

Injuries in Japanese Mini-Basketball Players During Practices and Games

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

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

Context: Mini-basketball is one of the most popular junior sports in Japan. Mini-basketball-related injuries may increase because of early specialization. However, no reports have been published to date concerning basketball injuries in children younger than 12 years of age.

Objective: To prospectively study the incidence, sites, types, and mechanisms of injuries in mini-basketball teams.

Design: Descriptive epidemiology study.

Setting: Mini-basketball teams in Kobe, Japan.

Patients or Other Participants: A total of 95 players in 7 community-based mini-basketball club teams (age range, 9 through 12 years).

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

Results: The overall injury rate was 3.83 per 1000 athlete-hours (AHs). The game injury rate (12.92/1000 AHs) was

higher than the practice injury rate (3.13/1000 AHs; $P < .05$). The most common anatomical areas of injury during games and practices were the head and neck (36.4%, 4.70/1000 AHs) and the upper limbs (47.8%, 1.50/1000 AHs). Sprains (42.9%, $n = 39$) were the most common type of injuries overall, followed by contusions (29.7%, $n = 27$). Most game injuries resulted from body contact (45.5%, 5.87/1000 AHs), whereas most practice injuries resulted from other contact (56.5%, 1.77/1000 AHs).

Conclusions: Game injury rates were higher than practice injury rates in Japanese mini-basketball players. The high practice injury rate in this study may be due to specific factors related to growth, such as individual differences in height, or to skills, such as inexperience in ball handling.

Key Words: elementary school-age players, injury epidemiology, injury surveillance

Key Points

- In Japanese mini-basketball players, injury rates were higher in games than in practices.
- The head and neck (including the face) was the area injured most often during games, compared with the upper limb during practices.
- The most prevalent injury types were sprains and contusions.
- Body contact was the mechanism responsible for the most game injuries, whereas other contact accounted for the most practice injuries.

In Japan, local sports clubs provide citizens with lifelong opportunities to enjoy sports while accommodating interest levels as well as individual needs, regardless of age, level, or type of skills.¹ Comprehensive community sports clubs have been established in response to such social needs, and the number of such clubs is increasing each year. As opposed to the United States, comprehensive community sports clubs must offer a selection of different sports depending on the season, and many participants are involved in only 1 sport during the year.¹ The influence of this selective availability on the junior generation is not negligible. Indeed, children may participate in only 1 sport throughout the year starting in primary school, and consequently, early specialization in sports is inevitable.² Early specialization increases the risks of overuse injuries and burnout,³ and thus, implementing

injury-prevention measures is key to safe participation in junior and youth sports.

Individual junior sports in Japan have associations that actively organize local and national competitions. Injury analysis and injury-prevention measures for junior athletes are urgently needed because of their higher risk of injury, but data published by the Sports Safety Association and other organizations are not comprehensive.⁴ The only data available are from limited analyses (eg, number of injuries and injury rates) and questionnaire surveys. Also, it is noteworthy that the number of studies on sports injuries in elementary school-age players (≤ 12 years old) is extremely low, both in Japan and overseas,^{5–10} although several groups have analyzed injuries in high school or older players.^{11–17}

In Japan, junior football has the largest number of elementary school aged-participants (approximately

320 000 players per year), followed by mini-basketball (approximately 150 000 players per year).^{18,19} Junior football-related injuries have been examined in overseas studies, but to our knowledge, mini-basketball-related injuries have not yet been analyzed. In addition, appropriate intervention for injury prevention is necessary for elementary school-aged players to improve their safe participation later in life. Therefore, accurate injury data for this age category are needed. Thus, the purpose of our study was to determine the injury incidence, site, type, and mechanism sustained during practices and games in Japanese mini-basketball players (<12 years old) during the 2013–2014 season.

