

**Title page**

**Regular Article**

**Title:** Assessment of adverse events and near-misses during voluntary community-driven sports activities by community residents: A cross-sectional study

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**Number of Figures:** 1

**Number of Tables:** 6

**Running Title:** Adverse events and near-misses in community sports

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## **Abstract**

Although physical activities have many health benefits, adverse events and near-misses, such as injuries and falls, can occur during these activities. This study aimed to assess the occurrence of adverse events and near-misses during sports activities conducted independently by community residents. A survey questionnaire was sent via the internet to the leaders or directors of sports organizations at six public sports centers or associations. In total, 108 individuals answered the survey, with 60% male and 40% female respondents. Individuals aged 50–69 years accounted for 60% of the total number of respondents. All respondents were asked about their experiences of adverse events and near-misses within the past three years: the reports of these incidents were obtained using the recall method. Duplicate adverse events and near-misses were identified based on the sports discipline; time of occurrence; and sex and age of person involved to determine if there were duplicate reports. Most of the respondents' activities as staff were performed once a month, with each activity lasting 1–2 h. Forty-five adverse events were reported, including 26 injuries, 13 falls, and 6 others (such as heat stroke, vertigo, and presyncope). Twenty-four near-misses were reported, including 12 near-collisions with people or objects, five near falls, and seven other incidents. We found that approximately 30% of the respondents experienced adverse events, suggesting the need for documentation of adverse events, implementation of safety measures, and proper safety education for operating staff.

**Keywords**

athletic injuries, accidental falls, ankle sprain, heat stroke, recreation

タイトル

地域住民が主体的に実施するスポーツ活動中の有害事象やヒヤリハットの評価：横断的研究

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要旨

身体活動・運動は、健康上の利点が数多くある一方で活動中には傷害や転倒などの有害事象およびヒヤリハットが発生している。本研究では、地域住民が主体的に実施する身体活動・運動中に発生した有害事象およびヒヤリハットの発生状況を明らかにすることを目的とした。調査方法は、6つの公共スポーツ団体・公共スポーツセンターの運動指導者または運動支援者を対象にオンラインアンケートを実施した。オンラインアンケートでは、過去3年間以内の有害事象・非谷内ハットについての経験を尋ね、想起法を用いて報告を得た。報告された有害事象・ヒヤリハットについては、ス

スポーツ種目、発生時期、関係者の性別・年齢をもとに重複報告がないかどうか確認した。オンラインアンケートの回答者は108名で、男性60%、女性40%であった。50-69歳の回答者が全体の60%を占めた。回答者の運動指導者・運動支援者としての活動は、ほとんどが月1回、1回の活動時間は1-2時間で、有害事象は45件報告された。有害事象の内訳は、けが26件、転倒13件、その他（熱中症、めまい、意識障害など）6件であった。また、ヒヤリハットは24件報告され、その内訳は、人や物と衝突しそうになった12件、転倒しそうになった5件、その他7件だった。この結果から、回答者の約30%が有害事象を経験していることがわかり、有害事象の記録を残す、安全対策の実施、運営スタッフへの適切な安全教育の必要性が示唆された。

キーワード

スポーツ外傷・障害、転倒、足関節捻挫、熱中症、レクリエーション

## 1 **Introduction**

2 The benefits of physical activity are numerous. The physical activity guidelines<sup>1,2</sup> reported  
3 positive effects of regular and moderate-intensity physical activity on mortality,  
4 cerebrovascular and coronary artery disease, hypertension, stroke, osteoporosis, type 2  
5 diabetes mellitus, metabolic syndrome, obesity, some types of cancer, depression, cognitive  
6 functions, and falls.

7 On the other hand, musculoskeletal injuries, cardiovascular events, and sudden death have  
8 been noted during these physical activities.<sup>2</sup> Reports of adverse events during sports activities  
9 included those involving athletes<sup>3-5</sup> and relatively high-intensity exercise, such as  
10 international athletic competitions.<sup>6-8</sup> They also included adverse events involving exercise  
11 therapy at medical institutions,<sup>9,10</sup> those involving local residents such as students,<sup>11,12</sup> and  
12 large-scale events such as marathons.<sup>13-15</sup> There have been reports on assessing adverse  
13 events during independent sports activities. In studies involving athletes, the frequency of  
14 occurrence was presented as the number of athletic injuries per activity day or hour. However,  
15 reports focusing on local residents are limited to school classes, extracurricular club activities,  
16 and large-scale events. This may be because local residents engage in a wide variety of sports  
17 activities as they gather together voluntarily and daily, making it difficult to accurately assess  
18 the status of their activities. Therefore, the actual status of injuries, accidents, and other  
19 adverse events during sports activities that were voluntarily and routinely done by local

20 community gatherings is unknown.

21 Regarding safety measures at sports sites, athletes and exercise therapy providers often have a  
22 full medical system for pre-exercise medical checkups and adverse events during activities  
23 due to their nature. However, in sports activities in group gatherings voluntarily conducted by  
24 local residents, it can be expected that medical systems might be insufficient. In addition, it is  
25 necessary to understand the actual situation and take safety measures accordingly, because it  
26 is assumed that there would be people who exercise with underlying diseases and a history of  
27 exercise injury.

28 There are several adverse effects that might occur during physical activity aside from the  
29 effects on the physical and mental health of the person involved. According to health  
30 behavior science, it has been pointed out that injuries and poor physical condition during  
31 physical activity can be the cause of slips (one-shot interruptions<sup>16</sup>), lapses (short-term  
32 interruptions), and relapses (long-term interruptions<sup>17</sup>) of exercise habits.<sup>18</sup> From a  
33 socioeconomic perspective, a study conducted in 2012 in the Netherlands reported that the  
34 indirect costs of medical expenses and lost productivity due to sports-related injuries were the  
35 third largest cost factor after household and traffic accidents.<sup>19</sup>

36 Sakae Ward, Yokohama City has been certified as a Safe Community, which is an  
37 international certification since October 2013. Safe Community is a program in which  
38 communities take to prevent accidents and injuries through cross-sectoral collaboration,



39 based on the idea that fatal accidents and injuries can be prevented by identifying their causes.  
40 The certification is granted after an assessment based on the indicators presented by the  
41 International Non-Governmental Organization (NGO) Safe Communities Certification Center  
42 (formerly World Health Organization [WHO] Collaborating Centre on Community Safety  
43 Promotion). In Sakae Ward, subcommittees have been established for eight themes: (i) child  
44 safety, (ii) sports safety, (iii) traffic safety, (iv) child abuse prevention, (v) safety for the  
45 elderly, (vi) disaster safety, (vii) suicide prevention, and (viii) crime prevention. In addition,  
46 the injury surveillance subcommittee has been collecting data through specialized measures.<sup>20</sup>  
47 The authors, commissioned by Sakae Ward, Yokohama City, have been cooperated with the  
48 Taskforce Committee for Sports Safety, Sakae Ward Safe Community, Yokohama City, to  
49 investigate adverse events and implementing safety measures during voluntary sports  
50 activities by Sakae Ward residents since 2019. Therefore, this study aimed to evaluate the  
51 occurrence and trends of adverse events and near-misses during community-driven physical  
52 and sports activities in groups that were voluntarily conducted by Sakae Ward residents. This  
53 evaluation was based on a questionnaire survey conducted by the Taskforce Committee for  
54 Sports Safety, Sakae Ward Safe Community, Yokohama City.

