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original research

Injuries in Japanese Junior Soccer Players During Games and Practices

Kenji Kuzuhara, MA, MEd, ATC, CSCS*‡; Masashi Shibata, PhD†; Ryo Uchida, PhD‡

*Department of Human Health, Faculty of Human Health, Aichi Toho University, Nagoya, Japan; †College of Nursing Art and Science, University of Hyogo, Japan; ‡Graduate School of Education and Human Development, Nagoya University, Japan

Context: Soccer is the most popular junior sport in the world. In junior sports, injury analysis and injury-prevention measures for players, especially those under 12 years of age, are urgently needed.

Objective: To prospectively study the incidence, sites, types, and mechanisms of injuries in elementary school-aged junior soccer players during games and practices.

Design: Descriptive epidemiology study.

Setting: Elementary school-aged junior soccer teams in Nagoya, Japan.

Patients or Other Participants: Eighty-nine players in 5 community-based club teams of junior soccer (U-12, age range = 11–12 years; U-11, age range = 10–11 years; U-10, age $\leq$10 years).

Main Outcome Measure(s): Data on all game and practice injuries for the 2013–2014 season were collected using an injury report form. Injury rates were calculated according to injury site, type, and mechanism.

Results: The overall injury rate was 2.59/1000 athlete-hours (AHs). The game injury rate (GIR; 6.43/1000 AHs) was higher than the practice injury rate (PIR; 1.49/1000 AHs; $P < .05$). The most common anatomical areas of injury during games and practices were the lower limbs (62.5% and 4.02/1000 AHs versus 38.5% and 0.57/1000 AHs, respectively). Contusions (27.6%, n = 8) were the most frequent type of overall injuries. Most game injuries resulted from body contact (43.8%, 2.81/1000 AHs), whereas most practice injuries resulted from other types of contact (53.8%, 0.83/1000 AHs).

Conclusions: The GIRs were higher than the PIRs in Japanese junior soccer players. A lower overall PIR suggested that players in the U-12 age group practiced under appropriate conditions. However, the higher GIR in this age category needs to be decreased.

Key Words: elementary school-aged children, epidemiology, injury surveillance

Key Points

- In Japanese junior soccer players, injury rates were higher during games than during practices.
- During games and practices, the most common anatomical area of injury was the lower limb.
- The most prevalent injury type was contusions.
- Most game injuries resulted from body contact, whereas more practice injuries resulted from other types of contact.

Soccer is the most popular sport in the world. In 2013, Japan boasted the highest number of registered soccer players in all categories at 963 340 athletes combined.[1] Among these categories, elementary school-aged (12 years) or younger children were the largest subset at 318 548 children. Despite this large population of children who play soccer, few sport-injury analyses have been conducted in junior sports, especially in elementary school-aged children.

In junior sports, the health benefits of regular soccer practice and training have been demonstrated.[2] In addition, early specialization in sport, such as performing only a specific type of sport throughout the year from early elementary school age, is progressing.[3] Early specialization increased the risks of overuse injuries and psychological burnout,[4–6] and implementing injury-prevention measures is an important goal for junior or youth sports. Soccer is categorized as a contact or collision sport, and the number of soccer-related injuries has increased with the increasing number of players.[7] Many reports of injuries in soccer players ranging from 13 years old to university student age are available, and the mechanisms of injuries in these age groups are known.[8–13] However, even internationally, few authors have investigated injuries in junior sport players aged 12 years and younger, and only a handful of reports exist for soccer, which involves a large population of players.[14–17]

In Japan, the various junior sport associations are actively involved in organizing local and national competitions. Injury analyses and preventive measures for junior athletes are urgently needed because the prevalence of soccer-related injuries is increasing among this population.[7,8] However, sufficient research related to junior sports has not been conducted in Japan, and the data published by the sports safety associations were not comprehensive.[18] The only data available were from limited analyses (eg, data on numbers and percentages of injuries) and questionnaire surveys. Also, it is noteworthy that the number of studies[14–17,19,20] on sports

injuries in elementary school-aged players ($\leq$12 years) is extremely low, both in Japan and overseas. Thus, the purpose of our study was to examine injuries sustained during games and practices in Japanese junior soccer players ($\leq$12 years) over the 2013–2014 season according to incidence, site, type, and mechanism.