METHODS

Participants

Ninety-five players (56 boys, 39 girls) on 7 community-based club teams (4 boys' teams, 3 girls' teams) of mini-basketball in Kobe, Japan, were involved in this study. The participants were elementary school third-grade to sixth-grade students with a mean age of 10.9 ± 1.0 years (boys = 11.1 ± 0.8 years, girls = 10.7 ± 1.1 years), height 142.2 ± 10.0 cm (boys = 143.3 ± 9.6 cm, girls = 140.9 ± 10.4 cm), and body weight 35.0 ± 7.8 kg (boys = 35.5 ± 8.2 kg, girls = 34.4 ± 7.4 kg). The participants on each club team were selected by the team's coaching staff. Mini-basketball is a game for boys and girls who are 11 years old or younger at the time of the competition.²⁰ However, in Japanese mini-basketball, elementary school-aged players are 12 years old or younger. A consent form was completed for each participant by the parent or guardian. This study was approved by the institutional review board at Aichi Toho University.

Definition of Injury

All injuries to team members during practices or games throughout the 2013–2014 period were recorded by team coaches or team-supporting parents. In this study, an *injury* was defined as any event, including trauma, overuse, or internal disease, related to sports, that conformed to 3 criteria¹⁶: (1) occurred during a regular practice or game, (2) led to a player missing any practice or game subsequent to the injury, and (3) caused the player to seek medical care from a physician or alternative medical specialist. Additionally, head or face injuries, including concussions, were registered even if the player did not miss a practice or game.¹⁶ A *traumatic injury* was defined as an injury resulting from an identifiable event (ie, an injury of sudden onset caused by body contact or contact with the ball, floor, or other object). An *overuse injury* was defined as an injury of gradual onset (associated with repetitive microtrauma) and without an identifiable responsible event. A *recurrent injury* was defined as an injury of the same type and at the same site as an index injury that occurred after a player's return to full participation following the initial injury. Illnesses or injuries that were not related to mini-basketball were not included.

Data Collection

Cooperation from the coaching staff and team-supporting parents was obtained for each team in this study because

the organizational resources are limited at this level of play and no medical staff are present. We explained the research to each coaching staffer and team-supporting parent. During the season from April 2013 to March 2014, team diary entries were recorded by each coaching staffer and team-supporting parent after every practice and game, and an injury survey was performed weekly by each coaching staffer and team-supporting parent. In the diary, information about team practices and games (ie, date, place, practice hours, number of games, number of players who participated in each practice and game) were recorded after every practice and game. For the injury survey, the injury date, place, area (head and neck, upper limb, trunk and back, lower limb, other), type, and mechanism (body contact, other contact, no contact) were recorded after a physician or alternative medical specialist determined the diagnosis. When a player got injured, the coaching staff or team-supporting parents provided first aid and took him or her to a sports clinic or regional hospital. We visited each team regularly to confirm that the team diary entries were being made and that the injury survey was being conducted. We also communicated regularly with the coaches of each team through e-mails and asked about compliance with the research.

Exposure and Incidence of Injury

Information regarding practices and games, including dates, places, times, number of games, number of players who were present at each practice and game, practice activities, names of coaching staff, and names of persons who did the recording were maintained in each team diary throughout the year. In official and cup mini-basketball games, a game is divided into four 6-minute periods with a 5-minute half-time interval. Two to three games occurred each day, depending on the game schedule and location. The specific amount of game and practice time in hours for each team was calculated from the team diary. Incidence of injury was calculated as the total number of injuries per 1000 hours of practice time based on real activity and per 1000 hours of game time as well as per 1000 hours of exposure (sum of practice and game hours).²¹ Game athlete-hours (AHs) were calculated from the total game hours and the number of players who participated in each game, and practice AHs were calculated from the total practice hours and the number of players who participated in each practice (Table 1). The game injury rate (GIR) and practice injury rate (PIR) were calculated by dividing the number of injuries by the number of hours per 1000 AHs; 95% confidence intervals (CIs) were calculated separately for practices and games. 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 calculated.