55

## 56 **Methods**

57 This is a descriptive epidemiological study that analyzed data from an online questionnaire.

58

## 59 Participants

60 The questionnaire targeted leaders and directors who were active in the member  
61 organizations of the Taskforce Committee for Sports Safety, Sakae Ward Safe Community,  
62 Yokohama City. The leader mainly conducts sports coaching and on-site management, while  
63 the director mainly supports the leader. The member organizations were the following: Sakae  
64 Ward Sports Association, Sakae Ward Sports Promotion Committee, Sakae Ward Youth  
65 Instructors Council, Sakae Ward Sawayaka Sports Promotion Committee, Nonprofit  
66 organization (NPO) Sakae Sports Club, and Sakae Sports Center.

67 The research team analyzed the data provided by Sakae Ward from the results of  
68 questionnaires administered to the survey participants. The 108 respondents who completed  
69 the survey were included in the study. Figure 1 summarizes the process for selecting analysis  
70 adverse events and near misses. This study was conducted upon the approval of the Ethical  
71 Review Committee of Sports Medicine Research Center at Keio University (approval  
72 number: 2020-03).

73 **Fig. 1.** Flowchart of selecting analysis adverse events and near misses

74

## 75 Questionnaire

76 The online questionnaire form, created using Yokohama City electronic application system,

77 was sent by e-mail through the Taskforce Committee for Sports Safety, Sakae Ward Safe  
78 Community, Yokohama City. The response period was from November 2020 to January 2021.  
79 The questions were designed to ask about experiences of adverse events and near-misses  
80 during sports activities within the past 3 years.

81 There were three main questions. The first question was about the personal attributes of the  
82 respondents (leaders and directors): organization, age, gender, sports discipline, exercise  
83 teaching experience, qualifications held, frequency of activities as leader/director, and  
84 number of people taught per session. The second question was about experience of adverse  
85 events: presence or absence of occurrence, circumstances at the time of occurrence, response  
86 after the occurrence, age, gender, and sports discipline of the person concerned. The third  
87 question was about near-misses: presence or absence of occurrence, circumstances of  
88 occurrence, age, sex, and sports discipline of the person concerned. Details of these survey  
89 items are given in Appendix Table 1. For those survey targets who were not familiar with the  
90 online questionnaire, Sakae Ward Office staff interviewed them by phone and entered  
91 responses on their behalf. After excluding personal information, the survey results were  
92 received by a research team at the Sports Medicine Research Center, Keio University, for data  
93 analysis. Note that sports activities in this study include physical activities such as walking  
94 and recreational activities such as athletic events. With reference to the definition used in the  
95 Japanese report<sup>21</sup>, adverse events were defined as any unfavorable events, such as accidents,

96 injuries, or illnesses that occurred to participants physically or mentally during exercise or  
97 physical activity. Furthermore, near-misses were defined as incidents that did not cause  
98 physical or mental harm to participants, but caused a "near-miss" or "aha" experience for  
99 instructors or supporters in the field of practice.<sup>21</sup>

100

#### 101 Statistical analysis

102 Data were described in terms of frequency (%) for nominal scale data, and  $\chi^2$  test or Fisher's  
103 exact probability test was performed as necessary. Proportional scale data, such as years of  
104 experience, were expressed as medians (interquartile range). The number of adverse event  
105 occurrences per 10 activities and per 1000 activity h were obtained by calculating the number  
106 of activities (times/month), activity h (hours/hour), and number of people/activity (persons/h)  
107 based on the activities of the leader/director who reported the adverse event. The  
108 questionnaire results were analyzed using IBM SPSS Statistics ver. 27 (IBM, Chicago, IL).

109

#### 110 **Results**

##### 111 Attributes of survey respondents (leaders and directors)

112 A questionnaire survey addressed leaders and directors who were active in the member  
113 organizations of the Taskforce Committee for Sports Safety, Sakae Ward Safe Community,  
114 Yokohama City. As a result, 108 respondents were recruited. Sixty-five (60.2%) respondents

115 were men and 43 (39.8%) were women. The age distribution of the respondents was 31  
116 (28.7%) in their 50–59 of age and 35 (32.4%) in their 60–69, showing that the respondents in  
117 this survey were relatively older adults. In terms of the positions of the respondents, the  
118 leaders who were mainly involved in teaching and on-site management accounted for 60.2%  
119 (39 men [36.1%] and 26 women [24.1%]) in 65 cases. The directors who were mainly  
120 involved in supporting leaders accounted for 38.0% (25 men [23.1%] and 16 women  
121 [14.8%]) in 41 cases. Moreover, the number of respondents who were in their 60s accounted  
122 for 32.4% (35), and 2 (2%) athletes and were in other fields. Recreation, including athletic  
123 event, was the most common sports practiced by the survey respondents (16 cases [14.8%]),  
124 followed by badminton (13 cases [12%]) (Table 1).

125 **Table 1.** Attributes of the respondents to the online questionnaire by sex and age

126

127 Regarding the respondents' experience in attending seminars on guidance and support for  
128 sports activities (including lifesaving seminars), 87 respondents (80.6%) answered that they  
129 had attended such seminars. Of these, 54 respondents (50.0%) had attended less than once a  
130 year, 30 (27.7%) had attended approximately once a year, and three (2.7%) had attended  
131 more than once a year. Fifty-seven respondents (52.8%) held some type of certification, with  
132 35 respondents (32.4%) indicating that they held certifications that included lifesaving  
133 training (first-aid lifesavers; health and exercise instructors; and lifesaving training

134 certificates provided by the Japanese Red Cross Society and the fire department). The other  
135 22 cases (20.3%) held instructor certifications in the respective sports disciplines.

136 The median activity history as a leader and director of the respondents was 10.0 (5.0–20.0)  
137 years in men and 11.5 (3.3–20.0) years in women. The frequency of activity was 1.0 (1.0–4.0)  
138 times/month in men and 4.0 (2.0–8.8) times/month in women. The duration of activity was  
139 2.0 (2.0–3.0) hours/time in men and 2.0 (1.3–2.0) hours/time in women. In addition, the  
140 number of participants per activity was 20.0 (15.0–30.0) in men and 19.0 (14.0–33.0) in  
141 women (Table 2). More than 100 participants responded that they participated in recreation,  
142 Sawayaka Sports (Boccia etc.), badminton, and walking.