METHODS

Participants

Eighty-nine players in 5 community-based junior soccer club teams (U-12, age range = 11–12 years; U-11, age range = 10–11 years; U-10, age $\leq$10 years) in Nagoya, Japan participated in this study. The participants were elementary school third-grade to sixth-grade students with a mean age of 10.3 $\pm$ 1.5 years. The athletes on each club team were selected to play by its coaching staff. This study was approved by the institutional review board at Aichi Toho University. A consent form was completed for each participant by the parent or guardian.

Definition of Injury

All injuries to team members during games or practices throughout the 2013–2014 period were recorded by team coaches or team-supporting parents. We defined an *injury* as any event, including a traumatic or overuse injury or a disease related to sport that met the following criteria[21]: (1) occurred during a regular game or practice, (2) led to a player missing any game or practice subsequent to the injury, and (3) caused the player to seek medical care from a physician or alternative medical specialist. Head or face injuries, including concussions, were recorded even if the player did not miss a game or practice.[21] A *traumatic injury* resulted from an identifiable event (ie, an injury of sudden onset caused by body contact or contact with the ball, field, or another object). An *overuse injury* was defined as an injury of gradual onset (ie, associated with repetitive microtrauma) and without an identifiable responsible event. A *recurrent injury* was an injury of the same type and at the same site as an index injury and occurred after a player had returned to full participation following the initial injury. Illnesses or injuries that were not related to junior soccer participation were not included. Injuries were classified according to the following anatomic locations: head and neck (including face), upper limb (distal to the acromioclavicular joint, including the shoulder joint), trunk and back (chest, back, abdomen, genitalia), and lower limb (buttocks, thighs, and distal structures).

Data Collection

Because organization is limited and medical staffs are not present at this level of play, we obtained cooperation from the coaching staff and team-supporting parents for each team after we explained the research to them. During the season from April 2013 through March 2014, team diary entries were recorded after every game and practice and an injury survey was performed weekly by both the coaching staff and team-supporting parents. For the team diary, information about team games and practices (the date, place, practice hours, number of games, and number of players) was recorded after every game and practice. For the injury survey, the injury date, location (head and neck, upper limb, trunk and back, lower limb, or other), type, and mechanism (body contact, other contact, or no contact) were recorded after a diagnosis from a physician or alternative medical specialist. When a player was injured, the coaching staff or team-supporting parents provided first aid and took the injured player to a sports clinic or regional hospital to see a physician. We visited each team every 1 or 2 months to confirm that the team diary entries were being made and the injury surveys were being conducted. We also regularly communicated with the coaches of each team via e-mail and asked about compliance with the research.

Exposure to and Incidence of Injury

Information regarding practices and games based on the diary for each team was used throughout the year. In official junior soccer games, a game is divided into two 20-minute periods with a 5-minute half-time. In training or cup junior soccer games, a game is divided into two 15-minute periods with a 5-minute half-time. Depending on the game schedule and location, 2 or 3 games took place per day. For the analysis, we used actual practice times from the team diary. The specific amounts of game and practice time in hours for each team were calculated from the team diary. The *incidence of injury* was calculated as the total number of injuries per 1000 athlete-hours (AHs) of actual and game and practice time as well as per 1000 hours of exposure (sum of game and practice hours).[22] Game and practice AHs were calculated from the total game or practice hours and the number of players who participated in each game or practice (Table 1). The *game injury rate* (GIR) and *practice injury rate* (PIR) were calculated by dividing the number of injuries in each event by the total number of AHs and then converting the value to reflect 1000 AHs.

Statistical Analyses

Frequencies and χ^2 tests were used to determine the differences in proportions of the anatomical areas affected and injury types and mechanisms during games and practices. We calculated 95% confidence intervals (CIs) separately for games and practices. To compare the rates between games and practices according to anatomical area, injury type, and injury mechanism, the game/practice ratios and their 95% CIs were determined. The *incidence rate ratio* (IRR) represented the relationship between the GIRs and PIRs and was calculated by dividing the GIR by the PIR. In general, if the CI for the IRR includes 1, the IRR is not significant; if the CI for the IRR does not include 1, the relationship is significant.[23] The CI for the IRR was used to determine the differences in the anatomical area affected, injury type, and injury mechanism during games and practices. If the observed χ^2 value exceeded the critical value at the α level of .05, the finding was significant. The statistical procedures were accomplished using Excel for Windows (version 1.13; Microsoft Corp, Redmond, WA).