Statistical Analyses

Frequencies and χ^2 tests were used to determine the differences in proportions of the anatomical area affected, injury type, and injury mechanism during practices and games. The injury rate ratio (IRR) represented the relationship between the GIR and the PIR and was calculated as the GIR divided by the PIR. In general, if the 95% CI for the IRR includes 1, the IRR is not

Table 1. Practice and Game Athlete-Hours (AHs) in Japanese Mini-Basketball Teams, 2013–2014

Measure	Team							Total
	A	B	C	D	E	F	G	
Players, No.	14	13	15	15	12	14	13	96
Practices, No.	78	56	163	46	49	158	63	613
Practice AHs	2764.5	1366.5	7207.0	1649.0	1744.5	5483.0	1845.0	22059.5
Games, No.	64	26	56	62	44	48	43	332
Game AHs	340.4	106.8	326.4	344.0	157.6	217.6	209.4	1702.2
Total AHs	3104.9	1473.3	7533.4	1993.0	1902.1	5700.6	2054.4	23761.7

statistically significant; if the CI for the IRR does not include 1, the relationship is statistically significant.²² The CI for the IRR was used to determine the differences in the anatomical area affected, injury type, and injury mechanism during practices and games. If the observed χ^2 values exceeded the critical α level of .05, these were regarded as significant. The statistical procedures were accomplished using Excel 2012 for Windows (version 1.13; Microsoft Corp, Redmond, WA).

RESULTS

A total of 91 injuries occurred from April 2013 through March 2014. Of these, 69 injuries (75.8%) occurred during practices and 22 injuries (24.2%) occurred during games. The overall injury rate was 3.83/1000 AHs. The overall GIR and PIR were 12.92/1000 AHs and 3.13/1000 AHs, respectively, and the GIR was higher than the PIR ($\chi^2 = 5.971, P < .05$; Table 2).

The upper limbs were injured most frequently ($n = 39, 42.9\%$), followed by the lower limbs ($n = 22, 24.2\%$) and the head and neck (including the face; $n = 19, 20.9\%$; Table 3). The most common anatomical areas of injury during games were the head and neck (36.4%, 4.70/1000 AHs), followed by the upper limbs (27.3%, 3.52/1000 AHs) and the lower limbs (22.7%, 2.94/1000 AHs). During practices, the anatomical areas injured most often were the upper limbs (47.8%, 1.50/1000 AHs), followed by the lower limbs (24.6%, 0.77/1000 AHs) and the head and neck (15.9%, 0.50/1000 AHs). The GIRs for the head and neck (IRR = 9.43, 95% CI = 3.79, 23.44) and lower limbs (IRR = 3.81, 95% CI = 1.41, 10.33) were significantly higher than the PIRs for the same regions.

With regard to injury types, sprains ($n = 39, 42.9\%$) were most prevalent, followed by contusions ($n = 27, 29.7\%$; Table 4). During games, the most frequent types of injuries were contusions (40.9%, 5.29/1000 AHs), followed by sprains (36.4%, 4.70/1000 AHs) and wounds (9.1%, 1.17/1000 AHs). During practices, the injury types seen most often were sprains (44.9%, 1.41/1000 AHs), followed by contusions (26.1%, 0.82/1000 AHs). The GIRs for sprains (IRR = 3.34, 95% CI = 1.54, 7.27), contusions (IRR = 6.48, 95% CI = 2.91, 14.42), and wounds (IRR = 6.48, 95% CI =

1.19, 35.38) were significantly higher than the PIRs for the same injury types.

As for injury mechanism, other contact with the ball, floor, or other objects was most common ($n = 46, 50.5\%$), followed by body contact ($n = 24, 26.4\%$; Table 5). During games, body contact (45.5%, 5.87/1000 AHs) was the most frequent injury mechanism, followed by other contact (31.8%, 4.11/1000 AHs). During practices, other contact (56.5%, 1.77/1000 AHs) was the mechanism cited most often, followed by body contact (20.3%, 0.63/1000 AHs). The GIRs for body contact (IRR = 9.26, 95% CI = 4.11, 20.85) and other contact (IRR = 2.33, 95% CI = 1.04, 5.21) were significantly higher than the corresponding PIRs.

DISCUSSION

Incidence of Injury

Our prospective observational study examined the current status of injuries in Japanese mini-basketball players (≤ 12 years old). The overall incidence was higher during games than during practices, which is consistent with findings in other studies.^{11–13,15,16} Thus, we confirmed that basketball-related injury incidence was higher during games than during practices, regardless of age category or competitive level (eg, high school or collegiate).