143 **Table 2.** Activities of the respondents to the online questionnaire

144

145 Adverse events

146 Of the 108 survey respondents, there were 45 reports of adverse events over the past 3 years,  
147 from which, two reports were obtained from 11 respondents. By sports discipline, eight cases  
148 (17.7%) were reported in soccer, seven (15.5%) in recreation, and six (13.3%) in softball.  
149 Among men, eight cases (17.7%) were reported in soccer, seven (15.5%) in recreation, and  
150 six (13.3%) in softball. Among women, four cases (8.8%) were reported in volleyball (Table  
151 3). Adverse events included "injury" in 26 cases (57.8%), "fall" in 13 cases (28.9%), and  
152 "other" in six (13.3%). In terms of response after an adverse event, all cases were handled in

153 some way, and there were no cases in which the initial response to an adverse event could not  
154 be made. Of the 45 adverse events, four cases (8.9%) (two injuries, one fall, and one other)  
155 were transported to emergency rooms and 10 cases (22.2%) (nine injuries and one fall) to  
156 hospitals.

157 **Table 3.** Number of adverse events stratified by sports discipline, sex, and age

158 Considering the possibility that differences in the background of the leaders/directors  
159 according to their experience in attending courses and their qualifications may have affected  
160 reporting adverse events, a  $\chi^2$  test was conducted. The results showed no statistically  
161 significant differences (experience in training courses  $p = 0.80$ , qualifications  $p = 0.21$ ).

162 The overall number of adverse events was 0.07 occurrences per 10 activities and 0.75  
163 occurrences per 1,000 h of activity. Recreation was the sports with the highest number of  
164 incidents per number of activities, with 0.49 incidents per 10 activities. Table tennis was the  
165 sports with the highest number of incidents per activity hour, with 4.17 incidents per 1,000  
166 activity h (Table 4).

167 All tendon injuries involved the Achilles tendon, with two occurring in men aged 40–49 and  
168 three in women aged 50–59. Among sports adverse events, three cases occurred in volleyball,  
169 one in badminton, and one in soccer. Ankle sprains occurred in one case each in soccer  
170 among male and female participants younger than 10 years, one in volleyball among women  
171 aged 50–59 years, and one in table tennis among women aged 60–69 years. Concussions and

172 chest and back contusions occurred during soccer, with a small number of occurrences.  
173 However, concussions occurred in children under 10 years of age playing soccer. Contusions  
174 mostly involved the chest and back in children under 10 years of age playing soccer.

175 **Table 4.** Frequency of adverse events by sports discipline (calculated values)

176

177 *Injuries*

178 Regarding the 26 injuries classified as "injury" in the adverse event category, the lower leg  
179 was the most common site of injury in eight cases, followed by the ankle/foot in four, and the  
180 wrist/hand in four. In terms of the classification of "injury" based on a diagnostic name, there  
181 were six cases of sprains, five of tendon injuries, four of fractures, and four of separated flesh.  
182 Considering diagnoses, Achilles tendon injuries and ankle sprains occurred most frequently in  
183 five and four cases, respectively (Table 5).

184 **Table 5:** Body part and type of injuries

185

186 *Falls*

187 Among the events classified as "falls" in the adverse event category, 11 occurred during  
188 sports activities and two during transportation; six occurred in the 70–79 age group and one  
189 in the 80–89 age group, with 53.8% of falls occurring in the 70–79 age group or older (Table  
190 6).



191 **Table 6.** Detailed circumstances of the fall cases

192

193 Near-misses

194 Regarding occurrence of near-misses over the past 3 years, 24 near-misses were reported,  
195 from which, one respondent reported two cases. The 24 near-misses were categorized into 12  
196 cases of near collision with person-to-person or person-to-object, five cases of near fall, and  
197 seven other cases, based on a close examination of the events descriptions. The other seven  
198 cases included three cases of near fall head-first to the floor during gymnastics, one case of  
199 an arrow from a person's head hitting the glasses worn during Kyudo (Japanese archery).  
200 These seven cases also included one case of performing an action different from the program  
201 without following the instructions. They also comprised one case of a participant with  
202 chronic illness and one case of a junior high school student throwing a metal ball into the  
203 middle of a crowd during petanque.

204 Fisher's exact probability and  $\chi^2$  tests were performed to determine the possibility that the  
205 reporting of near-misses might have been affected by the experience of leaders and directors  
206 in attending training courses and by the presence or absence of their qualifications. The  
207 results showed no statistically significant differences (experience in attending training  
208 courses,  $p = 1.00$ ; qualifications,  $p = 0.24$ ).

209

210 **Discussion**

211 This study was conducted using data from a survey targeting leaders and directors in Sakae  
212 Ward in 2020 as part of Safe Community, using a cross-sectoral collaboration program to  
213 prevent accidents and injuries. It aimed to evaluate adverse events and near-misses during  
214 sports activities in groups. The results of this study provided an indication of the occurrence  
215 and frequency of adverse events and near-misses during physical and sports activities in  
216 groups, which were performed voluntarily and routinely by local residents.

217

218 Attributes of survey respondents

219 The survey respondents comprised of 60% leaders and 40% directors. The age groups were  
220 50–59 (30%) and 60–69 (30%) years of age, and more than half of the respondents were in  
221 the 60–69 age group or older. This may be due to the fact that Sakae Ward has 31.3% of the  
222 total population aged 65 and above, making it the most aged ward among the 18 wards of  
223 Yokohama City. Recreation and badminton accounted for 15% and 12%, respectively, of the  
224 sports the respondents performed.

225 The median length of time in which the respondents had been active was 10 years, and 80.6%  
226 of respondents had attended courses related to their sporting activities. More than half of the  
227 respondents had certifications related to sports activities. However, only 32.4% of them had  
228 certifications including lifesaving courses. Given that sports-related sudden deaths have been

229 reported in surveys conducted in the general population in France<sup>22</sup>, it is suggested that all  
230 instructors and support personnel need to be trained in cardiopulmonary resuscitation (CPR).  
231 It has been reported that the emergency action plan (EAP) should be rehearsed at least once a  
232 year, and should specify responses to various types of adverse events that may occur and  
233 appropriate emergency transportation routes.<sup>23</sup> Although the training status of safety  
234 management during sports activities among leaders and directors could affect the accuracy of  
235 reporting adverse events and near-misses, no statistically significant difference was found in  
236 this study. This may be related to the longer activity history of the participants in this study.  
237 The median duration of each activity was 2 h in both men and women, and the number of  
238 participants per activity was about 20 in both men and women.

