 ANNC.
Design: Prospective observational cohort study.
Method: One hundred and ninety-two netball athletes were observed during a six-day tournament. Injuries were defined in three ways: 1) self-reported, 2) medical attention, and 3) sports incapacity. Medical attention health problems were recorded prospectively by the 16 team physiotherapists during the tournament and athlete self-reported health problem data was collected on four occasions (pre-tournament, post-tournament, 1-week post tournament and 4-weeks post tournament) using their smartphones. The same method was also used for health problem surveillance at the 2018 17/U & 19/U ANNC. Athletes also completed the Low Energy Availability in Females Questionnaire (LEAF-Q) and Pittsburgh Sleep Quality Index (PSQI).
Results: Ninety-five medical attention injuries were sustained by 73 athletes, at an incidence rate of 82.5 injuries/1000 player competition hours. Ankle sprains (n = 16) and lumbar pain (n = 12) had the highest incidence of medical attention injuries. Thirty per cent of athletes started the tournament with a self-reported health problem. Twelve sports incapacity injuries were recorded, with concussion (n = 5) and ACL rupture (n = 4) the most frequent. Fifty percent of athletes who completed the LEAF-Q were identified as being at risk of having low energy availability and 57% of PSQI respondents demonstrated poor sleep quality. There was no association between injury and athletes who were identified as being at risk of low energy availability or having poor sleep quality.
Conclusions: Ankle sprains, lumbar pain, and foot blisters are the most frequent medical attention injury and concussion, and ACL rupture were the most frequent sports incapacity injuries in pre-elite netball athletes. Also, a high number of athletes were identified as being at risk of low energy availability (n = 76, 50%) and poor sleep quality (n = 74, 57%). These athletes were not at higher risk of injury compared to those that were not identified as being at risk of low energy availability and poor sleep quality.

1. Introduction

Netball is the most popular team sport in Australia for women and girls, but participation decreases after the age of 15 with poor health or injury being the second greatest reason for drop-out [1]. Australia has remained on top of the world netball rankings over the last five years [2]. For sustained success, Netball Australia seeks to continue junior player development, with a critical component focussing on maintaining the health of athletes through injury and illness prevention strategies.

The first stage of health problem prevention is quality health problem surveillance [3]. Health problem surveillance has previously been conducted at the 2018 17/U & 19/U Australian Netball National Championships (ANNC) [4]. These championships are an opportunity for each Australian state to compete against the others and for Australian national

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squads to be selected. Ankle sprains, low back pain, and foot blisters were the most frequent injuries reported, with anterior cruciate ligament (ACL) ruptures the most severe at the 2018 ANNC [4]. Ankle sprains and knee injuries have consistently had the highest incidence rate in netball over the past 30 years [5–8]. We repeated injury surveillance at the 2019 17/U & 19/U ANNC to compare findings over a subsequent year to investigate similarities and differences.

The aetiology of sports injuries is complex and multifactorial [9]. Two potential factors are energy availability and sleep quality in development athletes [10]. Low energy availability is the significant contributing factor for relative energy deficiency in sport (RED-S) [11]. Impaired bone health, growth and development can be the result of low energy availability [11]. Early detection of athletes at risk of RED-S is critical to prevent long-term health issues. Additionally, inadequate sleep (<8 h per night) has also been shown to be associated with 1.7 times increased injury risk in adolescent athletes [12]. Therefore, it's important to identify those with poor sleep quality to allow for early intervention and a reduction of injury risk. To gain a better understanding of aetiology of the injuries identified at the 17/U & 19/U ANNC, we added the Low Energy Availability in Females Questionnaire (LEAF-Q) [13] and the Pittsburgh Sleep Quality Index (PSQI) [14] to the injury surveillance undertaken at the 2018 17/U & 19/U ANNC [4].

The objectives of this study are to:

1) Describe the type and mechanism of health problems that occurred across the six-day 2019 17/U & 19/U ANNC and during the four weeks following the tournament.
2) Compare health problem rates between the 2018 and 2019 17/U and 19/U ANNC.
3) Determine what the rate for risk of low energy availability and poor sleep quality is in athletes competing at the 2019 ANNC.