The overall incidence in this group (3.83/1000 AHs) was similar to that in US high school basketball players (3.2/1000 AHs to 4.1/1000 AHs).^{13,15} As for participation level, older players are faster, heavier, and stronger, and they generate more force on contact, perhaps resulting in a greater risk of injury.^{23,24} In addition, the incidence of injury increases with grade or age level in boys in football, rugby, and soccer.^{23,24} This tendency seems to be sport specific in contact and collision sports. However, the overall incidence of injury does not appear to be related to grade or age level in basketball players. In light of the current findings, future researchers should examine correlates of injuries in different grade and age groups.

In our study, the overall GIR and PIR were 12.92/1000 AHs and 3.13/1000 AHs, respectively. The GIR in Japanese mini-basketball players was lower than that in US high school basketball players (16.0/1000 AHs to 16.9/1000 AHs).^{15,23} The lower GIR we found may reflect a lower intensity of competition than in high school players. However, the PIR (3.13/1000 AHs) was 1.6 to 1.7 times higher than that in US high school basketball players (1.8/1000 AHs to 2.0/1000 AHs),^{15,23} suggesting problems with training conditions (eg, the number of days, duration, and coaching methods) that may lead to an injury-prone practice environment for Japanese mini-basketball players. Additionally, athletes in this study may have lacked injury-

Table 2. Total Injury Rates in Japanese Mini-Basketball Teams, 2013–2014

Measure	n	Injury Rate (95% Confidence Interval)	Game : Practice Rate Ratio (95% Confidence Interval)
Practices	69	3.13 (2.39, 3.87)	
Games	22	12.92 (7.52, 18.32)	
Total	91	3.83 (3.04, 4.62)	4.13 (2.56, 6.67) ^a

^a Difference was significant: $P < .05$.

Table 3. Injury Rates (IRs) by Anatomical Area in Japanese Mini-Basketball Teams, 2013–2014

Anatomical Area	Practices		Games		Game : Practice Rate Ratio (95% CI)	Total	
	n (%)	IR (95% CI)	n (%)	IR (95% CI)		n (%)	IR (95% CI)
Head and neck	11 (15.9)	0.50 (0.20, 0.79)	8 (36.4)	4.70 (1.44, 7.96)	9.43 (3.79, 23.44)	19 (20.9)	0.80 (0.44, 1.16)
Upper limb	33 (47.8)	1.50 (0.99, 2.01)	6 (27.3)	3.52 (0.70, 6.34)	2.36 (0.99, 5.63)	39 (42.9)	1.64 (1.12, 2.16)
Trunk and back	1 (1.4)	0.05 (0.00, 0.14)	0 (0.0)	0 (0.0)	0.00	1 (1.1)	0.04 (0.00, 0.12)
Lower limb	17 (24.6)	0.77 (0.40, 1.14)	5 (22.7)	2.94 (0.37, 5.51)	3.81 (1.41, 10.33)	22 (24.2)	0.93 (0.54, 1.32)
Other	7 (10.1)	0.32 (0.08, 0.56)	3 (13.6)	1.76 (0.00, 3.75)	5.55 (1.44, 21.46)	10 (11.0)	0.42 (0.16, 0.68)

Abbreviation: CI, confidence interval.

avoidance skills or could have been pursuing training that was overly intense. Furthermore, most mini-basketball players participate in only 1 sport throughout the year in Japan, unlike in the United States, where different sports are available depending on the season. The higher PIR we found might be the result of sport specialization in Japan.

Injury Sites and Injury Types

In our study, most injuries affected the upper limbs (42.9%), which is inconsistent with findings of other studies,^{11–16} which have demonstrated that the lower limbs were the most commonly injured areas in high school or collegiate basketball players. The patterns may be affected by age, suggesting that a specific feature of playing mini-basketball at the elementary school-aged level caused more upper limb injuries.