RESULTS

A total of 29 injuries occurred between April 2013 and March 2014. Of these, 16 injuries (55.2%) occurred during games and 13 injuries (44.8%) occurred during practices. The overall injury rate was 2.59/1000 AHs. The overall

Table 1. Game and Practice Athlete-Hours in Junior Soccer Teams in Japan, 2013–2014

Measure	Junior Soccer Team					
	U-12 Team A	U-11 Team B	U-10 Team C	U-11 and 12 Team D	U-10 Team E	Total
No. of players	12	14	24	19	20	89
No. of practices	54	60	64	29	22	229
No. of games (cup games for 8 players)	30	33	34	79	4	180
No. of games (cup games for 11 players)	43	0	0	3	0	46
No. of games (official games for 8 players)	14	27	39	13	27	120
No. of games (official games for 11 players)	5	0	0	0	0	5
Game athlete-hours	596.8	401.1	477.1	754.9	260.2	2490.1
Practice athlete-hours	1568.5	1718.0	2936.5	1482.0	1021.0	8726.0
Total athlete-hours	2165.3	2119.1	3413.6	2236.9	1281.2	11 216.1

GIR and PIR were 6.43/1000 AHs and 1.49/1000 AHs, respectively. The overall IRR was 4.31 (95% CI = 2.07, 8.96), which indicated that the overall GIR was higher than the overall PIR ($P < .05$; Table 2).

Regarding the anatomical areas of overall injuries, the lower limbs (n = 15, 51.7%) were affected most frequently, followed by the head and neck, including the face (n = 5, 17.2%), and the upper limb (n = 4, 13.8%; Table 3). During games, the most common anatomical area of injury was the lower limb (62.5%, 4.02/1000 AHs), followed by the head and neck (18.8%, 1.20/1000 AHs) and the upper limb (12.5%, 0.80/1000 AHs). During practices, the most frequent anatomical area of injury was the lower limb (38.5%, 0.57/1000 AHs), followed by the head and neck (15.4%, 0.23/1000 AHs) and the upper limb (15.4%, 0.23/1000 AHs). The GIR for the lower limb was higher than the PIR for the same region (IRR = 7.01 [95% CI = 2.40, 20.51]; $P < .05$).

With respect to types of overall injuries, contusions (n = 8, 27.6%) were the most frequent, followed by sprains, fractures, and wounds (each n = 5, 17.2%; Table 4). During games, contusions occurred most often (37.5%, 2.41/1000 AHs), followed by sprains (25.0%, 1.61/1000 AHs) and fractures (18.8%, 1.20/1000 AHs). However, the most common types of injuries during practices were wounds (23.1%, 0.34/1000 AHs), followed by contusions and fractures (each 15.4%, 0.23/1000 AHs). The GIRs for contusions and sprains were higher than the PIRs (IRR = 10.51 [95% CI = 2.21, 52.07] versus IRR = 14.02 [95% CI = 1.57, 125.4], respectively; $P < .05$).

As for the mechanisms of overall injuries, other contact with the ball, field, or another object (n = 13, 44.8%) occurred most often, followed by body contact (n = 8, 27.6%; Table 5). Body contact (43.8%, 2.81/1000 AHs) was the most common injury mechanism during games, followed by other contact (37.5%, 2.41/1000 AHs), whereas during practices, other contact (53.8%, 0.83/1000 AHs) was most common, followed by body contact (7.7%, 0.11/1000 AHs). The GIRs for body contact and other contact were higher than the corresponding PIRs (IRR = 24.53 [95% CI = 3.02, 199.4] versus IRR = 3.00 [95% CI = 1.01, 8.93], respectively; $P < .05$).

DISCUSSION

Our prospective observational study examined injuries in Japanese junior soccer players aged ≤12 years. The overall injury incidence was higher during games than during practices, which was consistent with findings in other studies.[8–10,12] Thus, we confirmed that the soccer-related injury incidence was higher during games than during practices, regardless of age category or competitive level.

