

# Skateboarding Injuries in Spain

## A Web-Based Survey Approach

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**Background:** The inclusion of skateboarding in the Tokyo 2020 Olympic Games reinforces this activity as a sport. As the number of skateboarders around the world and the difficulty of skateboarding maneuvers continue to increase, the number of skateboarding injuries may also rise. Thus, there is a need for more comprehensive investigations into the practice habits and injuries of skateboarders.

**Purpose:** To describe the sports habits and skateboarding injuries of a sample of skateboarders in Spain.

**Study Design:** Descriptive epidemiology study.

**Methods:** A web-based survey was shared among skateboarders in Spain. The survey collected data related to sports habits, skateboarding practice habits, and injury history. Comparisons between subgroups of sex, age, and experience were also conducted.

**Results:** The survey was completed by 197 participants (89.3% male) with a mean age of  $24.4 \pm 7.1$  years and a mean experience of  $9.7 \pm 7.2$  years. Most respondents (87.8%) reported not participating in any type of skateboarding-specific physical training program. Only 27.4% took part in skateboarding competitions, with a larger number of respondents younger than 18 years participating in competitive events. The mean number of sessions per week was  $3.3 \pm 1.7$ , and the mean length of sessions was  $3.3 \pm 1.5$  hours. The majority of participants (87.8%) reported having suffered injuries ( $n = 323$ ) as a result of skateboarding, mainly affecting the lower limbs (69.7%). The most common injury type was a ligament sprain (39.6%), especially of the ankle (39.3%). This injury was also reported as the most likely to recur (70.1%). A large number of injuries (54.2%) were considered severe (ie, >21 days to recover). Most injuries occurred while skateboarding gaps or stairs, including any type of a jump that involved a difference in height between the take-off and landing surfaces (25.7%). Female participants accounted for a larger number of ligament sprains than expected, and experienced skateboarders were more likely to suffer more severe injuries and head/trunk injuries.

**Conclusion:** Respondents to this survey were mainly young male adults who practiced skateboarding recreationally. Respondents of different sexes, ages, and experiences demonstrated different habits and injury patterns. The greater number of severe injuries highlights the need for injury surveillance in skateboarding to inform better prevention and rehabilitation practices.

**Keywords:** skateboarding; extreme sports; ankle; sports injuries; physical therapy/rehabilitation

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Skateboarding originated in the 1960s in California and has gone through intermittent periods of popularity throughout its history.<sup>1,2,10,43</sup> The introduction of polyurethane wheels and new board designs in the 1970s improved the speed and maneuverability of the skateboards, leading to a great increase in the number of skateboarders.<sup>9,36</sup> As a consequence, a rise in the number of injuries related to this practice was also observed.<sup>1,37</sup> This prompted the first studies on the risks of this activity, the ban on skateboarding from public spaces in several countries,<sup>9,43</sup> and a subsequent drop in the number of skateboarders in the late 1970s and 1980s.<sup>43</sup> In the following decades until present day, skateboarding has gone through a new period of popularization around the world,<sup>8,24,26,43</sup> leading to its inclusion in the 2020 Olympic Games.<sup>3</sup>

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With the upcoming professionalization of skateboarding in the next few years, the number of skateboarders is expected to keep increasing, alongside the degree of difficulty of the maneuvers performed.<sup>24</sup> This may in turn lead to more injuries related to this sport.<sup>10,36</sup> Hence, there is a need for more comprehensive investigations to better understand skateboarding injuries and to inform better practices to address injury prevention and rehabilitation.<sup>8,36</sup> This becomes even more critical in countries where, despite noticeable increases in the popularity of skateboarding in recent years, there is a lack of studies addressing the injuries associated with this sport. For instance, while the number of skateboarders was estimated to have increased by 300% in Spain from 2010 to 2015,<sup>27</sup> there are currently no studies of skateboarding injuries in this country.

