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Injury and illness epidemiology in professional Asian football: lower general incidence and burden but higher ACL and hamstring injury burden compared to Europe

Original article

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Abstract

Background

While football injury and illness epidemiology surveillance at professional club level in Europe is available, epidemiological data from other continents are lacking.

Purpose

Investigating injury and illness epidemiology in professional Asian football.

Study Design

Descriptive prospective study.

Methods

Professional teams from the Asian Football Confederation (AFC) league were followed prospectively for three consecutive AFC seasons (2017 through 2019, 13 teams per season, 322 team-months). Time-loss injuries and illnesses in addition to individual match and training exposure were recorded using standardized digital tools in accordance with international consensus procedures.

Results

In total, 232 665 h of exposure (88.6% training and 11.4% matches) and 1159 injuries were recorded; 496 (42.8%) occurred during matches, 610 (52.6%) during training; 32 (2.8%) were reported as 'not applicable' and for 21 injuries (1.8%) information was missing. Injury incidence was significantly greater during match play (19.2±8.6 injuries per 1 000 h) than training (2.8±1.4, $p<0.0001$), resulting in a low overall incidence of 5.1±2.2.

The injury burden for match injuries was greater than from training injuries (456±336 days per 1 000 h vs 54±34 days, $p<0.0001$). The two specific injuries causing the greatest burden were complete ACL ruptures (0.14 injuries [95% CI 0.9 to 0.19] and 29.8 days lost [29.1 to 30.5] per 1 000 h) and hamstring strains (0.86 injuries [0.74 to 0.99] and 17.5 days [17.0 to 18.1] lost per 1 000 h).

Re-injuries constituted 9.9% of all injuries. Index injuries caused 22.6±40.8 days of absence compared to 25.1±39 for re-injuries ($p=0.62$). The 175 illnesses recorded resulted in 1.4±2.9 days of time loss per team per month.

Conclusion

Professional Asian football is characterized by an overall injury incidence similar to that reported from Europe, but with a high rate of ACL ruptures and hamstring injury, warranting further investigations.

Key words: Soccer, Epidemiology, Injury mechanism, Longitudinal study

INTRODUCTION

Injuries in professional football do not only affect player health, but also represent a significant threat to performance and financial burden for the clubs. [1-3] According to the van Mechelen model, [4] the first step of injury prevention is to accurately describe the injury epidemiology. This crucial step allows a better understanding of the injury risk and pattern (i.e., mechanism, type, location, and severity), permitting the initiation of appropriate prevention plans.

To date, different football populations [5-7] have been investigated, yet most data on professional male footballers have been collected in Europe. However, since regional differences have been demonstrated even within Europe,[8] it is important to extend studies to other continents. In Asia, data on injury epidemiology in senior men's football are limited, typically from one team followed over a few seasons [9 10] or some teams followed over one season or during a tournament.[1 11 12] Only one published study has collected data from more than one team and over more than one season. [13] However, in this study only injuries with a time loss of minimum 7 days were recorded, which severely limited the ability to compare the data to other studies. [14]

This has led us to call for regional epidemiological studies using standardized methodology to assess potential differences between continents,[15] and to initiate the Asian Football Confederation (AFC) Injury Surveillance Programme, modelled after the Union of European Football Associations (UEFA) Professional Club Injury Study and comprising Champions League level teams on the continent. Therefore, the aim of this study was to investigate the injury characteristics in professional Asian football, represented by 22 professional teams from 9 countries, monitored for three seasons. We hypothesized that the incidence and pattern of injuries in Asia would differ from Europe.

METHODS

We recorded individual time-loss injuries/illnesses and training/match exposure in Asian adult (≥18 years old) male professional football players through the 2017, 2018 and 2019 seasons. Twenty-two teams participating in the AFC (Asian Football Confederation) Champions League or the AFC Cup at least one of these three seasons accepted our invitation to participate, representing the following countries: Australia (n=3), China (1), Hong Kong

(1), Japan (3), Qatar (5), Thailand (1), United Arab Emirates (3), Kingdom of Saudi Arabia (1), India (1), and Iran (3). We followed these teams from January 2017 to December 2019 (included), throughout the domestic seasons as well as the periods of the AFC tournaments. For Qatar, United Arab Emirates and Kingdom of Saudi Arabia , the season is from the first week of July till the last week of May with 4 weeks winter break in December. The season starts in January and ends in November for teams from Australia, China, Hong Kong, Japan and Iran. In India, the season is from January to June. We included teams that provided at least three consecutive months of data. We included male, adult (≥18 yrs old) players being either a first-team squad member or training regularly with the first team. Players with pre-existing injuries at the start of the season were included in the study only after successful return to play from these conditions. Players newly recruited to a club were included from their recruitment date. Players transferred to another club were tracked until the date of transfer.