The overall injury incidence, including the GIR and PIR, for the U-12, U-11, and U-10 groups was 2.59/1000 AHs. In one of the few studies of injuries in the ≤U-12 age category,[17] the overall incidence was 3.4/1000 AHs; our overall incidence was 0.76-fold lower. According to researchers[14] who analyzed injuries at the USA Cup international junior soccer tournament during the 10-year period from 1988 to 1997, competition injuries showed a decreasing trend in the U-12 age category. This result suggested that wider participation in soccer from 1988 through 1997 led to improvements in conditioning and experience.[14] Furthermore, in 2003, the Fédération Internationale de Football Association-Medical Assessment and Research Centre developed an injury-prevention program for soccer players called "The 11,"[24,25] which was renamed "11+" in 2006 after several modifications and improvements.[26] Such initiatives have also influenced and consequently improved conditioning and provided greater experience in soccer for U-12 junior soccer players, which may have led to the low overall injury incidence we observed.

The PIR in the present study (1.49/1000 AHs) was markedly lower than in the 13–15-year-old (3.3 to 14.1/1000 AHs) and 16–19-year-old (3.22 to 17.4/1000 AHs) categories in a previous study.[27] As indicated by earlier investigators,[8] the incidence of injury in soccer might be

Table 2. Total Injury Rates in Junior Soccer Teams in Japan, 2013–2014

Incidence Condition	Games		Practices		IR Ratio (95% CI)	Total	
	No.	IR (95% CI)[a]	No.	IR (95% CI)		No.	IR (95% CI)
Total injury rates	16	6.43 (3.28, 9.58)	13	1.49 (0.68, 2.30)	4.31 (2.07, 8.96)[b]	29	2.59 (1.65, 3.53)

Abbreviation: CI, confidence interval; IR, incidence rate.

[a] IRs are per 1000 athlete-hours.

[b] $P < .05$.

Table 3. Injury Rates by Anatomical Areas in Junior Soccer Teams in Japan, 2013–2014

	Games		Practices			Total	
Anatomical Areas	No. (%)	IR (95% CI)[a]	No. (%)	IR (95% CI)	IR Ratio (95% CI)	No. (%)	IR (95% CI)
Head and neck	3 (18.8)	1.20 (0.00, 2.56)	2 (15.4)	0.23 (0.00, 0.55)	5.26 (0.88, 31.48)	5 (17.2)	0.45 (0.06, 0.84)
Upper limb	2 (12.5)	0.80 (0.00, 1.91)	2 (15.4)	0.23 (0.00, 0.55)	3.50 (0.49, 24.85)	4 (13.8)	0.36 (0.01, 0.71)
Trunk and back	1 (6.3)	0.40 (0.00, 1.19)	1 (7.7)	0.11 (0.00, 0.33)	3.50 (0.22, 55.96)	2 (6.9)	0.18 (0.00, 0.43)
Lower limb	10 (62.5)	4.02 (1.53, 6.51)	5 (38.5)	0.57 (0.07, 1.07)	7.01 (2.40, 20.51)[b]	15 (51.7)	1.34 (0.66, 2.02)
Other			3 (23.1)	0.34 (0.00, 0.73)	0.00	3 (10.3)	0.27 (0.00, 0.57)

Abbreviations: CI, confidence interval; IR, incidence rate.

[a] IRs are per 1000 athlete-hours.

[b] $P < .05$.

influenced by age, sex, and competitive level. This low PIR may have been due to multiple factors: many of our participants were U-12–aged boys who had not yet reached physical maturity, injury prevention was addressed during practice sessions, and practices were conducted at age-appropriate intensities.

Yet the GIR in our study was 6.43/1000 AHs, which was similar to the GIR among those in the U-14 age category (6.5/1000 AHs) in France.[9] Considering that the overall incidence and PIR we found were lower than those in previous studies, we can interpret our GIR as relatively high. Indeed, our GIR was greater than the PIR by 4.31-fold. To our knowledge, no previous authors have compared the GIR and PIR in this age category; however, the GIR was 1.5- to 8.7-fold greater than the PIR in all age categories $\geq$13 years.[8–10,12] The incidence of injuries during games was also greater than during practices in the U-12, U-11, and U-10 age groups we examined, indicating that a reduction in the GIR is a future challenge.

