

# Early Sport Specialization Trends and Injuries in Former High School Athletes Specialized in Sports

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**Purpose:** Determining the effects of early specialization in a specific sport is difficult. Therefore, it is necessary to investigate its effects based on the type of sports. The purpose of this study was to investigate the proportion of participants who had been participating in a single sport, in individual or team sports from an early age and to compared the prevalence of acute and overuse injuries among these participants.

**Methods:** A total of 1377 adult participants (team sports = 700, individual sports = 637) retrospectively completed a questionnaire assessing sports participation from elementary school to high school and injury history (acute and overuse) at high school age. The proportions of the specialized / nonspecialized groups per sport type were compared, and differences in acute or overuse injury prevalence were examined.

**Results:** The proportion of the specialized group participants who continued to play the same single sport from elementary school age to high school age was greater in team sports (33.6%) than that in individual sports (19.2%) ( $p < 0.01$ ). The specialized group participating in team sports had a greater prevalence of overuse injury at high school age than the nonspecialized group ( $p < 0.05$ ) who previously participated in several sports. However, the prevalence of overuse injury at high school did not significantly differ between the specialized and nonspecialized groups participating in individual sports.

**Conclusion:** More children who continued to play only one sport from elementary school age to high school age played in team sports in Japan. They also had a higher prevalence of overuse injuries when they were at high school age. It is necessary to consider the environment to play multi sports before high school age, especially in team sports.

**Keywords:** children, injury and prevention, musculoskeletal, youth, history

## Introduction

In recent years, avoiding early specialization in sports has been recommended for the physical and mental wellbeing of young athletes.<sup>1</sup> Sports specialization is defined as “intense, year-round training in a single sport at the exclusion of other sports”.<sup>1,2</sup> Sport specialization in athletes younger than 18 years of age has also been reported as risk factor for musculoskeletal overuse injuries.<sup>3</sup> As an evaluation method for early specialization, the three-point Jayanthi scale,<sup>1,2</sup> which is based on the responses to 3 yes/no questions about sports specialization (year-round training, choosing a main sport, and quitting other sports), is used by scholars and researchers. Although this scale can be used to determine the degree of specialization of the subject at a point in time, it is not suitable for investigating the effects of the continuation of specialization or focus on a specific sport from an early stage. In addition, it is difficult to determine specialization by the above scale because each sport is generally played year-round, as is the case in Japan. Instead, in a previous studies in Japan, the proportion of single-sport and multisport players was reported according to the number of sports played. The results showed that the number of multisport players decreased significantly after junior high school,<sup>4,5</sup> and playing multiple sports was associated with fewer overuse injuries.<sup>4</sup> The reason for the limited presence of multiple sports in Japan may be due to the fact that year-round sports activities are common in Japan, making it difficult to participate in multiple sports at the same time. As a result, the children may continue to play only a single sport from their elementary school age, resulting in early specialization and possibly increased injuries when they focus on competition in the high school age.

According to another study,<sup>6</sup> the degree of early specialization is higher in individual sports. Furthermore, the specialization group in individual sports had more chronic disorders and fewer acute injuries than the specialization group in team sports.<sup>6</sup> This study reported the different effects of early specialization depending on the sport type; however, different results are expected depending on the sports circumstances and culture of each country. For example, in Japan, basketball, baseball, soccer, and volleyball are the most common team sports, whereas tennis and kendo are the most common individual sports.<sup>4</sup> These results differed from those of the previous study.<sup>6</sup> Since the early specialization and its effects are different in each sport type, a further study needs to be conducted in countries where different sports are popular.

Therefore, the purpose of this study was to clarify the proportion of participants who continued participating in a single sport in individual or team sports from an early age and compared the prevalence of acute and overuse injuries among these participants. As a hypothesis, it is expected that the proportion of those who continue to play only one sport from elementary school age to high school age is higher for individual sports, and overuse injuries will increase at high school age if the athletes have continued to specialize in one sport from an early age. It is thought that this is due to the repetition of the same athletic movements, which place a continuous load on the same part of the body.