Data collection

A contact person among the medical staff (team doctor or physiotherapist) in each club was in charge of collecting the data, using standardized tools. A detailed study manual outlining the details of data collection was distributed to the contact person before the team's enrollment into the study. Demonstration sessions were organized, depending on user needs (in person or online sessions). Data were recorded using a custom-made Microsoft Office Excel® file for quick data entry, using pull-down menus to classify each injury (such as body part, injury type and diagnosis). Injury cards were also provided in Microsoft Office Word® to assist clinicians in taking notes during daily clinical activity, prior to entry into the master file. A potential risk to data confidentiality was minimized as follows: the Excel files utilized for data collection were password protected and the data were de-identified (code instead of player names) before being sent to the study group. The password was known only the clinician and the member(s) of the study group in charge of data collection. The clubs were asked to submit their data every month by email. All players were verbally informed about the purposes and procedures of the study by the team doctor/physiotherapist and provided verbal consent before participating in the study.

Definitions

To facilitate comparison with previous studies, injury definitions and data collection procedures followed the 2006 consensus statement on epidemiological studies in football [16] and the IOC model for recording illnesses.[17] The results have been reported according to the 2020 IOC consensus statement on injury and illness epidemiology. [14]

All injuries and illnesses resulting in a player being unable to fully participate in training or match play (i.e., time-loss injuries) were recorded, and the player was considered injured until the team medical staff allowed full participation in training and availability for match selection. Individual player exposure during training sessions and matches was reported (individual session duration for each player, in min). Injuries or illnesses that did not cause time off from football activities were not recorded in the database. Also, injuries occurring outside football activities were also not considered.

For each injury, the following characteristics were recorded: Diagnosis, onset (sudden vs. gradual), severity (number of days of time loss), injury type, body part, mechanism (sprinting, tackling, twisting/change of direction, kicking, jumping, stretching, and other), index injury (first injury of one type recorded during the study) or re-injury (injury to the same body part and same structure type within one year from index injury), training or match (cases of gradual-onset injuries, where the injury was not clearly attributed to a specific session, were classified as other). For the illnesses. diagnosis, number of days of time loss, affected system (from a predefined list), were recorded. We have classified cases as missing data when, despite all efforts to retrieve the data, the information could not be obtained.

Injury severity was classified according to the duration of time loss as follows: Mild (0-3 days), minor (4-7), moderate (7-28) and severe (>28).

Statistical analyses

Descriptive data are presented as the mean with standard deviations. For Injury pattern severity, the median and interquartile range (IQR) were used. Injury incidence was calculated as the number of time-loss injuries per 1 000 player hours. Injury burden was calculated as the total number of days lost per 1 000 player hours. Poisson distribution and test-based methods were used to construct confidence intervals and compare rates. The significance level was set at $p<0.05$. Statistical analyses were carried out using Power Pivot (Microsoft Excel 2019) and SPSS 22.0 program for OS X (SPSS, Inc., Chicago, IL, USA).

RESULTS

Population

The characteristics of teams and players over the three-season observation period are presented in table 1. Over the 3 seasons, 900 unique players participated to the study with 709, 163, and 28 players participated a least to one season, two seasons and 3 seasons, respectively.

*** Insert table 1 near here***

Exposure

Over the 3 seasons, 108, 107 and 107 team months were covered, representing an observation period of 8.3±2.9, 8.5±2.7 and 8.2±2.9 months per team, respectively. In total, 232 665 h (88.6% training and 11.4% match play) of exposure were recorded (72 431 h, 80 470 h and 80 470 h for the 2017, 2018 and 2019 seasons, respectively). This represents a total exposure of 5 480±705 h per team per season. The mean overall exposure per player to football during one full season was 255±80 h, 225±75 h of training and 30±11 h of match play. The training-to-match ratio was 7.5±2.4.