2. Methods

All athletes (n = 192; 17/U athletes = 96, 19/U athletes = 96) competing at the 2019 17/U & 19/U ANNC were invited to participate in the present study. Sixteen female teams completed nine matches across the six-day tournament (11–16 April 2019). The methods for collecting medical attention and athlete self-report injury data at the 2018 17/U & 19/U ANNC have previously been published [4] and were repeated in 2019. Additionally, all athletes were asked to complete the Low Energy Availability in Female Questionnaire (LEAF-Q) [13] and the Pittsburgh Sleep Quality Index (PSQI) [14] via their AMS accounts two weeks prior to the commencement of the 2019 ANNC. These two factors were identified by Netball Australia as potential concern as they are risk factors for illness [15,16] and injury [11]. If an athlete's LEAF-Q score was equal to or greater than the cut off score of 8 (LEAF-Q $\geq$ 8) they were contacted following the tournament and advised to consult their Sports Physician and/or a Sports Dietician for follow-up. If their PSQI scores were above the cut off score of 5 (PSQI $\geq$5) they were sent a sleep quality fact sheet (Supplement 2) following the tournament. If the identified athlete was under the age of 18, her parent/guardian was also advised of the LEAF-Q & PSQI results and provided with the same advice as the athlete.

Ethics approval was obtained from the Australian Institute of Sport Human Research Ethics Committee (Approval number: 20180404). All participants or their parents/guardians provided consent via their individual online Athlete Management System (AMS) accounts and all data (clinical examination and athlete self-reported) were collected via the AMS centralised database (Smartabase, Fusion Sport, Brisbane, Australia).

Health problems were defined in three ways: 1) self-reported, 2) medical attention, and 3) sports incapacity. Athlete self-reported health problems were defined as sensations that are interpreted by an athlete as being indicators of abnormal body function [17]. All athletes were asked to complete the Oslo Sports Trauma Research Centre Questionnaire on Health Problems (OSTRC-H) [18,19] via their AMS accounts using their smartphone at four time points: 1) the start of the tournament, 2) end of the tournament, 3) one week post-tournament and 4) four weeks post-tournament. This questionnaire asks the athlete to report any injuries or illnesses experienced in the past week in terms of participation, training volume, effect on performance, and symptoms:

1) Have you had any difficulties participating in normal training and competition due to injury, illness, or other health problems during the past week?
2) To what extent have you reduced your training volume due to injury, illness, or other health problems during the past week?
3) To what extent has injury, illness or other health problems affected your performance during the past week?
4) To what extent have you experienced symptoms/health complaints during the past week?

If they report a health problem, the athletes are then asked if they had an illness or injury, what their symptoms were, the location of the illness or injury, how many days off they had and whether they saw a medical professional. The questionnaire allows for multiple injuries and illnesses to be reported.

A medical attention injury was defined as loss or abnormality of bodily structure or functioning that following examination is diagnosed by a clinical professional as a medically recognised injury [17]. Team physiotherapists were asked to record all medical attention injuries using a standardised injury record form within the AMS. The lead author (ES) met with all team physiotherapists prior to the tournament to explain the injury record system and clarify any areas of uncertainty. Each medical attention health problem recorded in the AMS database by team physiotherapists was assigned a four-character Orchard Sports Injury Classification System 10.1 injury diagnosis code [20], which details the body part and nature of the injury sustained. Additional information was recorded to classify the body side of the injury (i.e., left, right, bilateral, central), date of injury occurrence, and the number of days the player was unable to participate both fully and partially in netball competition. In addition, the physiotherapist recorded mechanism of injury, court location, position, time of match, tournament day and whether the athlete could continue playing immediately after injury. Sports incapacity injuries were defined as an injury that required an athlete to miss any duration of match play during the tournament as recorded by the team physiotherapist in AMS injury record or where the athlete reported a reduction in participation as assessed by the OSTRC-H [17]. Recurrent injury was defined as an injury that occurs after an index injury that is of the same diagnosis, following a player's return to full participation from the index injury [21].

Exposure was quantified according to the 'athlete participation' method, which defines participants as those that are on the game roster whether they played or not [22]. The number of athletes per team (n = 12) was multiplied by the number of teams (total = 16, 17/U = 8, 19/U = 8), number of matches (n = 9) and the number of minutes per match (n = 40) and then divided by the number of minutes per hour (n = 60). This resulted in a total of 1152 player competition hours, or 576 player competition hours for each of the 17/U or 19/U athlete cohorts.