Skateboarding injuries are typically acute in nature,<sup>36</sup> ranging from small lacerations to bone fractures, and mainly involve the upper limbs.<sup>8,36,43</sup> Sex and age have been suggested as potential injury risk factors<sup>8</sup> in skateboarding, as the risk of hospital admission for male skateboarders was found to be almost double that of female skateboarders,<sup>29</sup> and several studies have found higher percentages of injuries in children and adolescents when compared with older populations.<sup>9,26,33,38,43</sup> Experience has also been related to a higher risk of severe injuries, as more experienced skateboarders attempt riskier maneuvers at higher speeds.<sup>19</sup>

Because of the lack of injury surveillance for skateboarding in most countries, the number and type of injuries associated with skateboarding have typically been described through hospital records.<sup>9,26,43</sup> While this method provides accurate injury descriptions, the information collected on skateboarders' habits of practice is very limited. Therefore, associations between practice habits and injury occurrence cannot be drawn. Also, the number of skateboarders reached is modest, representing only a small fraction of the skateboarding population.<sup>36</sup>

Web-based questionnaires provide access to large populations at reduced costs<sup>15</sup> and have proved to be useful in the study of sports injuries.<sup>12,13,22,28</sup> Examples can also be found within the skateboarding literature investigating skateboarders' sociodemographics and most common injuries.<sup>19</sup> However, the lack of a standardized validated questionnaire prevents the generalizability of these results to wider populations<sup>36</sup> and comparison between studies.<sup>17</sup> Recently, the Questionnaire of Sport Habits and Skateboarding Injuries was created and validated to collect information on sports habits and skateboarding practice habits alongside injury records.<sup>34</sup> This tool was designed by a group of skateboarding experts and sports scientists, and it was developed to be administered online. While prospective injury surveillance has not been implemented in skateboarding, the use of this questionnaire can be a first approach to standardized research of skateboarding injuries, allowing for comparisons between different populations.

The purpose of this study was to describe skateboarders' sports habits and skateboarding practice habits and the most common injuries in Spain using the Questionnaire of Sport Habits and Skateboarding Injuries. The type of

injury, anatomic location, severity, type of treatment, recurrence, and obstacle on which it happened were described. Also, comparisons of sports habits, skateboarding practice habits, and injury data were made depending on the sex, age, and experience of the respondents.

## METHODS

### Data Collection

This study was of a retrospective observational design. The Questionnaire of Sport Habits and Skateboarding Injuries was uploaded online on Google Docs, a free-of-charge platform protected by multiple mechanisms that make it one of the most secure available.<sup>32</sup> Respondents were reached with support from popular Spanish skateboarding websites (ie, Patín en Común [www.patinencomun.com] and Dogway Skateboard Magazine [www.dogwaymedia.com]) and 8 skateboarding shops around the country that shared the survey on their websites. No financial or other incentives of any kind were provided to the respondents for completing the survey. Participants were made aware of the purpose of the survey and the inclusion criteria to take part: (1) being an active skateboarder, (2) having more than 12 months of skateboarding experience, and (3) being based within Spain. Consent for participation in the research study was given by voluntarily completing the survey. Respondents were required to access the survey through their email account to prevent the recording of multiple entries by the same person. This process of authentication was created by Google, and the email addresses were not recorded in the data collection sheets so that anonymity was preserved. This study received ethical approval from the Research Ethical Committee of the University of A Coruña (CEI-UDC). The survey was accessible for 3 months from March 1, 2015 to May 30, 2015.

The questionnaire consisted of 4 main sections: The first section, Personal Data, included skateboarder characteristic information (ie, sex, age, and stance). In the following 2 sections (ie, Sports Habits and Skateboarding Practice Habits), participants were asked about their sports habits (ie, years of skateboarding experience, sessions of skateboarding per week, hours per session, following a skateboarding training program, participation in other sports, and following another sport training program) and their skateboarding practice habits (ie, completion of a warm-up before each session, completion of a cool-down after each session, participation in skateboarding competitions, and completion of a skateboarding-specific training program for competitions). The last section, Injury Record, started with a question about whether participants had suffered any injury as a result of skateboarding. If applicable, participants were asked about the year the injury occurred, type of injury, anatomic location, severity, treatment, recurrence of injury, and obstacle on which the injury occurred. In case of multiple injuries and to maximize injury data collection, participants were allowed to include a total of 10 different injuries. A more detailed description of the questionnaire can be found as supplementary material (Appendix).