The most frequent anatomical areas of injury during games were the head and neck, including the face (36.4%). The GIR to this area was significantly higher (4.70/1000 AHs) than the PIR (0.50/1000 AHs). Such anatomical patterns of injury are different from those seen in previous research (high school: lower extremities = 66.2% to 66.5%; collegiate: lower extremities = 57.9% to 60.8%).^{11,12,17} Possible reasons for such differences are variations in growth and developmental levels among elementary school-aged players. In particular, prominent height growth is often seen around the time of peak height velocity.²⁵ The resulting considerable differences in height may increase the risk of head and face injuries in short players.

During practices, the most common anatomical areas of injury were the upper limbs, which is inconsistent with other findings.^{11,12,17} According to those authors, the anatomical areas injured most often during practices were the lower extremities (high school: lower extremities = 69.6% to 78.4%; collegiate: lower extremities = 60.6% to 65.6%).^{11,12,17} Junior players at the elementary school-aged level may not have established skills (eg, ball handling) and may tend to watch the ball only while playing. Inattention

to the surroundings could increase the risk of physical contact.

Sprains were the most prevalent type of injury and accounted for 42.9% of overall injuries, followed by contusions (29.7%). These findings agree with those of previous investigations^{15,16} in high school basketball players (sprains = 44.8% to 56.0%, contusions = 15.0% to 24.8%), indicating that sprains and contusions are common injuries in junior or youth basketball players, irrespective of age or competitive level. Injury-prevention measures, such as improving injury-avoidance skills when landing, jumping, and falling; ball-handling skills while moving; and balancing ability need to be addressed.

Injury Mechanism

The most frequent injury mechanism during games was body contact (45.5%), which is consistent with findings of other studies.^{11,12} We could not compare these results with those in younger youth basketball players because of a lack of relevant data. Higher levels of aggressiveness and more body contact are expected during games, regardless of age or competitive level.

However, the most common injury mechanism during practices was other contact with the ball, floor, or other objects (56.5%), which is inconsistent with findings of other studies.^{11,12} Possible reasons for this difference are individual variations in growth among elementary school-aged players. In addition, the official ball size (no. 5: circumference = 69 to 71 cm, diameter = 22 cm, weight = 470 g to 500 g) may be too big or heavy (or both) for some players. Therefore, body control on falling after losing balance may be insufficient, resulting in contact of the hands with the floor.

Basketball players in junior high schools, as well as those in elementary schools, have rarely been examined, either in Japan or overseas. An upward international trend in junior and youth athletic injuries is occurring, and basic epidemiologic data are essential to establish a safe sporting environment for these players. Preventive measures are

Table 4. Injury Rates (IRs) by Injury Type in Japanese Mini-Basketball Teams, 2013–2014

Injury Type	Practices		Games		Game : Practice Rate Ratio (95% CI)	Total	
	n (%)	IR (95% CI)	n (%)	IR (95% CI)		n (%)	IR (95% CI)
Sprain	31 (44.9)	1.41 (0.92, 1.90)	8 (36.4)	4.70 (1.44, 7.96)	3.34 (1.5, 7.27)	39 (42.9)	1.64 (1.12, 2.16)
Strain	2 (2.9)	0.09 (0.00, 0.22)	0 (0.0)	0	0.00	2 (2.2)	0.08 (0.00, 0.20)
Contusion	18 (26.1)	0.82 (0.44, 1.20)	9 (40.9)	5.29 (1.84, 8.74)	6.48 (2.91, 14.42)	27 (29.7)	1.14 (0.71, 1.57)
Fracture	4 (5.8)	0.12 (0.00, 0.36)	0 (0.0)	0	0.00	4 (4.4)	0.17 (0.01, 0.33)
Osgood-Schlatter syndrome	3 (4.3)	0.14 (0.00, 0.29)	0 (0.0)	0	0.00	3 (3.3)	0.13 (0.00, 0.27)
Wound	4 (5.8)	0.18 (0.00, 0.36)	2 (9.1)	1.17 (0.00, 2.80)	6.48 (1.19, 35.38)	6 (6.6)	0.25 (0.05, 0.45)
Other	7 (10.1)	0.32 (0.08, 0.55)	3 (13.6)	1.76 (0.00, 3.75)	5.55 (1.44, 21.46)	10 (11.0)	0.42 (0.16, 0.68)

Abbreviation: CI, confidence interval.