239

#### 240 Analysis of adverse events

241 Of the 108 survey respondents, approximately 30% reported experiencing adverse events.  
242 The adverse events were classified as 26 injuries, 13 falls, and six others.  
243 In a report on injuries during sports activities, Kamada et al.<sup>11</sup> surveyed Japanese students  
244 (12–18 years) and reported that the injuries occurred most commonly in the lower extremities  
245 (15.4%). In addition, a systematic review<sup>24</sup> of epidemiological studies of sports injuries  
246 including ankle sprains reported that ankle sprains were a major injury in many sports  
247 disciplines. In this study, 57.7% of the injuries occurred in the lower extremities (the

248 ankle/foot, lower leg, knee, thigh, and hip), with ankle sprains accounting for 4 of 26 injuries  
249 (15.3%). This suggests that many injuries occurred in the lower limbs in voluntary exercise  
250 by Sakae Ward residents, and that the main injury was likely to be an ankle sprain, which is  
251 consistent with the findings of previous studies. According to the National Athletic Trainers'  
252 Association position statement<sup>25</sup>, prevention of ankle sprains and their recurrence requires the  
253 use of taping/supporters, a comprehensive approach with emphasis on balance and  
254 neuromuscular control. It is recommended to continue rehabilitation for at least 3 months, to  
255 strengthen and improve the peri-ankle, hip extensor, and abductor muscle groups, and to  
256 reduce ankle dorsiflexion range of motion limitation. It is also important to include an  
257 appropriate warm-up prior to the main exercise, such as the warm-up program for injury  
258 prevention represented by the FIFA11+<sup>26</sup> published by the Federation Internationale de  
259 Football Association.

260 Regarding post-injury response, rest, ice, compression, and elevation (RICE) treatment, is  
261 widely known as a common response in sports settings, and icing has been shown to be  
262 effective in reducing post-injury pain.<sup>27</sup> Considering lower extremity injuries, especially  
263 ankle sprains, which are expected to occur more frequently, preventive training, warm-up  
264 before main exercise, and measures at the time of injury should be taken as necessary.

265 A descriptive epidemiological study using data from the National Database of Health  
266 Insurance Claims and Specific Health Checkups of Japan<sup>28</sup> reported that 44% of Achilles

267 tendon ruptures occurred in patients aged 40–59 years. In this study, all cases of Achilles  
268 tendon injuries occurred in the 40-49 and 50-59 age groups. Achilles tendon injuries are  
269 thought to be caused by tendon degeneration and uncoordinated muscle activity.<sup>29</sup> It has been  
270 reported that even in trained athletes, exercise intensity with a ratio of the last week's  
271 cumulative load (acute load) to the last four weeks' cumulative load (chronic load) (Acute  
272 Chronic Workload Ratio [ACWR]) of 0.8 to 1.3 minimizes the risk of injury. However, an  
273 ACWR above 1.5 is reported to be in the danger zone.<sup>30,31</sup> Therefore, we suggest that rapid  
274 exercise and exercise intensity that is too high is a risk for injury, and that daily physical  
275 activity and exercise can prevent inappropriate muscle contraction and improper movement.

276 On the other hand, one concussion and one chest contusion in participants under 10 years of  
277 age that could result in a commotio cordis were identified in soccer, with a small number of  
278 reports. Concussions are caused by direct or indirect external trauma to the head. Since the  
279 symptoms and recovery process of concussion vary from one individual to another, the return  
280 to competition must be halted for a while until symptoms are evaluated.<sup>32</sup> In particular, in  
281 young athletes, the return-to-play process should be more conservative, taking into account  
282 the effects on the developing brain damage.<sup>32</sup> Commotio cordis is the second most common  
283 cause of sudden cardiac death in young athletes<sup>33</sup>, and measures such as installation of  
284 Automated External Defibrillators (AED), CPR training, and the development of EAPs  
285 should be considered.

286 Thirteen adverse events classified as falls were reported: 11 during sports activities and two  
287 during transportation. The two cases that occurred during transportation included a case of a  
288 man aged 80–89 years who fell at the entrance of an archery range, and the other case was  
289 that of a male participant aged 10 years or younger slipped and fell while running. Seven of  
290 the 13 falls (53.8%) occurred in participants aged 70–79 years or older. Risk factors for falls  
291 include age over 80 years, history of previous falls, poor balance, muscle weakness, poor  
292 vision, and medication use.<sup>34</sup> Therefore, we suggest that falls can be prevented through daily  
293 health checks such as a blood pressure, a body temperature measurement, and hearing about age,  
294 history of falls, and implementation of multi-component exercises<sup>35</sup> that have been shown to  
295 be effective in preventing falls. Furthermore, it is also important to consider environmental  
296 factors such as poor floor conditions, inappropriate shoes and clothing, and too much dark  
297 lighting in the activity area.

298 Four out of six (67%) of the other adverse events were suspected to be heat stroke, since all  
299 cases occurred between July and September, which are the summer months in Japan. A study  
300 analyzing data on emergency medical evacuations for heat stroke in Fukuoka City, Japan,  
301 indicated that the older adults aged 70–79 years or older were most susceptible to heat  
302 stroke.<sup>36</sup> In this study, three out of four suspected heat stroke cases (75%) were in the 70–79  
303 age group. According to the American College of Sports Medicine consensus statement<sup>37</sup>,  
304 prehospital management of heat stroke should include early recognition. The importance of

305 the following three measures is demonstrated: (i) early recognition, (ii) immediate cooling,  
306 and (iii) transport to a medical facility. In this study, the response to all four cases of  
307 suspected heat stroke was observation (including transfer to a cooler location and  
308 rehydration), clearly indicating the need for on-site training in the initial assessment of heat  
309 stroke, ice and ice baths for cooling the body, and preparation of a list of medical facilities to  
310 which the patient could be transported.

311 The frequency of adverse events calculated in this study was 0.07 per 10 activities and 0.75  
312 per 1,000 h of activity. Recreation was the sports activities with the highest number of  
313 occurrences per number of activities, with one adverse event occurring in every 20 activities.

314 The sports with the highest number of incidents per activity hour was table tennis, with one  
315 incident per 250 h of activity. Studies reporting adverse events during sports activities  
316 performed by community residents are limited. However, a prospective cohort study<sup>38</sup>

317 conducted in Finland reported 1.2 walking injuries per 1,000 h of activity based on data  
318 collected through interviews. Compared to the present study, the number of injuries was 0.63  
319 per 1,000 h, which was approximately half of the result yielded in the previous study. In

320 activities other than walking, the number of adverse events in the present study is estimated  
321 to be lower than that in the study by Parkkari et al.<sup>38</sup> This may be due to differences in study  
322 methods, demographic attributes of participants, and intensity of sports activities. It should

323 also be noted that the number of occurrences in this study was calculated based on the

324 activities of instructors and supporters who reported adverse events that may be far from the  
325 true number of occurrences. However, the information on the frequency of adverse events  
326 revealed in this study may be useful for the prevention and countermeasures of adverse  
327 events during physical activity.