## Definitions

**Stance.** Stance referred to the participant's preference for which foot stands in front of the other when skateboarding.<sup>41</sup> There are 2 types of stances: "regular," or left leg leading, and "goofy," or right leg leading.<sup>19</sup>

**Session.** Session referred to every single day on which a skateboarding practice was attended by the respondent regardless of the length in time.

**Injury.** Based on the Injury Surveillance System of the National Collegiate Athletic Association (NCAA),<sup>5</sup> an injury included any musculoskeletal pain or discomfort that resulted from skateboarding and that led to the total cessation or modification of skateboarding and/or other physical activities or that warranted a visit to a health care professional.<sup>11</sup> Injuries were classified depending on the type of damage and the tissue or musculoskeletal structure affected as follows: joint and ligament (ie, ligament sprain, ligament rupture, dislocation, torn cartilage), bone fracture, contusion, muscle and tendon (ie, muscular injury, tendinous injury), and wound (ie, hemorrhage, laceration).

**Retrospective Estimation of Injury Risk.** To quantitatively estimate the risk of injuries within the sample of respondents, the calculation of the injury risk<sup>31</sup> was adapted to the retrospective design of the present study. The number of skateboarders injured over a 12-month period was divided by the total number of skateboarders who took part in this study.<sup>31</sup> The inclusion criteria required participants to be active skateboarders with at least 12 months of experience before survey completion. Therefore, only injuries occurring during the year before the survey were considered for the calculation of the injury risk.

**Injury Frequency per Unit of Exposure.** A retrospective estimate of the injury incidence rate was also calculated, adapting the injury incidence rate per 1000 hours of practice equation<sup>31</sup> to the design of this study. Only injuries occurring in the year before the survey were considered for this calculation, as explained in the previous paragraph. The number of injuries was multiplied by 1000 and divided by the number of respondents times the hours of exposure (ie, mean length of session times mean number of sessions per week times 52 weeks in a year).

**Severity.** Injuries were classified into 3 levels according to the length of time that the skateboarder had to refrain from participating in skateboarding: minor (1-7 days), moderate (8-21 days), and severe (>21 days).<sup>5</sup>

**Injury Recurrence.** Recurrent injuries were classified following the consensus statement on injury definitions<sup>11</sup>: early recurrence (ie, within 2 months after an athlete's return to full participation), late recurrence (ie, 2-12 months after an athlete's return to full participation), and delayed recurrence (ie,  $\geq 12$  months after an athlete's return to full participation). Contusions and wounds were exempt from consideration for recurrent injuries.

## Statistical Analysis

The criterion for inclusion for statistical analysis was the successful completion of the 15 questions. Relative frequencies expressed as percentages and absolute numbers were

used to describe nominal and ordinal variables. The mean and standard deviation were calculated to describe scalar variables. Respondents' sports habits and skateboarding practice habits were compared between groups according to sex, age (ie, <18 and  $\geq 18$  years), and skateboarding experience (ie, <3 and  $\geq 3$  years). Injury-related data were also compared depending on sex, age of the participants at the time of injury (ie,  $\geq 18$  and >18 years), and skateboarding experience at the time of injury (ie, <3 and  $\geq 3$  years). Contingency tables were built to investigate the associations between variables, and typified residuals were calculated. For nominal or nominal-to-ordinal variables, a phi test was performed to measure the degree of association between binary variables, and the Cramer V was used when at least one of the variables was not binary. For variables with multiple possible entries, the answers were grouped to reduce the number of categories and to allow the interpretability of the results (eg, the answers to anatomic location were grouped as head/trunk, upper limbs, and lower limbs). To assess the association between ordinal variables, the Kendall tau-b was used when both variables had the same number of possible values, and the Kendall tau-c was used when both variables had a different number of possible values. When comparing scalar variables, groups were tested for normality using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Because of the nonnormal distribution of at least one of the groups in each comparison, the Mann-Whitney *U* test was performed to compare scalar variables. The level of significance for every test was set at  $\alpha = 0.05$ , and all statistical analyses were performed using SPSS version 20.0 for Windows (IBM) licensed by the University of A Coruña.