Descriptive analysis was performed for the 17/U and 19/U athlete cohorts at the 2019 ANNC. The differences between age groups for medical attention injuries, sports incapacity injuries, and injury classification were measured by calculating incidence rate ratios (IRR) and Fisher's exact test to test for significance. The 2018 and 2019 ANNC competition years were also compared by calculating IRR for medical attention injuries and specific injury diagnoses. Injury incidence rates were calculated using the formula: number of new injuries/number of exposures per 1000 h [23]. Incidence rate ratios were also calculated to compare age groups and ANNC competition years. Analysis of the OSTRC-H questionnaire outcomes across the four dates completed by the 2019 cohort utilised the McNemar chi-square test, as this involved comparison of non-independent groups (repeated sampling). Comparison of the OSTRC-H outcomes between the 2018 and 2019 ANNC cohorts

was performed using the Pearson chi-square test. Specifically, the number of athletes with a health problem one-week and four-weeks post tournament, the number of athletes training at a reduced volume four-weeks post tournament and the number of athletes who thought their performance was affected by injury or illness during the tournament.

3. Results

One hundred and ninety-two athletes were observed for medical attention injuries at the 2019 17/U & 19/U ANNC. Ninety-five medical attention injuries were sustained by 73 athletes over a six-day period, at an incidence rate of 82.5 injuries/1000 player competition hours. Sports incapacity incidence rate was 10.4/1000 player competition hours. There was no significant difference between 17/U & 19/U medical attention injury rates (17/U, n = 47; 19/U, n = 48; IRR = 0.98; 95% CI: 0.64–1.50; p = 0.92). Lateral ankle ligament sprains (n = 16, 16.8%), lumbar pain (n = 12, 12.6%), and foot blisters (n = 8, 8.4%) were the most frequently recorded injuries. All medical attention injuries with greater frequency than two are listed in Table 1. There were 12 (12.6% of total injuries) medical attention sports incapacity injuries recorded, with concussion (n = 5) and ACL rupture (n = 4) the most frequent. There were twice as many 17/U sports incapacity injuries compared to 19/U sports incapacity injuries; however, this was not statistically significant (17/U, n = 8, 8.4%; 19/U, n = 4, 4.2%; IRR = 2.00; 95% CI: 0.54–9.08; p = 0.27). Ninety-five per cent (n = 90) of injuries were classified as new injuries and occurred 18 times more frequently than recurrent injuries (n = 5, 5%; IRR = 18.00; 95% CI: 7.43–56.78, p < 0.01). Details of the mechanism of injury, injury onset, and classification of injury according to each body area are outlined in Table 2.

Compared with the 2018 ANNC results [4], there were a similar number of total medical attention injuries in 2019 (2018, n = 103; 2019, n = 95; IRR = 1.08; 95% CI: 0.81–1.45; p = 0.57) as well as 19/U injuries (2018 19/U, n = 64; 2019 19/U, n = 48; IRR = 1.33; 95% CI: 0.90–1.98; p < 0.13) and 17/U injuries (2018 17/U, n = 39; 2019 17/U, n = 47; IRR = 0.83, 95% CI: 0.53–1.30; p = 0.39). Across 2018 and 2019, there was no change in frequency of ankle sprains (2018, n = 14; 2019, n = 16; IRR = 0.88; 95% CI: 0.40–1.91; p = 0.72), lumbar pain (2018, n = 10; 2019, n = 12; IRR = 0.84; 95% CI: 0.32–2.10; p = 0.68), foot blisters (2018, n = 11; 2019, n = 8; IRR = 1.38; 95% CI: 0.50–3.94; p = 0.50), ACL ruptures (2018, n = 3; 2019, n = 4; IRR = 0.75; 95% CI: 0.11–4.43, p = 0.73), and concussion (2018, n = 3; 2019, n = 5; IRR 0.60; 95% CI: 0.09–3.08, p = 0.51). Additionally, in 2019 there were significantly less injury records that did not include mechanism of injury data compared to 2018 (2019, n = 10; 2018 n = 32; $\chi^2 = 12.48$, p = 0.00).

The response rate for the four OSTRC-H questionnaires (1: at the start of the tournament, 2: end of the tournament, 3: one-week post-tournament, and 4: four weeks post-tournament) was greater in 2019 (93%, 99%, 78% and 74% respectively) than in 2018 (90%, 76%, 41% and 34% respectively). Of the 175 athletes that completed the first and second OSTRC-H in 2019, 30% (n = 53) started the tournament with a self-reported health problem. There was a significant increase in the number of athletes (n = 74, 42%) who self-reported a health problem at the end of the tournament compared to the start ($\chi^2 = 11.76$, p < 0.01; OR = 2.11; 95% CI: 1.19–3.85).