328

### 329 Analysis of near-misses

330 Approximately 30% of the respondents reported near-miss experiences. A close examination  
331 of the 24 near-misses reported in this study revealed that 12 involved near-collisions between  
332 person-to-person or person-to-object, five involved near falls, and seven involved others that  
333 occurred during gymnastics. There are games that always have the potential for collisions and  
334 falls, such as contact between a baseball batter and an infielder or a fall during gymnastics.  
335 Therefore, it is important to provide safe technical instruction and create an environment that  
336 prevents accidents related to the characteristics of the game. In addition, there were some  
337 cases that required improvement in participant management and reminders during exercise,  
338 such as when participants did not follow the leader's instructions, a participant had a chronic  
339 illness, or a participant threw a petanque ball into the presence of others. Since  
340 leaders/directors have a duty of care for safety, it is important for them to thoroughly explain  
341 and check the safety of participants prior to their participation in exercise. Medical screening  
342 by physicians prior to participation in ultramarathon events has been reported to be effective



343 in preventing adverse events.<sup>13</sup> However, it is not realistic for all community residents to be  
344 checked by a physician prior to sports activities in their daily activities. Therefore, we suggest  
345 that it would be important for leaders/directors and participants themselves to confirm  
346 screening prior to exercise participation, such as using the Physical Activity Readiness  
347 Questionnaire.<sup>39</sup>

348

#### 349 Limitations

350 This study might be affected by recall bias because the adverse events and near-misses that  
351 occurred in the past 3 years were surveyed by questionnaire. In fact, the number of adverse  
352 events and near-misses reported was higher in 2019 and 2020. Furthermore, in 2020, due to  
353 the worldwide pandemic of novel coronavirus infection (COVID-19), a state of emergency  
354 was declared in Japan. The Japanese government called on the public to refrain from going  
355 out from April 7 to May 31 in Sakae Ward, Yokohama City. Even after the state of emergency  
356 was declared, there were restrictions on the use of public sports facilities from the summer to  
357 the fall of 2020. Therefore, the number of activities in 2020 was likely lower than in previous  
358 years. Third, this study was conducted only in Sakae Ward. In addition, sports leaders and  
359 directors belonging to the six organizations that make up the Taskforce Committee for Sports  
360 Safety, Sakae Ward Safe Community, Yokohama City were the participants of this study,  
361 whereas the current status of physical activity conducted by organizations other than these or

362 by individuals remains unknown. Selection bias may have influenced the results. Thus, there  
363 might be limitations to the generalizability and representativeness of this study. However,  
364 there are 13 cities in Japan that have received Safe Community certification<sup>40</sup>, and it is  
365 expected that similar initiatives are being conducted in other municipalities. We suggest that  
366 researchers can contribute to the creation of a safe and secure environment for physical  
367 activity and exercise for local residents by getting involved in surveys and initiatives that  
368 local governments are proactively implementing.

369

## 370 **Conclusion**

371 This study investigated the occurrence of adverse events and near-misses during  
372 community-driven group sports activity in Sakae Ward. The results revealed the attributes  
373 and activities of the leaders and directors involved in the management of sports activities.  
374 The adverse events included "injuries," "falls," and "others" such as heat stroke. The  
375 near-misses revealed situations that could have become adverse events. Although the  
376 frequency of adverse events and near-misses in this study was low, the fact that  
377 approximately 30% of the survey respondents experienced adverse events suggests the need  
378 for documentation of adverse events, implementation of safety measures, and proper safety  
379 education for operating staff. Preventive measures should be taken against the risks  
380 highlighted in the results of this study, and an EAP should be prepared in the event of an

381 incident.

382

### 383 **Acknowledgements**

384 We would like to express our gratitude to Sakae Ward, Yokohama City for their cooperation  
385 in this study. This study was conducted in response to data provided by the "Project for the  
386 Promotion of Measures to Prevent Injuries and Accidents During Exercise" conducted by  
387 Sakae Ward, Yokohama City.

388

### 389 **Conflict of Interests**

390 The authors declare that there are no conflicts of interests.

391

### 392 **Author Contributions**

393 AH and YO designed the study. AH analyzed the data and drafted the manuscript. YO and  
394 TH edited and revised the manuscript. All authors approved the final version of the  
395 manuscript for submission.

396 **Data Statement:** The datasets generated and analyzed during the current study are available  
397 from the corresponding author on reasonable request.

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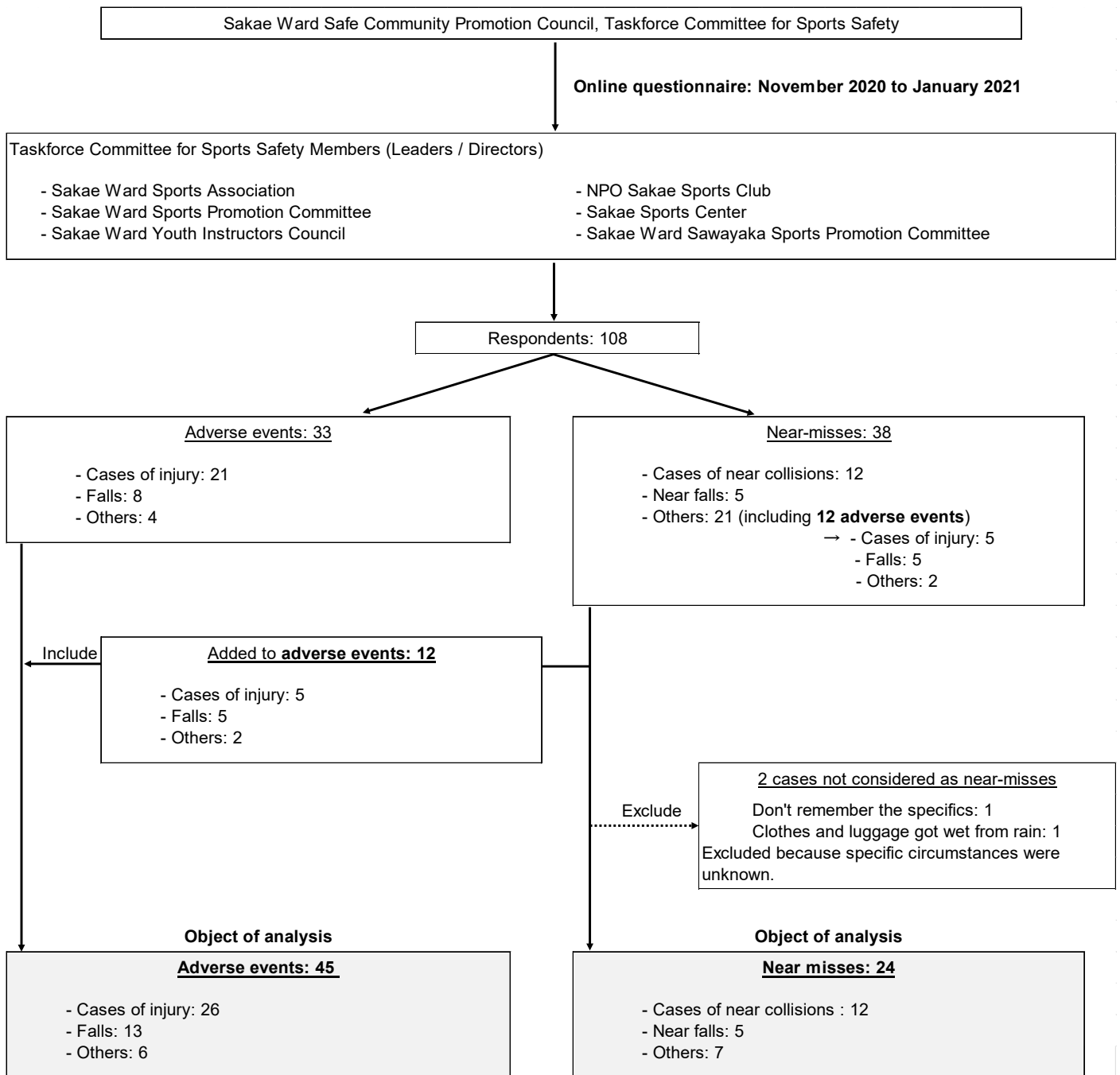
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NPO: Nonprofit organization