## RESULTS

Of the 200 participants who submitted the survey, 3 surveys were discarded because of incomplete data. A total of 197 respondents, 89.3% male ( $n = 176$ ) and 10.7% female ( $n = 21$ ), completed the questionnaire successfully. The mean age was  $24.4 \pm 7.1$  years, with 23.4% ( $n = 46$ ) being younger than 18 years and 76.6% ( $n = 151$ ) being 18 years or older. The mean years of skateboarding experience was  $9.7 \pm 7.2$  years, with 14.2% ( $n = 28$ ) of the participants reporting fewer than 3 years and 85.8% ( $n = 169$ ) reporting 3 or more years of experience. Stance was almost equally divided between regular (52.8%;  $n = 104$ ) and goofy (47.2%;  $n = 93$ ).

### Sports Habits and Skateboarding Practice Habits

The mean number of sessions per week was  $3.3 \pm 1.7$ , and the mean length of each session was  $3.3 \pm 1.5$  hours. A comparison between male and female skateboarders found no significant differences for either the weekly number ( $P = .959$ ) or length of the sessions ( $P = .152$ ). Although the number of sessions per week was not different between those younger and 18 years or older ( $P = .217$ ), those younger than 18 years seemed to have longer sessions ( $P = .005$ ). Similarly, differences in the number of sessions per week

TABLE 1  
Type of Injury by Sex, Age, and Experience<sup>a</sup>

Injury	Sex		Age		Experience		Total
	Male	Female	<18 y	≥18 y	<3 y	≥3 y	
Joint and ligament	128 (45.9)	30 (68.1)	89 (51.5)	69 (46.0)	91 (48.8)	67 (48.9)	158 (49.1)
Ligament sprain	103 (36.9)	25 (56.8)	79 (45.7)	49 (32.7)	81 (43.5)	47 (34.3)	128 (39.6)
Dislocation <sup>b</sup>	13 (4.7)	1 (2.3)	4 (2.3)	10 (6.7)	6 (3.2)	8 (5.8)	14 (4.3)
Ligament rupture	10 (3.6)	2 (4.5)	4 (2.3)	8 (5.3)	3 (1.6)	9 (6.6)	12 (3.7)
Torn cartilage	2 (0.7)	2 (4.5)	2 (1.2)	2 (1.3)	1 (0.5)	3 (2.2)	4 (1.2)
Bone fracture	70 (25.1)	4 (9.1)	37 (21.4)	37 (24.7)	38 (20.4)	36 (26.3)	74 (22.9)
Contusion	24 (8.6)	0 (0.0)	15 (8.7)	9 (6.0)	19 (10.2)	5 (3.6)	24 (7.4)
Muscle and tendon	35 (12.5)	5 (13.6)	18 (10.4)	22 (14.6)	25 (13.4)	15 (11.0)	40 (12.4)
Muscular injury	21 (7.5)	2 (6.8)	9 (5.2)	14 (9.3)	11 (5.9)	12 (8.8)	23 (7.1)
Tendinous injury	14 (5.0)	3 (6.8)	9 (5.2)	8 (5.3)	14 (7.5)	3 (2.2)	17 (5.3)
Wound	10 (3.6)	2 (4.6)	6 (3.4)	6 (4.0)	7 (3.8)	5 (3.7)	12 (3.7)
Laceration	6 (2.2)	1 (2.3)	3 (1.7)	4 (2.7)	4 (2.2)	3 (2.2)	7 (2.2)
Graze	4 (1.4)	1 (2.3)	3 (1.7)	2 (1.3)	3 (1.6)	2 (1.5)	5 (1.5)
Other	12 (4.3)	3 (6.8)	8 (4.6)	7 (4.7)	6 (3.2)	9 (6.6)	15 (4.6)
Total <sup>c</sup>	279 (86.4)	44 (15.6)	173 (53.6)	150 (46.4)	186 (57.6)	137 (42.4)	323 (100.0)

<sup>a</sup>Data are reported as n (%).

<sup>b</sup>Included total or partial.