One hundred and eighty-nine (99%) athletes completed the OSTRC-H at the end of the tournament. Seventy (37%) of these athletes reported 77 injuries, 14 of these self-reported injuries caused sports incapacity. The most frequent self-report injuries are listed in Table 3. Thirty-nine (51%) of these injuries were not recorded in AMS as a medical attention injury. Fifty-seven (60%) of the AMS medical attention injuries were not self-reported by the athletes.

There was no difference between 2019 and 2018 in the number of injured athletes one week and four weeks post-tournament. Thirty-two athletes (27% of OSTRC-H respondents) in 2019 and 26 athletes (49% of OSTRC-H respondents) in 2018 reporting a health problem one week following the tournament ($\chi^2 = 3.34$, p = 0.07). Forty athletes (28% of OSTRC-H respondents) in 2019 and 26 athletes (40% of OSTRC-H respondents) in 2018 reported a health problem four weeks following the tournament ($\chi^2 = 2.87$, p = 0.09). There was also no difference between 2019 and 2018 in the number of athletes who trained at a reduced volume four weeks post tournament and the number of athletes who thought their tournament performance was affected by a health problem. Forty athletes (28% of OSTRC-H respondents) in 2019 and 22 athletes (34% of OSTRC-H respondents) in 2018 reported training at a reduced volume four weeks following the tournament due to a self-reported health problem ($\chi^2 = 0.69$, p = 0.41). Sixty-nine athletes (36% of OSTRC-H respondents) in 2019 and 55 athletes (38% of OSTRC-H respondents) in 2018 thought their performance was affected by a health problem during the tournament ($\chi^2 = 0.07$, p = 0.80).

One hundred and fifty-two (80%) athletes (17/U: n = 75; 19/U: n = 77) completed the LEAF-Q two weeks prior to the ANNC in 2019. Collectively across both age groups seventy-six (50%) athletes had a score of eight or higher and thirty-seven (49%) of these athletes were 17/U and thirty-nine (51%) were 19/U. Risk ratios were not statistically significant when comparing those identified as being at risk of having low energy availability (LEAF-Q ≥ 8) and those that were injured during the 2019 ANNC (RR = 0.98, 95%CI 0.66–1.44; p = 0.92).

One hundred and thirty (68%) athletes completed the PSQI two weeks prior to ANNC. Seventy-four (57%) athletes returned a score of five or greater, demonstrating poor sleep quality. Of the 60 (45%) 17/U respondents, 35 (58%) of these athletes had poor sleep quality. Thirty-nine (54%) of the 19/U respondents were identified as having poor sleep quality. Risk ratios were not statistically significant when comparing those identified as having poor sleep quality (PSQI ≥5) and those that were injured during the 2019 ANNC (RR = 1.03; 95%CI: 0.70–1.51; p = 0.88).

Table 1
Top eight medical attention injuries at the 2019 17/U & 19/U ANNC.

Diagnosis	Injury diagnosis (n =)	Sports incapacity (n =)
Ankle ligament sprain	16	1
Lumbar pain	12	0
Foot blisters	8	0
Concussion	5	5
Thigh haematoma	4	0
ACL rupture	4	4
Shin pain	4	0
Thoracic pain	3	0

4. Discussion

Health problem surveillance has now been prospectively investigated across two years of the 17/U & 19/U ANNC. Lateral ankle ligament sprains, lumbar pain, and foot blisters were the most frequently recorded injuries in 2018 and 2019 [4]. The number of sports incapacity injuries fell from 22 in 2018 [4] to 12 in 2019; however, the number of ACL ruptures increased by one (2018, n = 3; 2019, n = 4) and concussions still featured with three in 2018 and five in 2019 [4]. Further prevention strategies are indicated to address these significant ongoing health issues.

The International Olympic Committee (IOC) consensus statement on youth athletic development states: 'No youth athlete should compete – or train or practice in a way that loads the affected injured area, interfering with or delaying recovery – when in pain or not completely rehabilitated and recovered from an illness or injury' [10]. Thirty-one per cent of athletes started the tournament with a self-reported health problem, an increase from 27% in 2018 [4]. Our results indicate that a concerted effort needs to be made to heed the advice of the IOC [10] and improve the health of athletes attending the tournament. Improved awareness of pre-elite injury/illness prevention and management needs to occur across the system, including state bodies, clubs, coaches, managers, parents, and athletes.

Table 2
Mechanism of injury, classification and onset for each body area at the 2019 17/U & 19/U ANNC.