## Materials and Methods

### Study Setting

This cross-sectional study retrospectively analyzed the data obtained from a web-based questionnaire survey and the data collected in a previous study.<sup>4</sup> Details on the sample size setting can be found in the previous study.<sup>4</sup> This study was approved by the ethical review board of Japan Women's College of Physical Education and complied with the ethical principles of the Declaration of Helsinki. All participants electronically consented to participate in this study before answering the questionnaires.

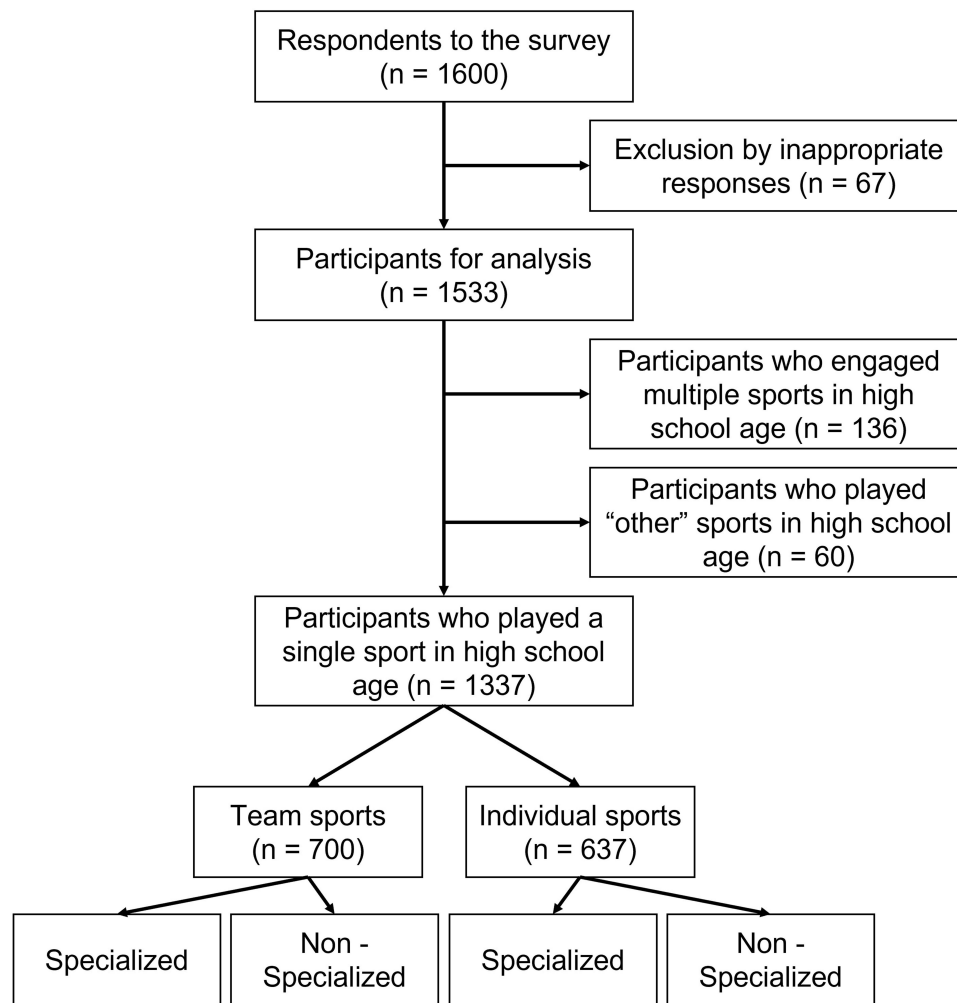
### Electronic Questionnaire

Questionnaire details can also be found in the previous study.<sup>4</sup> The questionnaire proceeds to the main questions if the participants continued sports activity from elementary school to high school. The main questions assessed the history of acute and overuse injuries. Participants selected the presence or absence of injury at each school age using the check box with the following question "Please select the age and location of all sport-related acute injuries you have experienced (that occurred suddenly and required >1 week of rest)" or "Please select the age and location of all sports overuse injuries you have experienced. (that had occurred gradually and restricted playing regardless of the duration)." Answers to these questions were considered only from the data of the high school age for the study analysis. We defined acute injury and overuse injury according to the previous study as described above.<sup>4</sup>

### Participants

The questionnaire was randomly distributed among people registered with a web questionnaire supplier (Rakuten Insight Inc.) in June 2020 to recruit 1600 participants.<sup>4</sup> The participants were classified as shown in Figure 1. From the total of 1600 respondents, 67 participants were excluded because of inappropriate answers. We also excluded participants who engaged in multiple sports at high school age ( $n = 136$ ) and who played "other" sports at high school age ( $n = 60$ ). Most of these participants played a single sport in high school, and in order to standardize the participants, we excluded those who engaged in multiple sports at high school age. In addition, participants who selected "other" were excluded because it was not possible to distinguish between individual or team sports.