We noted that overall injuries most often affected the lower limbs, accounting for 51.7% of all injuries. This result was consistent with earlier findings[14,16,17] in the same age categories. Moreover, this result was also similar to that in the $\geq$13 years of age category,[8,10,14,17] demonstrating that the lower limbs were the most common injury site in junior soccer players and responsible for more than half of all injuries, regardless of age.

The most frequent anatomical area of injury during games and practices was also the lower limb (62.5% of game injuries and 38.5% of practice injuries). The injury rate of the lower limb was significantly higher during games (4.02/1000 AHs) than during practices (0.57/1000 AHs). Such anatomical patterns of injury during games and practices were similar to those seen in previous studies.[13,28]

Contusion was the most prevalent type of injury and accounted for 27.6% of overall injuries, followed by sprain, fracture, and wound (17.2% each). These results demonstrated a similar trend as in a previous study of U-14 players (contusion = 26.0%, sprain = 18.1%).[10] In that work,[10] contusions occurred most frequently in U-15 and U-16 players, accounting for 36.6% and 29.9%, respectively, of all injuries; however, muscle strain was the second most common injury in these age groups. In a different investigation,[8] although contusion was also the most frequent type of injury in U-13 players, accounting for 32.0% of injuries, muscle strain was the most common type in U-15, U-17, and U-19 players, accounting for 34.0%, 30.0%, and 34.0%, respectively, of all injuries. In addition, contusion had the greatest GIR, followed by sprains. Based on these findings, it appears that contusions occurred most often in younger soccer players (U-12, U-13, and U-14).

With regard to injury mechanisms, the most common cause during games was physical contact between players, followed by contact with other objects (such as the ball or the ground). These results were consistent with those in a previous study[13] on university-level soccer players that showed the most common cause was physical contact, accounting for 61.0% of all injuries. Peterson et al[12] reported that approximately 50% of all injuries were caused by player contact in the U-14 to U-18 age categories and that half of these were associated with foul play. Although injuries caused by contact with objects such as the ball or the ground were most frequent in elementary school-aged players during practices, 47.0% of all injuries in university-level soccer players occurred without physical contact.[13] This difference may be due to the younger player's greater chance of becoming injured when falling after losing his or her balance because their practice grounds in Japan are typically composed of hard soil rather than natural or artificial grass.

Few authors have investigated injuries in international junior soccer players younger than age 12. Epidemiologic

Table 4. Injury Rates by Injury Type in Junior Soccer Teams in Japan, 2013–2014

	Games		Practice			Total	
Injury Type	No. (%)	IR (95% CI)[a]	No. (%)	IR (95% CI)	IR Ratio (95% CI)	No. (%)	IR (95% CI)
Sprain	4 (25.0)	1.61 (0.04, 3.18)	1 (7.7)	0.11 (0.00, 0.33)	14.02 (1.57, 125.4)[b]	5 (17.2)	0.45 (0.06, 0.84)
Strain	1 (6.3)	0.40 (0.00, 1.19)	0 (0.0)	0.00	0.00	1 (3.4)	0.09 (0.00, 0.26)
Contusion	6 (37.5)	2.41 (0.48, 4.34)	2 (15.4)	0.23 (0.00, 0.55)	10.51 (2.21, 52.07)[b]	8 (27.6)	0.71 (0.22, 1.20)
Fracture	3 (18.8)	1.20 (0.00, 2.56)	2 (15.4)	0.23 (0.00, 0.55)	5.26 (0.88, 31.48)	5 (17.2)	0.45 (0.06, 0.84)
Wound	2 (12.5)	0.80 (0.00, 1.91)	3 (23.1)	0.34 (0.00, 0.73)	2.34 (0.39, 14.00)	5 (17.2)	0.45 (0.06, 0.84)
Other	0 (0.0)	0.00	5 (38.5)	0.57 (0.07, 1.07)	0.00	5 (17.2)	0.45 (0.06, 0.84)

Abbreviations: CI, confidence interval; IR, incidence rate.

[a] IRs are per 1000 athlete-hours.

[b] $P < .05$.