Injury incidence

In total, 1 159 injuries were registered, 496 (42.8%) occurred during matches and 610 (52.6%) during training; 32 (2.8%) were reported as ‘not applicable’ and 21 (1.8%) with missing information. A total of 846 injuries were reported as sudden onset (73%), 195 gradual onset (17%), while 19 were unsure (1.7%) and for 99 injuries (8.5%), information was missing. Re-injuries constituted 9.9% of all injuries. Index injuries caused 23±41 days of time loss compared to 25±39 days for re-injuries (p=0.62).

The overall injury incidence was 5.1±2.2 injuries/1 000 h (3.8±1.3 injuries per month per team), with greater incidence during matches (19.2±8.6 injuries/1 000 h) than training (2.8±1.4 injuries/1 000 h, p<0.0001).

Injury patterns

Thigh and knee injuries represented the greatest injury incidence and burden (table 2). The two specific injuries causing the greatest burden were complete ACL ruptures (0.1±0.09 injuries per team per month) and hamstring strains (0.6±0.4 injuries per team per month) (Table 2).

Insert table 2 near here

Sprinting was the most common injury mechanism for a total of 231 injuries (20%), followed by other (206; 18%), tackling (185; 16%), twisting/change of direction (169; 15%), kicking (148; 13%), jumping (86; 7%), and stretching (53; 5%).

Figure 1 represents a risk matrix based on the incidence and severity of the most commonly reported body parts by mode of onset.

Insert figure 1 near here

Injury burden and severity

The total injury burden was 112±56 days/1 000 h. The injury burden for match injuries was greater than the burden resulting from training injuries (456±336 days/1 000 h vs 54±34 days/1 000 h, $p<0.0001$). The majority of injuries were moderate (n=515; 44.4%) followed by minor (n=254; 21.9%), severe (n=229; 19.8%) and mild (n=161; 13.9%). Injury severity categories by body region are detailed in Appendix 1.

Illnesses

In total, 175 illnesses were registered, which corresponds to an incidence of 0.9±0.9 illnesses/1 000h of exposure (0.5±0.8 illnesses per month per team). The illness burden was 2.5±2.4 days of absence/1 000 h, corresponding to 1.4±2.9 days of time loss per month per team. The most commonly affected systems were the upper respiratory tract (n=23, 42.6%) and gastrointestinal tract (n=16, 29.6%).

DISCUSSION

The principal finding of this study was that while incidence of injuries in this group of professional Asian players was low compared to previous studies from Europe, the burden of hamstring and ACL injuries was high.

Injury risk

The injury incidence observed during training and match play in the current study are consistent with a previous study performed at the club level in Qatar, [12] both using the same consensus statement methodology. However, a prospective study in Iran reported a much

greater total time-loss injury incidence. [10] This may result from differences in the approach to data collection.

Despite the low injury incidence of the Asian clubs compared to UEFA clubs [18 19] (5.1 vs 7.7-8.0 injuries/1 000 h, respectively, 65%), the injury burden observed in the present study was only slightly lower than the European clubs with 112 vs 130 days/1 000 h (86%), respectively. [19] This apparent discrepancy results from greater injury severity in the AFC clubs. It should also be noted that the difference in injury burden was limited to match injuries (37 vs 53 days/1 000 h for the AFC vs UEFA, respectively); the training injury burden did not differ (455 vs 456 days/1 000 h, respectively). [20] This suggests a more substantial impact from match injuries in European clubs, compared to their Asian counterparts. This greater burden from match injuries in the UEFA Professional Club Injury Study may be related to greater player match exposure in Europe (41 h per season) [18] compared to Asia (30 h) or, simply, by larger squads of high-quality players, allowing clubs to rehab players longer after injury.