	Body area										
	Ankle	Foot	Trunk[a]	Lower leg	Head & neck	Knee	Wrist, hand & fingers	Hip & groin	Upper limb[b]	Thigh	Total
Total (n =)	24	14	16	8	8	9	5	2	4	5	95
Mechanism											
Accident/other	0	0	1	0	0	0	1	0	0	0	2
Catching	0	0	0	0	0	0	4	0	0	0	4
Change of direction	2	0	0	0	0	0	0	0	0	0	2
Collision	1	0	0	2	5	1	0	0	2	4	15
Contested landing	4	0	1	0	1	2	0	0	0	0	8
Jumping	1	0	0	1	0	1	0	0	0	0	3
Land on another	7	0	0	0	0	0	0	0	0	0	7
Non-contested landing	0	0	0	0	0	4	0	0	0	0	2
No specific incident	5	13	10	5	0	0	0	2	1	1	37
Missing	4	1	4	0	2	1	0	0	1	0	10
Classification											
New injury	23	14	14	7	8	8	5	2	4	5	90
Recurrent injury	1	0	2	1	0	1	0	0	0	0	5
Onset											
Trauma	18	0	1	2	7	7	5	0	2	4	46
Overuse	5	9	12	5	0	2	0	2	2	1	38
Other	1	5	3	1	1	0	0	0	0	0	11

[a] Thoracic and Lumbar spine.
[b] Shoulder, Elbow & Forearm.

Table 3
Most frequent self-reported injuries at the 2019 17/U & 19/U ANNC.

Injury location	Frequency
Ankle	18
Lower leg	10
Lumbar spine	10
Foot	9
Knee	9
Head	5
Hip and Groin	3
Neck	3
Wrist and hand	3

There was an increase in concussions at the 2019 17/U & 19/U ANNC compared to the 2018 17/U & 19/U ANNC, but this was not statistically significant. Concussion incidence appears to have increased over the past 20 years. In 1998, Finch et al. [24] reported a frequency of 1.6% (n = 4) over two consecutive five-month seasons and in 2014, there was one concussion recorded from 154 netball injuries presenting to an emergency department across a 2-year period [25]. Possible explanations for this apparent increase in concussions during the 2018 and 2019 17/U & 19/U ANNC, are that historically they were not recognised and diagnosed, or that changes in game style over time has resulted in more collisions now occurring in netball [26,27]. Improving concussion surveillance and understanding mechanisms of injury are important steps towards preventing concussion and should be prioritised, as it is an injury that results in sports incapacity and can cause long-term sequelae.

A spike in training load can increase risk of injury or illness for the following four weeks [28]. We collected self-reported health problem data (i.e., OSTRC-H), one and four weeks after the tournament to assess post-tournament health problems. Approximately one-third of athletes were training at a reduced volume due to injury or illness following the 2018 and 2019 17/U & 19/U ANNC. Athletes are required to play nine matches in 6 day at possibly a higher intensity than they would normally play. Preparation for this workload is very difficult when these athletes have other competing commitments such as school, university, or work [29,30]. This data warrants a review of the 17/U & 19/U ANNC format – perhaps a system where teams are divided into two pools to limit the number of fixtures could be considered to reduce health consequences. Additionally, awareness and utilisation of recovery modalities [31,32] during this multiday tournament could be reviewed.

Mechanism of injury data provides valuable information for how we might prevent injuries in the future. There continued to be a high number of injuries classified as 'no specific incident' (n = 37). Perhaps we need to clarify how clinicians establish mechanism of injury for overuse injuries or we only report mechanism of injury for traumatic injuries. Collision was the next highest mechanism of injury (n = 15), netball is regarded as a non-contact sport. Perhaps officials need to be included in injury prevention discussions to reduce the number of collisions and therefore the number of injuries.