The participants who played a single sport at high school age ( $n = 1337$ ) were divided into team sports ( $n = 700$ ) and individual sports ( $n = 637$ ). The division was based on previous studies,<sup>6,7</sup> in which team sports were those in which several athletes competed at the same time, and individual events were those in which a single athlete (or a pair of athletes) competed. The team sports included handball, volleyball, basketball, softball, baseball, soccer, lacrosse, rhythmic gymnastics, dance, cheerleading, and cheer dance. The individual sports included track and field, swimming, tennis, soft tennis, badminton, table tennis, gymnastics, ballet, fencing, archery, naginata, kendo, karate, and skiing. Additionally, we divided the two groups by specialized and nonspecialized. The specialized group was defined as participants who continued a single specific sport from elementary school



**Figure 1** Inclusion and categorization of participants.

age to high school age. Besides the specialized group, the nonspecialized group was the one who had previously experienced any other sports before high school age.

## Statistical Analysis

The proportion of the specialized/nonspecialized groups among team and individual sports were calculated and compared using the chi-square test, with effect sizes calculated as Phi ( $\phi$ ). Injury prevalence was calculated for all acute injuries and all overuse injuries among team and individual sports. Differences in acute or overuse injury prevalence in the specialized/nonspecialized groups were examined using the chi-square test, with effect sizes calculated as Phi ( $\phi$ ) each for team and individual sports, respectively. All statistical analyses were performed using SPSS statistics version 19.0 for Windows (IBM; Brush Prairie, WA, USA).

## Results

The characteristics of participants and proportion of specialized/nonspecialized athletes among team or individual sports is shown in [Table 1](#). A total of 33.6% of athletes participating in team sports were in the specialized group, compared to 19.2% of the athletes in individual sports. There was a statistically significant difference in the proportion of athletes among team or individual sports ( $p < 0.001$ , Phi ( $\phi$ ) =  $-0.163$ ). Proportion of specialized athletes by sports in team or individual sports is shown in [Table 2](#). Differences in acute or overuse injury prevalence in the specialized/nonspecialized groups is shown in [Figure 2](#). In team sports, there was no significant difference in the prevalence of acute injury at high school age between the specialized and nonspecialized

**Table 1** Characteristics of Participants

	Team Sports	Individual Sports	P value
Participants, N	700	637	
Males, N (%)	393 (56.1)	270 (42.4)	< 0.001
Age, y	30.1±5.2	30.3±5.1	n.s.
Specialized athletes, N (%)	235 (33.6)	122 (19.2)	< 0.001
Nonspecialized athletes, N (%)	465 (66.4)	515 (80.8)	