Injury types and locations

Figure 1 displays the relationship between incidence and severity, is likely the most helpful tool to guide risk management and determine priorities for injury prevention.[21] This risk matrix documents that ACL injuries and hamstring strains contribute the by far greatest, but similar, injury burden (29.8 and 17.5 days/1 000 h, respectively) although hamstring strains were more common and ACL tears were the most severe, as expected. These results are in accordance with other studies carried out at professional level using the consensus study methodology. [18 22] Nevertheless, despite a similar median layoff time for ACL tear among Asian and the European players (197 vs 201 days, respectively), the ACL rupture rate (0.14 injuries/1 000 h) in the present study was twice that of the UEFA study (0.06 injuries/1 000 h) [23] and our previous study in the Qatar Stars League (0.08 injuries/1 000 h). [24] These differences could be due to the already described differences in injury patterns by geographical regions.[25 26] Football teams playing in colder regions in Europe have higher injury rates compared to teams playing in warmer regions; conversely, the ACL injury incidence was lower in northern European teams, especially for noncontact ACL injuries.[27] Factors such as pitch surfaces (natural/synthetic, type of grass),[26] skill level of the players, the load from participation in the Asian Champions League and long travel distances could also impact injury patterns. In that regard, Asia is a vast continent covering 11 time zones, adding

jet lag to long-haul travel fatigue when participating in the AFC competition. Even variation in temperatures from one match to the next over few days – playing in the snow on a Sunday to the heat on Wednesday, then back to cold, could impact injuries and illness patterns. We do not know whether these factors can explain some of the differences observed, but they certainly deserve future investigations.

Even though the median lay-off per ankle injury was similar in the UEFA and the AFC studies (7 vs 8 days, respectively), both ankle injuries and ankle sprain burdens were higher in Europe compared to Asia with 16.3 vs 10.6 and 9.6 vs 7.4 days /1 000 h, respectively.[27] One potential reason is that the physical demand in Asian football is less than in Europe and may have facilitated earlier return to play. For instance, the Australian football league[28] reported high speed runs and sprints match loads as 50% less than the English Premier League.[29]

Hip/groin injuries represented 10.3% of the total number of injuries, which is similar to the 12.5% in the UEFA study.[22] However, the total incidence of hip/groin injuries was twice as high as in Europe (1.1 vs 0.5 injuries/1 000 h, respectively). It can be speculated that the high risk of hip/groin injuries reflects by the higher mean training-to-match ratio in Asia compared to the Europe [18]: 7.5 vs 5.2 (calculated from the data in the UEFA study[18]), respectively. In this regard, a recent study has shown that the amount of sprinting during football matches had a harmful association with muscle injury occurrence.[30]

Further investigations are needed to inform the differences in injury patterns between the only available continental surveillance studies, the high ACL and hamstring injury incidence and burden in Asia and the greater impact of ankle and hip/groin injuries in Europe.

Re-injuries

The proportion of re-injuries was lower than that of the UEFA study (9.9% vs 12%, respectively). [18] The mean absence following re-injuries was the same, 25 days versus 23 days for index injuries, and similar to Europe where reinjuries caused an average of 24 days of absence. [18] In contrast, studies from Scandinavian professional football, using the same consensus statement definition as the AFC and the UEFA study, reported re-injury rates ranging from 22% to 30%. [31-33] One possible explanation might be the difference in competitive level. One might speculate that top-level clubs in the European and Asian

Champions League have more extensive medical support, providing for more personalized rehabilitation of injured players. This deserves more attention, as it is well known that the pressure to perform is probably greater in professional than sub-professional football, potentially increasing the risks taken by the triad, player, physician and coach, when deciding on return to play, especially when it comes to key players.

Sudden vs. gradual onset

Sudden onset injuries represented 73% of all recorded injuries. The risk matrix clearly shows that the injury burden (days lost x incidence) from sudden-onset was greater than gradual-onset injuries, especially for thigh and knee injuries. Unfortunately, no similar representation of burden data is available in the literature allowing a comparison. We suggest that future studies present such data to help practitioners better appraise the burden of different types of injuries in their teams/leagues.[14]

Gradual onset injuries represented 16.8% of overall injuries, clearly representing a lower proportion than the UEFA study (28%). [18] This was accompanied by a higher mean training-to-match ratio in the present study compared to the UEFA study.[18] We cannot explain the lower proportion of gradual-onset injuries, although the training-to-match ratio was high. Whether there are cultural differences between Europe and Asia in reporting physical complaints is not known. Nevertheless, using a time-loss definition of injuries only detects the tip of the iceberg for overuse injuries.[34 35] This, substantial underestimation has been clearly shown by Harøy, et al. [36] using the OSTRC (Oslo Sports Trauma Research Center) Questionnaire to monitor groin problems in athletes.