Two injury surveillance methods, athlete self-report and medical attention, were introduced in 2018 at the 17/U & 19/U ANNC and repeated in 2019. The athlete self-report response rate improved to be above 70% across all four OSTRC-H collection periods in 2019, compared to 2018 [4] when the response rate was below 50% for the two post-tournament OSTRC-H. There were also fewer missing data points for medical attention injuries in the second year of health problem surveillance. For example, in 2018, 32 (31%) injury records did not include mechanism of injury data; in 2019, this decreased to 10 (11%) incomplete injury records. However, there was a higher discrepancy in data between the two injury surveillance methods in 2019, compared to 2018 [4]. In 2019,fifty-one percent of athlete self-report data was not recorded as a medical attention injury and 60% of medical attention injuries were not recorded as a self-report injury. Despite this discrepancy, the ankle, lumbar spine, and foot were listed in the top four most frequent self-report injuries which is very similar to the most frequent medical attention injuries. Possible explanations for this discrepancy are 1) athletes did not think their injury warranted a medical review, 2) physiotherapists were not thorough with their record keeping, 3) athletes did not view their complaint as an injury or 4) athletes did not self-report their injury because of the extra time it takes to complete the OSTRC-H accurately. Strategies need to be implemented for future injury surveillance projects to limit this discrepancy to obtain accurate data.

Establishing quality injury surveillance takes time and commitment by all personnel working within high-performance sport and is a critical component of injury prevention. We were able to implement health problem surveillance across two 17/U & 19/U ANNC due to the strong support received from Netball Australia, highlighting the critical role National Sporting Organisations (NSOs) play in injury/illness prevention. Our method for obtaining health problem data from a pre-elite level national tournament is a good example of how other NSOs may also employ health problem surveillance in their pre-elite populations at similar events.

Low energy availability has been shown to be associated with injury [11] and illness [11,15,16]. Half (n = 76) of the athletes attending the ANNC who completed the LEAF-Q were identified as being at risk of low energy availability (LEAF-Q≥8). This is similar to the prevalence rate of 53% of females (n = 29) [16] and 40% of females (n = 34) [15] previously reported in Australian athletic populations. Both of these studies found LEAF-Q scores equal to or greater than eight were associated with illness. This is likely due to the manner in which the LEAF-Q has been designed and validated. The LEAF-Q can be used to identify females at low risk of low energy availability (LEA) related conditions however as this questionnaire has not yet been validated in a netball population or development athletes, caution is advised until further validation studies are undertaken. Further diagnostic workup is needed to determine the presence of LEA-related conditions in athletes with a LEAF-Q score ≥ 8 [37].

Poor sleep quality can increase the risk of injury [12,33,34] and illness [35]. At least 57% of athletes attending the ANNC were identified as having poor sleep quality. This is similar to previous observational studies of pre-elite athletes, which reported 42.2% of athletes having poor sleep quality [36] and 66% not having the recommended 8 h of sleep per night [32]. We did not find a correlation between poor sleep quality and injury, contrary to a previous study reporting that adolescent students who slept less than 8.1 h/night were 1.7 times more likely to sustain an injury [12]. Perhaps the lack of association between poor sleep quality and injury could be due to a small window (6 days) of injury data collection. Despite this study not showing a link between poor sleep and injury, it is suggested that interventions to address sleep quality may remain an important component to overall health and team performance [32].

A limitation of this research is the use of the athlete participation method rather than athletes at risk method to define athlete exposure [22]. This method tends to inflate athlete exposure, resulting in deflated injury rates. We used the same athlete exposure definition in 2019 as we did in 2018 to allow for comparisons to be made. However, future netball injury surveillance research should consider using the athlete at risk method for athlete exposure during tournament play because matches are played with a consistent number of players.

5. Conclusion

Ankle sprains, lumbar pain, and foot blisters are the most frequent medical attention injury and concussion, and ACL rupture were the most frequent sports incapacity injuries in pre-elite netball athletes. Also, a high number of athletes were identified as being at risk of low energy availability (n = 76, 50%) and poor sleep quality (n = 74, 57%). These athletes were not at higher risk of injury compared to those that were not identified as being at risk of low energy availability and poor sleep quality. Use of athlete self-report and medical attention injury surveillance methods is an effective way of establishing the injury profile of pre-elite netball athletes.

Practical Implications

- Prevention of ankle sprains, ACL ruptures, and concussion must remain a priority in pre-elite netball athletes.
- Formatting of junior tournaments must be realistic to allow for appropriate preparation.
- We must heed the advice of the IOC and stop our youth athletes from competing or training when injured or ill.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Confirmation of ethical compliance

The Strengthening the Reporting of Observational studies in Epidemiology in Sports Injury and Illness Surveillance (STROBE-SIIS) was followed. [16] Ethics approval was obtained from the Australian Institute of Sport Human Research Ethics Committee (Approval number: 20180404). All participants or their parents/guardians provided consent via their individual online Athlete Management System (AMS; Smartabase, Fusion Sport, Brisbane, Australia) account.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jsampl.2022.100003.

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