Fig. 1: Flowchart for selecting analysis adverse events and near misses

Table 1: Attributes of the respondents to the online questionnaire by sex and age

Age	Male, n (%)								Female, n (%)							
	20-29	30-39	40-49	50-59	60-69	70-79	80-89	Total	20-29	30-39	40-49	50-59	60-69	70-79	80-89	Total
<b>Position</b>																
Leader		1 (0.9)	4 (3.7)	8 (7.4)	13 (12.0)	11 (10.2)	2 (1.9)	39 (36.1)		3 (2.8)	2 (1.9)	7 (6.5)	9 (8.3)	4 (3.7)	1 (0.9)	26 (24.1)
Director	1 (0.9)		4 (3.7)	7 (6.5)	9 (8.3)	3 (2.8)	1 (0.9)	25 (23.1)	1 (0.9)		2 (1.9)	9 (8.3)	3 (2.8)	1 (0.9)	0 (0.0)	16 (14.8)
Other <sup>a</sup>					1 (0.9)			1 (0.9)		1 (0.9)						1 (0.9)
<b>Total</b>	<b>1 (0.9)</b>	<b>1 (0.9)</b>	<b>8 (7.4)</b>	<b>15 (13.9)</b>	<b>23 (21.3)</b>	<b>14 (13.0)</b>	<b>3 (2.8)</b>	<b>65 (60.2)</b>	<b>1 (0.9)</b>	<b>4 (3.7)</b>	<b>4 (3.7)</b>	<b>16 (14.8)</b>	<b>12 (11.1)</b>	<b>5 (4.6)</b>	<b>1 (0.9)</b>	<b>43 (39.8)</b>
<b>Organization</b>																
Sakae Ward Sports Association	1 (0.9)	1 (0.9)	3 (2.8)	9 (8.3)	7 (6.5)	9 (8.3)	2 (1.9)	32 (23.1)	1 (0.9)	1 (0.9)		5 (4.6)	6 (5.6)	3 (2.8)	1 (0.9)	17 (15.7)
Sakae Ward Sports Promotion Committee			1 (0.9)					1 (0.9)		3 (2.8)	4 (3.7)	8 (7.4)	3 (2.8)	2 (1.9)		20 (18.5)
Sakae Ward Youth Instructors Council			2 (1.9)	5 (4.6)	9 (8.3)	2 (1.9)		18 (16.7)								0 (0.0)
Sakae Ward Sawayaka Sports Promotion Committee			2 (1.9)	1 (0.9)	7 (6.5)			10 (9.3)				1 (0.9)	1 (0.9)			2 (1.9)
NPO Sakae Sports Club						1 (0.9)	1 (0.9)	2 (1.9)				2 (1.9)	1 (0.9)			3 (2.8)
Sakae Sports Center						2 (1.9)		2 (1.9)								0 (0.0)
Other <sup>b</sup>								0 (0.0)					1 (0.9)			1 (0.9)
<b>Total</b>	<b>1 (0.9)</b>	<b>1 (0.9)</b>	<b>8 (7.4)</b>	<b>15 (13.9)</b>	<b>23 (21.3)</b>	<b>14 (13.0)</b>	<b>3 (2.8)</b>	<b>65 (60.2)</b>	<b>1 (0.9)</b>	<b>4 (3.7)</b>	<b>4 (3.7)</b>	<b>16 (14.8)</b>	<b>12 (11.1)</b>	<b>5 (4.6)</b>	<b>1 (0.9)</b>	<b>43 (39.8)</b>
<b>Sports</b>																
Recreation (Athletic meeting etc.)			2 (1.8)	4 (3.7)	8 (7.4)			14 (12.9)				1 (0.9)	1 (0.9)			2 (1.8)
Badminton			1 (0.9)	2 (1.8)	1 (0.9)		1 (0.9)	5 (4.6)			1 (0.9)	4 (3.7)	2 (1.8)			7 (6.4)
Table tennis				1 (0.9)		1 (0.9)		2 (1.8)	1 (0.9)				4 (3.7)	1 (0.9)	1 (0.9)	7 (6.4)
Gymnastics			1 (0.9)				1 (0.9)	2 (1.8)			2 (1.8)	3 (2.7)	1 (0.9)			6 (5.5)
Sawayaka Sports (Boccia etc.)			1 (0.9)	1 (0.9)	2 (1.8)	3 (2.7)		7 (6.4)		1 (0.9)						1 (0.9)
Baseball			2 (1.8)	1 (0.9)	1 (0.9)	1 (0.9)	1 (0.9)	6 (5.5)								0 (0.0)
Soccer		1 (0.9)		3 (2.7)		1 (0.9)		5 (4.6)								0 (0.0)
Soft tennis					3 (2.7)			3 (2.7)						1 (0.9)		1 (0.9)
Softball					3 (2.7)	1 (0.9)		4 (3.7)								0 (0.0)
Volleyball								0 (0.0)				3 (2.7)	1 (0.9)			4 (3.7)