Illnesses

The mean total illness incidence for all teams was 0.9±0.9 illness/1 000 h. Expressed differently, a team may expect one time-loss illness every two months (0.5±0.8 illnesses per month per team). Also, the burden from illness was limited, with an average of 1.4±2.9 days lost per month per team. This is similar to previous findings in European football[37] and therefore we can conclude that, despite some specific differences in illness epidemiology between the European and Asian continent,[38] illness incidence in professional footballers is low in both Asia and Europe. In accordance with the findings in the UEFA study, the most commonly affected systems were the upper respiratory and gastrointestinal tracts. Therefore,

it seems that even when mild illnesses occur, allowing players to continue to train and/or compete as reported by the team physicians, the major cause for stopping football activity because of illness seems to be consistent across the Asian and European continents.

Study limitations

The present data could be subject to some underreporting. Data were assessed on a monthly basis with regard to completeness, correctness, accuracy, plausibility and compliance with the definitions and categories and the club doctor/physiotherapist was contacted to resolve any deficiencies. Most clubs adhered with this, but in some cases the reporting frequency was lower; the longest period between two consecutive data submissions was three months. Cultural diversity and other factors represented challenges in engaging the same teams over three consecutive seasons. Geographical distance and language could potentially impact compliance with the present study protocol and resulting outcomes negatively. However, the study group has taken several measures to ensure data completeness and consistency: 1) providing a manual of the study (in English), with a detailed description of the study methodology; 2) an initial meeting with all club representatives prior to launching the study, explaining the study guidelines and procedures (in person and/or on-line meetings in English) and two subsequent group meetings for specific workshops, reinforcing collaboration and engagement with the study, and 3) offering continuing technical support to the participating clubs, responding to any query within 24 h. Also, the specifically designed digital tools provided, potentially with direct positive impact on daily practice, may have helped compliance. [39 40] This has resulted in a relatively limited proportion of missing data – with negligible effect on the outcomes.

Factors such as manager changes could have impacted injury rates from season to season and within seasons. Finally, although this study is directly comparable to the UEFA study, readers should consider the differences in performance level and player quality between confederations when interpreting the results.

Conclusion

The present study shows that the injury and illness patterns at the professional Asian football level were characterized by an overall injury incidence similar to that reported from Europe,

but with a high rate of ACL ruptures and hamstring injuries. This deserves further investigations and tailoring injury prevention programmes could be considered.

What are the new findings?

- The injury and illness patterns at the professional Asian football level are consistent with the only other football confederation that has established systematic injury and illness surveillance to date (UEFA).
- Professional Asian football is characterized by a high rate of ACL ruptures and hamstring injury.
- Player match exposure in Asia (30 h) is lower than Europe (41 h)

how might it impact on clinical practice in the future?

- These data will provide clinicians with prognostic information about the overall injury incidence and patterns in professional Asian football.

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Conflict of interest The authors of the present study declare no conflict of interest with regard to the content of the present study.

Contributors MT, CE and KC lead the project, were responsible for data collection, project management and for writing the initial version of the manuscript. MT was responsible for the statistical analysis. MT, CE, RB and KC were involved in the analysis and interpretation of the results. All authors have revised the manuscript critically for important intellectual content and approved the final version. In doing so, we agree to be accountable for all aspects of the work.

Patient consent for publication Not required.

Ethics approval This study protocol was approved and supported by the Medical Committee of the AFC and ethics approval was obtained from the Anti-Doping Lab Qatar Ethical Committee (E-2016000157).

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Data availability statement Data is confidential and not available upon request

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Tables and figures

Table 1. Player population characteristics.

Season	2017	2018	2019	Total
Teams (N)	13	13	13	
Players (N)	408	396	429	1233
- Goalkeepers	46	44	31	121
- Defenders	116	107	91	314
- Midfielders	156	151	230	537
- Attackers	90	94	77	261
Players per team (N)	31±6	28±5	31±7	30±8
Age (yrs)	26±5	26±5	25±5	26±5
Body mass (kg)	73±9	73±10	72±8	73±9
Height (cm)	178±7	178±9	177±9	178±8

Table 2. Injury pattern by body region, injury type and diagnosis.