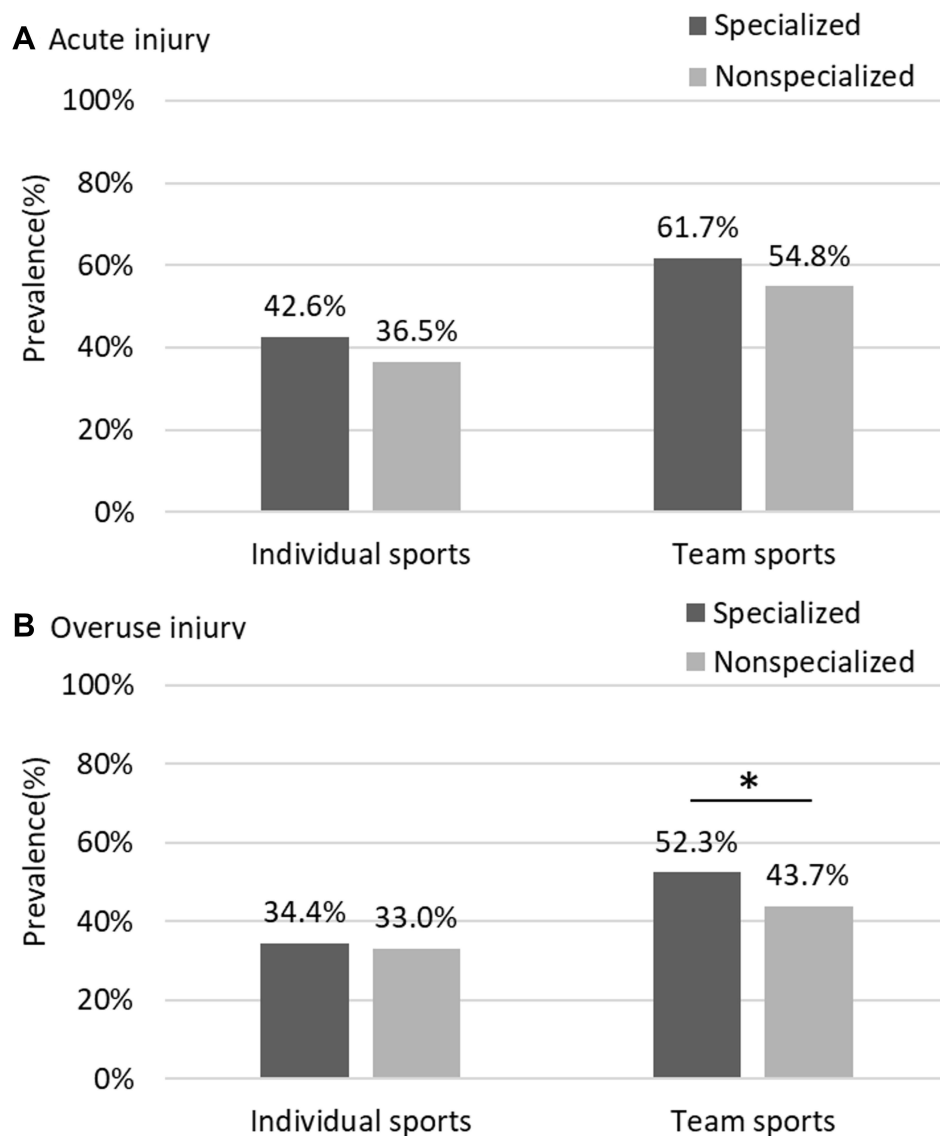
**Table 2** Specialized Athletes by Sports, N (%)

Team Sports		Individual Sports	
Volleyball	39/104 (37.5%)	Tennis	13/120 (10.8%)
Basketball	56/97 (57.7%)	Badminton	13/90 (14.4%)
Soccer	70/75 (93.3%)	Track and field	26/67 (38.8%)
Baseball	60/74 (81.1%)	Soft tennis	7/56 (12.5%)
Dance	3/38 (7.9%)	Table tennis	13/48 (27.1%)
Handball	2/33 (6.1%)	Swimming	26/40 (65.0%)
Softball	0/24 (0.0%)	Archery (Japanese archery)	0/34 (0.0%)
Cheer leading	1/8 (12.5%)	Kendo	16/28 (57.1%)
Rhythmic gymnastics	3/7 (42.9%)	Gymnastics	1/9 (11.1%)
Cheer dance	1/3 (33.3%)	Ballet	7/7 (100.0%)
Lacrosse	0/2 (0.0%)	Skiing	0/7 (0.0%)
		Karate	0/6 (0.0%)
		Naginata	0/2 (0.0%)
		Fencing	0/1 (0.0%)

groups, while athletes in the specialized group had a greater prevalence of overuse injuries at high school age than nonspecialized athletes ( $p < 0.05$ ,  $\Phi (\varphi) = 0.082$ ). In individual sports, there was no significant difference in the proportion of those who had acute and overuse injuries at high school age between the specialized and nonspecialized groups.