Table 5. Injury Rates by Injury Mechanism in Junior Soccer Teams in Japan, 2013–2014

	Games		Practice			Total	
Injury Mechanism	No. (%)	IR (95% CI)[a]	No. (%)	IR (95% CI)	IR Ratio (95% CI)	No. (%)	IR (95% CI)
Body contact[b]	7 (43.8)	2.81 (0.73, 4.89)	1 (7.7)	0.11 (0.00, 0.33)	24.53 (3.02, 199.4)[d]	8 (27.6)	0.71 (0.22, 1.20)
Other contact[c]	6 (37.5)	2.41 (0.48, 4.34)	7 (53.8)	0.83 (0.21, 1.39)	3.00 (1.01, 8.93)[d]	13 (44.8)	1.16 (0.53, 1.79)
No contact	2 (12.5)	0.80 (0.00, 1.91)	0 (0.0)	0.00	0.00	2 (6.9)	0.18 (0.00, 0.43)
Other or unknown	1 (6.3)	0.40 (0.00, 1.19)	5 (38.5)	0.57 (0.07, 1.07)	0.70 (0.08, 5.99)	6 (20.7)	0.53 (0.10, 0.96)

Abbreviations: CI, confidence interval; IR, incidence rate.

[a] IRs are per 1000 athlete-hours.

[b] Body contact: contact with players.

[c] Other contact: contact with ball, field, or other objects.

[d] The χ^2 test demonstrated a difference in injury mechanisms ($P < .05$).

data are essential to establish a safe sporting environment for these players, and the first step in injury prevention is to research the injury status of elementary school-aged soccer players. For junior soccer teams, no medical staff, such as an athletic trainer or a physical therapist, is present to provide medical care during games and practices. During games in particular, the medical staff should be onsite to provide appropriate care for the health and safety of junior soccer players.

In recent years, intervention programs aimed at preventing lower limb injuries have been investigated at the youth soccer level (14 to 19 years old).[29–32] Injury-prevention programs focusing on the lower limb are also necessary for elementary school-aged junior soccer players to address these most common injuries. In addition, other injury-prevention skills, such as avoiding injury when contacting with players, landing and falling, and balancing while moving need to be taught.

LIMITATIONS

Certain limitations of our study should be noted. We examined only 5 anatomical areas of injury (head and neck, upper limb, trunk and back, lower limb, other) and 4 injury mechanisms (body contact, other contact, no contact, other or unknown). We did not collect information on injury severity (minor, moderate, major) or time to return to play because no medical staff, such as an athletic trainer or physical therapist, was available to each club team. The U-13 to college-aged (19 to 22 years old) teams are typically better organized. Coaching staff, including a head coach and an assistant coach, and medical staff, including an athletic trainer or physical therapist, are often employed by these teams. Therefore, for an injury survey conducted during 1 year or season, the medical staff can record injury data during games and practices or can develop an injury-surveillance system for the team. Although many junior sports teams exist at the elementary school-age level in Japan, they are not as well organized as high school or collegiate teams in the United States. In Japanese junior soccer teams, it was difficult to conduct injury surveys because an injury-reporting system for collecting and storing a large volume of injury data, such as the National Athletic Injury/Illness Reporting System,[21] was absent. Also, elementary school-aged teams are looked after by their coaching staff and parents and guardians, not by a medical staff including an athletic trainer or physical therapist. Thus, the number of teams that can be visited regularly by researchers is limited, which affects the reliability of the injury survey. Epidemiologic injury surveys in junior soccer players should be conducted over several years in Japan to ensure a safe sporting environment for junior and youth players in the future.

CONCLUSIONS

This is one of the few year-round injury studies of elementary school-aged junior soccer players. The overall injury rate, including injuries that occurred during games and practices, was lower in our investigation than in previous research. In particular, the PIR was low, suggesting that age-appropriate intensive practices were being conducted. The incidence of injuries during games was greater than during practices in this age category. The most common injury site during games and practices was the lower limb, and contusions were the predominant injury type. Furthermore, the GIR was greater than the PIR at the elementary school level, indicating that reducing the GIR is a future challenge for athletes in this age category.

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Address correspondence to Kenji Kuzuhara, MA, MEd, ATC, CSCS, Department of Human Health, Faculty of Human Health, Aichi Toho University, 3-11 Heiwagaoka, Meito-ku, Nagoya 465-8515 Japan. Address e-mail to kuzuhara.kenji@aichi-toho.ac.jp.