	No. of Injuries [%]	Severity Median (95% CI), d	Incidence, Injuries/1 000 h (95% CI)	Burden, Days lost/1 000 h (95% CI)
Head/face	23 [2]	7 (5 to 15)	0.10 (0.06 to 0.15)	1.2 (1.1 to 1.4)
Concussion	11	7 (5 to 15)	0.05 (0.02 to 0.08)	0.4 (0.4 to 0.5)
Shoulder/clavicle	18 [2]	23 (5 to 59)	0.08 (0.05 to 0.12)	3.6 (3.4 to 3.9)
Dislocation/subluxation	6	73 (18 to 195)	0.03 (0.01 to 0.05)	2.1 (2.0 to 2.3)
Arm and hand	22 [2]	10 (4 to 23)	0.10 (0.06 to 0.14)	1.7 (1.6 to 1.9)
Torso	29 [3]	7 (4 to 14)	0.13 (0.08 to 0.18)	1.4 (1.3 to 1.6)
Low back/sacrum/pelvis	60 [5]	6 (4 to 10)	0.26 (0.20 to 0.33)	4.0 (3.8 to 4.3)
Hip/groin	119 [10]	9 (6 to 11)	0.51 (0.42 to 0.61)	7.3 (7.0 to 7.6)
Muscle rupture/strain/cramps	77	9 (7 to 11)	0.33 (0.26 to 0.41)	3.9 (3.7 to 4.2)
Thigh	355 [31]	12 (10 to 13)	1.53 (1.37 to 1.69)	28.0 (27.3 to 28.7)
Muscle rupture/strain/cramps	311	13 (11 to 15)	1.34 (1.20 to 1.50)	26.6 (25.9 to 27.3)
Hamstring muscle strain	200	14 (12 to 17)	0.86 (0.74 to 0.99)	17.5 (17.0 to 18.1)
Knee	220 [19]	17 (13 to 26)	0.95 (0.82 to 1.08)	51.9 (51.0 to 52.8)
Meniscus/cartilage	46	15 (11 to 30)	0.20 (0.15 to 0.26)	8.4 (8.0 to 8.8)
Sprain/ligament injury	114	29 (18 to 41)	0.50 (0.40 to 0.59)	37.6 (36.8 to 38.4)
ACL complete tear	32	197 (182 to 243)	0.14 (0.09 to 0.19)	29.8 (29.1 to 30.5)
MCL injury	63	14 (9 to 25)	0.27 (0.21 to 0.35)	6.1 (5.8 to 6.4)
Tendon injury/bursitis	24	8 (3 to 44)	0.10 (0.07 to 0.15)	3.1 (2.8 to 3.3)
Lower leg/Achilles tendon	100 [9]	9 (7 to 14)	0.42 (0.34 to 0.51)	6.9 (6.5 to 7.2)
Fracture	5	42 (23 to 180)	0.02 (0.01 to 0.05)	1.5 (1.4 to 1.7)
Muscle rupture/strain/cramps	64	12 (8 to 18)	0.28 (0.21 to 0.35)	4.4 (4.1 to 4.7)
Ankle	162 [14]	7 (6 to 10)	0.70 (0.59 to 0.81)	9.6 (9.3 to 10.1)
Fracture	3	115 (37 to 244)	0.01 (0.001 to 0.04)	1.6 (1.4 to 1.7)
Sprain/ligament injury	136	7 (6 to 10)	0.59 (0.49 to 0.69)	7.4 (7.0 to 7.7)
Foot/toe	50 [4]	7 (5 to 14)	0.21 (0.16 to 0.28)	3.9 (3.6 to 4.1)
Fracture	9	42 (22 to 50)	0.04 (0.02 to 0.07)	2.2 (2.2 to 2.4)
Missing information	1			

Apart from concussion, only injury type subgroups with an injury burden of >1.5 days lost/1 000 h are included in the table.

Figure 1. Risk matrix depicting the relationship between incidence (number of injuries per 1 000 h) and severity (average number of days lost with 95% confidence intervals) for each body region that were split into sudden and acute onset mechanism of injury. The darker the color, the greater the burden; isobars depict a burden of 5, 10, 20 and 30 days per 1 000 h, respectively. Only body regions with an injury burden (average number of days lost per 1 000 h) of >1 and a minimum number of >3 cases are included in the figure.