## Discussion

In the present study, the proportion of participants who specialized early and continued a single sport was clarified, in terms of whether they participated in team or individual sports. Based on the situation in Japan, we examined the proportion of participants who continued to play only one sport from elementary school age to high school age and those who did not. In contrast to a previous studies in which the degree of specialization was higher in individual sports<sup>6</sup> or not differ between team and individual sports,<sup>8</sup> in this study the proportion of participants who continued to play a single sport was higher for team sports than for individual sports in Japan (33.6% and 19.2%, respectively). This result differs from our hypothesis. The reason for the lower proportion of specialized groups in individual sports may be due to the difference in the sport activities that are being conducted. In the previous study, tennis, gymnastics, and dance were classified as the common as single conducted sports,<sup>6</sup> but in Japan, gymnastics and dance are rarely practiced as a single sport.<sup>4</sup> In addition, dancing at junior high schools and high schools in Japan is mainly a group performance, so it was classified as team sports in this study. Among individual sports in Japan, a high proportion of participants in swimming and kendo continued to play a single sport from early on in their careers, while in other sports they often experienced more than one sport.



**Figure 2** Differences in acute or overuse injury prevalence in specialized/nonspecialized groups. (A) acute injury, (B) overuse injury. \* $p < 0.05$ .

With regard to team sports, similar to a previous study,<sup>6</sup> basketball, baseball, volleyball, and soccer are often played as a single sport in Japan.<sup>4</sup> Therefore, the high proportion of a specialized group is not due to differences in sports activities, but to the circumstances of the way team sports is implemented in Japan, where there are few opportunities to play other sports and difficulty in moving to other sports. The percentage of baseball players who quit other sports during childhood or who have participated in other sports in the US was 44.5%,<sup>9</sup> and the percentage of high specialization among subjects aged 12–18 was 35.9% in basketball<sup>10</sup> and 35.2% in soccer.<sup>10</sup> Since the questions are different, we cannot make a simple comparison as performed in the previous study. In contrast, team sports in Japan (especially baseball, soccer, and basketball, which have large populations) are specialized from a younger age—from 6 to 12 years old at elementary school age. In the Long-Term Athlete Development Model, early specialization in ball sports is not recommended,<sup>11</sup> and it is necessary to consider the environment for sports to play multiple sports in the elementary and junior high school years.

In the present study, we clarified the prevalence of acute injury and overuse injury in the participants at high school age who continued to participate in only one sport from elementary school age to high school age and those who did not. The prevalence of overuse injury was higher in the group that specialized in a single team sport. Previous studies,<sup>8</sup> which

do not specify the type of sports, suggest that early sports specialization can be a potential factor in occurrence of early sports-related injuries. This is probably due to the repetition of the same movements in the sport over a long period of time. As mentioned above, there is a high tendency in Japan to continue playing a single sport for a long period of time in team sports. Therefore, it may be necessary to increase the opportunities to be exposed to other sports before reaching high school age to reduce the risk of injuries when children specialize in sports in their high school years. On the other hand, there was no difference in acute injury between the group that specialized and the group that did not in both team and individual sports. In the previous study,<sup>6</sup> the group that specialized early in team sports had more acute injuries, probably because the team sports included sports with a high risk of acute injuries, such as American football and cheerleading. Other studies have also shown that early specialization increases overuse injury,<sup>3,12–15</sup> but not acute injury,<sup>14</sup> and the results of this study are consistent with those reports.

There are several limitations to this study. First, this study was a cross-sectional study using a self-reported questionnaire that required participants to recall information. Therefore, recall bias is a concern. To decrease the effect of recall bias, we limited the age of the participants to their 20s and 30s. Nonetheless, it is possible that participants may not recall the injury and underestimate or misrepresent their acute and overuse injuries. Secondly, data on the details of the injury, such as whether it was a first or recurrent injury, the mechanism of injury, and the duration of absence, were not collected. Since the major risk of injury in a particular injury is previous injuries,<sup>16</sup> it is necessary to examine the risk of repeated acute and overuse injury due to early specialization. The mechanism of injury (contact or non-contact) and the severity of injury should also be examined in the future, adding the aspect of sports specialization.

## Conclusion

It was found that the proportion of participants that continued to play in a single sport differed between team sports and individual sports, and that it was greater for team sports. The group that specialized in team sports was also associated with a higher prevalence of overuse injuries when they were in high school. These findings suggest that it is necessary to consider the environment for sports before high school age especially with regard to team sports.

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## Disclosure

The authors declare that they have no potential conflicts of interest for this work.

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