Walking				1 (0.9)	1 (0.9)			2 (1.8)						1 (0.9)		1 (0.9)
Dance sports								0 (0.0)	1 (0.9)	1 (0.9)			1 (0.9)			3 (2.7)
Kyudo (Japanese archery)							2 (1.8)	2 (1.8)								0 (0.0)
Kendo							1 (0.9)	1 (0.9)								0 (0.0)
Tennis							1 (0.9)	1 (0.9)								0 (0.0)
Gateball								1 (0.9)								0 (0.0)
Ttug of war					1 (0.9)			1 (0.9)								0 (0.0)
Bowling					1 (0.9)			1 (0.9)								0 (0.0)
Target bird golf							1 (0.9)	1 (0.9)								0 (0.0)
Powerlifting					1 (0.9)			1 (0.9)								0 (0.0)
Other <sup>c</sup>	1 (0.9)	1 (0.9)	2 (1.8)	2 (1.8)				6 (5.5)	2 (1.8)	1 (0.9)	3 (2.7)	3 (2.7)	1 (0.9)			10 (9.2)
<b>Total</b>	<b>1 (0.9)</b>	<b>1 (0.9)</b>	<b>8 (7.4)</b>	<b>15 (13.8)</b>	<b>23 (21.2)</b>	<b>14 (12.9)</b>	<b>3 (2.7)</b>	<b>65 (60.1)</b>	<b>1 (0.9)</b>	<b>4 (3.7)</b>	<b>4 (3.7)</b>	<b>15 (13.8)</b>	<b>12 (11.1)</b>	<b>5 (4.6)</b>	<b>1 (0.9)</b>	<b>42 (38.8)</b>

a: Other (2): participant, athlete, b: Other (1): Neighborhood association (Tai Chi), c: Others (16): Yoga, athletics, yachting, petanque, golf, event support, preventive care exercise, Pilates, infant physical education, tai chi, aerobics, etc.

The empty cells represent 0 (0%).

Table 2: Activities of the respondents to the online questionnaire

	Male	Female
Activity history (years)	10.0 (5.0 - 20.0)	11.5 (3.3 - 20.0)
Activity frequency (times/month)	1.0 (1.0 - 4.0)	4.0 (2.0 - 8.8)
Activity duration (hours/session)	2.0 (2.0 - 3.0)	2.0 (1.3 - 2.0)
Number of participants (persons/session)	20.0 (15.0 - 30.0)	19.0 (14.0 - 33.8)

Median (interquartile range), Respondents: Leader, Director, Other (participant, athlete)

Activity history: Number of years of exercise teaching experience

Activity frequency: Approximate number of activities per month

Activity duration: Approximate duration per activity

Number of participants: Approximate number of persons per sports activity

Table 3: Number of adverse events by sport discipline, sex, and age

Age	Male, n (%)											Female, n (%)										
	-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	Unknown	Total	-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	Unknown	Total
<b>Sports</b>																						
Soccer	3 (6.6)	3 (6.6)			2 (4.4)						8 (17.7)											0 (0.0)
Recreation (Sports Day etc.)	1 (2.2)				1 (2.2)		1 (2.2)	1 (2.2)		3 (6.6)	7 (15.5)											0 (0.0)
Softball					3 (6.6)		1 (2.2)	2 (4.4)			6 (13.3)											0 (0.0)
Soft tennis										2 (4.4)	2 (4.4)								2 (4.4)			2 (4.4)
Volleyball											0 (0.0)					4 (8.8)						4 (8.8)
Walking							1 (2.2)	2 (4.4)			3 (6.6)								1 (2.2)			1 (2.2)
Badminton					1 (2.2)						1 (2.2)				1 (2.2)	1 (2.2)						2 (4.4)
Table tennis										1 (2.2)	1 (2.2)								1 (2.2)	1 (2.2)		2 (4.4)
Baseball		2 (4.4)									2 (4.4)											0 (0.0)
Kyudo (Japanese archery)									1 (2.2)		1 (2.2)											0 (0.0)
Target bird golf								1 (2.2)			1 (2.2)											0 (0.0)
Other					1 (2.2)						1 (2.2)	1 (2.2)										1 (2.2)
<b>Total</b>	<b>4 (8.8)</b>	<b>5 (11.1)</b>	<b>0 (0.0)</b>	<b>0 (0.0)</b>	<b>8 (17.7)</b>	<b>0 (0.0)</b>	<b>3 (6.6)</b>	<b>6 (13.3)</b>	<b>1 (2.2)</b>	<b>6 (13.3)</b>	<b>33 (73.3)</b>	<b>1 (2.2)</b>	<b>0 (0.0)</b>	<b>0 (0.0)</b>	<b>0 (0.0)</b>	<b>1 (2.2)</b>	<b>5 (11.1)</b>	<b>1 (2.2)</b>	<b>4 (8.8)</b>	<b>0 (0.0)</b>	<b>0 (0.0)</b>	<b>12 (26.6)</b>

The empty cells represent 0 (0%).



**Table 4: Frequency of adverse events by sports discipline (calculated values)**

	Adverse events (cases)	Respondents (persons)	Number of activities (activities per month)	Number of activities over 3 years	Number of occurrences per 10 activities	Average activity time (hours per activity)	Total activity time over 3 years	Number of occurrences per 1,000 hours
<b>Soccer</b>	8	5	46	1,656	0.05	2.6	21,528	0.37
<b>Recreation (Athletic meeting etc.)</b>	7	4	4	144	0.49	3.8	2,160	3.24
<b>Softball</b>	6	4	11	396	0.15	2.8	4,356	1.38
<b>Walking</b>	4	3	16	576	0.07	3.7	6,336	0.63
<b>Volleyball</b>	4	2	28	1,008	0.04	2.0	4,032	0.99
<b>Soft tennis</b>	4	3	16	576	0.07	3.7	6,336	0.63
<b>Table tennis</b>	3	2	5	180	0.17	2.0	720	4.17
<b>Badminton</b>	3	3	10	360	0.08	5.0	5,400	0.56
<b>Baseball</b>	2	2	18	648	0.03	6.0	7,776	0.26
<b>Target bird golf</b>	1	1	12	432	0.02	2.0	864	1.16
<b>Kyudo (Japanese archery)</b>	1	1	4	144	0.07	2.0	288	3.47
<b>Other</b>	2	2	2	72	0.28	2.0	288	6.94
<b>All</b>	45	32	172	6,192	0.07	3.2	60,084	0.75

**Number of activities over 3 years = Number of reported activities (activities per month) \*12 months \*3 years**

**Number of occurrences per 10 activities = (number of adverse events/ number of activities over 3 years) \*10**

**Average activity time (hours per activity) = [Sum of each activity time (hours per activity) reported in the same sport discipline]/ [number of reports in the same sport discipline]**