Table 5. Injury Rates (IRs) by Injury Mechanism in Japanese Mini-Basketball Teams, 2013–2014

Injury Mechanism	Practices		Games		Game : Practice Rate Ratio (95% CI)	Total	
	n (%)	IR (95% CI)	n (%)	IR (95% CI)		n (%)	IR (95% CI)
Body contact	14 (20.3)	0.63 (0.30, 0.96)	10 (45.5)	5.87 (2.23, 9.51)	9.26 (4.11, 20.85)	24 (26.4)	1.01 (0.61, 1.41)
Other contact	39 (56.5)	1.77 (1.22, 2.32)	7 (31.8)	4.11 (1.06, 7.16)	2.33 (1.04, 5.21)	46 (50.5)	1.94 (1.38, 2.50)
No contact	8 (11.6)	0.36 (0.11, 0.61)	2 (9.1)	1.17 (0.00, 2.80)	3.24 (0.69, 15.26)	10 (11.0)	0.42 (0.16, 0.68)
Other or unknown	8 (11.6)	0.36 (0.11, 0.61)	3 (13.6)	1.76 (0.00, 3.75)	4.86 (1.29, 18.32)	11 (12.1)	0.46 (0.19, 0.73)

Abbreviation: CI, confidence interval.

based on epidemiologic research, and the first step in injury prevention is to establish the extent of the injury in elementary school-aged basketball players. For mini-basketball teams, no medical staff, such as an athletic trainer or physical therapist, are present to provide medical care during practices and games. Because of the higher risk of injury in mini-basketball, especially during games, medical staff should be on-site to provide appropriate medical care. Given the prevalence of lower limb injuries in youth athletes who specialize in basketball, football, and handball, injury-prevention programs focusing on the lower limb have been proposed.^{26–30} Yet in our study, the head and neck (including the face) were injured most frequently during games and the upper limb was injured most frequently during practices, which could reflect a specific feature of mini-basketball players. Therefore, intervention programs focusing on preventing head and neck (including the face) and upper limb injuries should be implemented for mini-basketball players.

Limitations

We examined only 5 categories of anatomical areas of injury (head and neck, upper limb, trunk and back, lower limb, other) and 4 categories of injury mechanisms (body contact, other contact, no contact, other or unknown), which are important for an in-depth analysis of injury types and mechanisms. We did not collect information on injury severity (minor, moderate, major) or time to return to play because medical staff, such as athletic trainers, were unavailable to the club teams. In contrast, US high school and collegiate basketball teams are typically well organized, often employing both a coaching staff (including a head coach and an assistant coach) and a medical staff (including an athletic trainer or a physical therapist). The medical staff can record injury data during practices and games and develop an injury-surveillance system for the team. Although many junior sports teams exist at the elementary school-aged level in Japan, they are not as well organized as US high school and collegiate teams. It is very difficult for Japanese mini-basketball teams to conduct injury surveys because no injury-reporting system such as the National Athletic Injury/Illness Reporting System (NAIRS)¹⁶ is available for collecting and storing a large volume of injury data, and medical staff are absent. Also, elementary school-aged teams are supervised by their coaching staff and parents and guardians but not by athletic trainers. The number of teams that can be regularly visited by researchers is limited, which affects the reliability of injury surveys. The observation period of epidemiologic injury studies in Japan should be extended over several years to establish a safe sporting environment for junior and youth athletes in the future.

CONCLUSIONS

To our knowledge, this is the first injury survey to investigate Japanese elementary school-aged mini-basketball players throughout the year using a time unit: 1000 AHs. The overall injury incidence was higher during games than during practices. A unique finding of this study was that the PIR was higher in Japanese mini-basketball players than in US high school players. Also, the head and neck injury rate was highest during games, whereas the upper limb injury rate was highest during practices. Sprains and contusions were common injuries, and most game injuries resulted from body contact, but most practice injuries resulted from other contact.

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