**Total activity time over 3 years = reported activity time (hours per activity) \*number of activities over 3 years**

**Number of occurrences per 1,000 hours = (number of adverse events/ total activity time over 3 years) \*1,000**

**Table 5: Body part and type of injuries, n (%)**

	<b>Sprain</b>	<b>Tendon injury</b>	<b>Bone fractures</b>	<b>Muscle injury</b>	<b>Chronic injury</b>	<b>Concussion</b>	<b>Skin Injuries</b>	<b>Bruises</b>	<b>Total</b>
<b>Lower leg</b>		5 (19.3)	1 (3.9)	2 (7.7)					<b>8 (30.8)</b>
<b>Foot joint/sufficient</b>	4 (15.4)								<b>4 (15.4)</b>
<b>Hand joints/hands</b>	1 (3.9)		2 (7.7)				1 (3.9)		<b>4 (15.4)</b>
<b>Elbow</b>					1 (3.9)			2 (7.7)	<b>3 (11.6)</b>
<b>Head/Face</b>						1 (3.9)	1 (3.9)		<b>2 (7.7)</b>
<b>Front Wrist</b>			1 (3.9)						<b>1 (3.9)</b>
<b>Chest/Back</b>								1 (3.9)	<b>1 (3.9)</b>
<b>Femoral joint</b>				1 (3.9)					<b>1 (3.9)</b>
<b>Thighs</b>				1 (3.9)					<b>1 (3.9)</b>
<b>Knee</b>	1 (3.9)								<b>1 (3.9)</b>
<b>Total</b>	<b>6 (23.1)</b>	<b>5 (19.3)</b>	<b>4 (15.4)</b>	<b>4 (15.4)</b>	<b>1 (3.9)</b>	<b>1 (3.9)</b>	<b>2 (7.7)</b>	<b>3 (11.6)</b>	<b>26 (100)</b>

The empty cells represent 0 (0%).

Table 6: Detailed circumstances of the fall cases

	<b>Sex</b>	<b>Age</b>	<b>Sports</b>	<b>Place</b>	<b>Details</b>
<b>1</b>	Male	40-49	Recreation	Schoolyard	Stumbled over uneven ground.
<b>2</b>	Male	40-49	Softball	Baseball ground	Fell over while picking up the ball.
<b>3</b>	Male	40-49	Softball	Baseball ground	Fell while running for a base.
<b>4</b>	Male	40-49	Recreation	Schoolyard	Fell down just before passing the baton in a relay race.
<b>5</b>	Male	70-79	Walking	Road	Stumbled over a step.
<b>6</b>	Male	70-79	Soft tennis	Tennis court	Fell forward while chasing a ball.
<b>7</b>	Male	70-79	Soft tennis	Tennis court	Fell down while picking up a short ball.
<b>8</b>	Female	70-79	Soft tennis	Tennis court	Fell backwards while trying to hit the ball.
<b>9</b>	Male	70-79	Recreation	Parks/sports fields	Slipped and fell while running.
<b>10</b>	Male	70-79	Recreation	Parks/sports fields	Fell while running in the parent participation event at the Sports Day.
<b>11</b>	Male	Unknown	Recreation	Schoolyard	Fell while running.
<b>12</b>	Male	-9	Badminton	Building entrance	Slipped on the floor while running and fell.
<b>13</b>	Male	80-89	Kyudo (Japanese archery)	Building entrance	Tripped and fell on a step in a doorway.

**[Appendix Table 1] Questionnaire items**

Question Item		Response Method
<b>Questions about responders (Leader and Director)</b>		
1	Age	Selective 10-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, 80-89, 90-99, others
2	Sex	Selective Male, Female
3	Organization	Selective Sakae Ward Sports Association, Sakae Ward Sports Promotion Committee, Sakae Ward Youth Instructors Council, NPO Sakae Sports Club, Sakae Sports Center, Sakae Ward Sawayaka Sports Promotion Committee
4	Activity Location	Descriptive
5	Sports discipline	Selective Kendo, Kyudo (Japanese archery), Baseball, Volleyball, Table tennis, Tennis, Soft tennis, Badminton, Softball, Karate, Gymnastics, Basketball, Walking, Soccer, Gateball, Tug of war, Bowling, Target bird golf, Dance sports, Powerlifting, Recreation (Athletic event etc.), Sawayaka Sports (boccia etc.), Other
6	Position: Leader/Director*	Selective Leader, Director, Other
7	History of Activities as Leader/Director	Descriptive Number (year)
8	Qualifications	Descriptive
9	Experience of attending seminars	Selective No experience, less than once a year, about once a year, More than once a year, Other
10	Frequency of Activities as Leader/Director	Descriptive Number (times/month)
11	Activity time	Descriptive Number (hours/time)
12	Number of participants	Descriptive Number (persons/time)
<b>Questions about adverse events</b>		
13	Occurrence and type of adverse events	Selective Not occurring, Fall, Chest pain, Aggravation of chronic disease, Injury, Other
14	Year	Selective 2017, 2018, 2019, 2020, Don't remember
15	Month	Selective January, February, March, April, May, June, July, August, September, October, November, December, don't remember
16	Sex	Selective Male, Female
17	Age	Selective -9, 10-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, 80-89, 90-99, Unknown
18	Sports discipline	Selective Kendo, Kyudo (Japanese archery), Baseball, Volleyball, Table tennis, Tennis, Soft tennis, Badminton, Softball, Karate, Gymnastics, Basketball, Walking, Soccer, Gateball, Tug of war, Bowling, Target bird golf, Dance sports, Powerlifting, Recreation (Athletic event etc.), Sawayaka Sports (boccia etc.), Other
19	Location	Selective Gymnasium, Soccer field, Baseball field, Tennis court, Training gym, Other grounds, Park, Other
20	Response at the time	Selective No treatment, Observation (recovery/improvement with rest), On-the-spot first aid, Hospital visit, Emergency transport, Other

21	Details of response	Descriptive	
22	Situation at the time of the fall	Descriptive	
23	Part of injury	Selective	Head/face, neck, chest/back, abdomen/back, hip joint, thigh, knee joint, lower leg, foot joint/foot, shoulder joint, upper arm, elbow joint, forearm, forearm, joint/part
24	Name of injury	Descriptive	(Name of disease)
25	Situation at time of injury	Descriptive	
26	Another case	Descriptive	

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**Questions about near-misses**

27	Occurrence and year of near- misses	Selective	Not occurring, 2017, 2018, 2019, 2020, Don't remember
28	Month	Selective	January, February, March, April, May, June, July, August, September, October, November, December, don't remember
29	Sex	Selective	Male, Female
30	Age	Selective	-9, 10-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, 80-89, 90-99, Unknown
31	Sports discipline	Selective	Kendo, Kyudo (Japanese archery), Baseball, Volleyball, Table tennis, Tennis, Soft tennis, Badminton, Softball, Karate, Gymnastics, Basketball, Walking, Soccer, Gateball, Tug of war, Bowling, Target bird golf, Dance sports, Powerlifting, Recreation (Athletic event etc.), Sawayaka Sports (boccia etc.), Other
32	Location	Selective	Gymnasium, Soccer field, Baseball field, Tennis court, Training gym, Other grounds, Park, Other
33	Details of the near-miss incident	Descriptive	
34	Another case	Descriptive	

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\*Leader: a person who mainly conducts sports coaching and on-site management; Director: a person who mainly supports the leader