<sup>c</sup>Expressed as percentage of the whole population (n = 323).

were not found between participants with fewer and with 3 or more years of experience ( $P = .714$ ), but a trend was found suggesting that sessions were longer for participants with less than 3 years of experience ( $P = .054$ ). For 57.9% of the respondents (n = 114), each session included a warm-up, and 46.7% (n = 92) performed a cool-down after each session, with no significant differences found between the males and females ( $P = .314$  for warm-up;  $P = .929$  for cool-down). A larger number of participants 18 years or older reported performing a warm-up ( $P = .024$ ), and a trend seemed to indicate the same for skateboarders with 3 or more years of experience ( $P = .082$ ). Skateboarders with greater experience also reported including a cool-down after the session significantly more ( $P = .004$ ), whereas no differences were found between the age groups ( $P = .861$ ).

Most respondents (87.8%; n = 173) reported not partaking in any skateboarding-specific physical training program, with no significant differences between the groups for sex ( $P = .271$ ), age ( $P = .409$ ), or experience ( $P = .798$ ). Only 27.4% (n = 54) entered skateboarding competitions, with no significant differences found between the groups for sex ( $P = .900$ ) or experience ( $P = .757$ ) but with a significantly greater number of competitors in those younger than 18 years ( $P < .001$ ). Also, 20.4% (n = 11) of the competitors reported completing a specific physical training program for skateboarding competitions. Comparisons between the sex, age, and experience groups within the competitor population were not performed because of the small sample size. Approximately half of the respondents (54.3%; n = 107) took part in other sports apart from skateboarding. Female skateboarders participated in other sports significantly more than their male counterparts ( $P = .011$ ), and a trend suggested the same for older skateboarders ( $P = .077$ ). No significant differences were found between experience groups ( $P = .790$ ).

### Skateboarding Injuries

Of the 197 respondents, 87.8% of the skateboarders (n = 173) reported a total of 323 injuries while skateboarding. Male participants suffered 86.4% (n = 279) of the injuries. Of the total injuries, 53.6% (n = 173) occurred when skateboarders were younger than 18 years, and 57.6% (n = 186) occurred when skateboarding experience was less than 3 years. Injuries requiring medical assistance and/or treatment by a health care professional (eg, physician, physical therapist, or combination of both) amounted to 76.8% (n = 248) of the total, with no significant differences between the groups for sex ( $P = .697$ ), age ( $P = .767$ ), or experience ( $P = .165$ ). There were 62 injuries that were sustained in the year before this study, resulting in an estimated injury risk of 0.31 (95% CI, 0.25-0.37) in the current population. The estimated injury incidence rate in the same population during the same year was 0.55 (95% CI, 0.49-0.61) per 1000 hours of practice.

The most common injury was a ligament sprain (39.6%; n = 128), followed by a bone fracture (22.9%; n = 74) and contusion (7.4%; n = 24). A significant difference was found between male and female participants ( $P = .030$ ). Typified residuals revealed a smaller number of contusions and bone fractures than expected alongside a greater number of joint and ligament injuries in the female group. No significant differences were found between the groups for age ( $P = .617$ ) and experience ( $P = .150$ ). Further descriptions of the type of injury are presented in Table 1.

The most common anatomic location of the injuries was the ankle (39.3%; n = 127), followed by the knee (13.9%; n = 45) and wrist/forearm (9.9%; n = 32). Most injuries affected the lower limbs (69.7%; n = 225). No significant differences were found between male and female participants ( $P = .288$ ) and those younger and 18 years or older ( $P = .796$ ). Although not significant,

TABLE 2  
Anatomic Location by Sex, Age, and Experience<sup>a</sup>

Location	Sex		Age		Experience		Total
	Male	Female	<18 y	≥18 y	<3 y	≥3 y	
Trunk/head	21 (7.5)	4 (9.1)	11 (6.4)	14 (9.9)	9 (4.8)	16 (11.6)	25 (7.7)
Head/neck	10 (3.6)	1 (2.3)	6 (3.5)	5 (3.3)	7 (3.8)	4 (2.9)	11 (3.4)
Thorax/abdomen	7 (2.5)	1 (2.3)	2 (1.2)	6 (4.0)	1 (0.5)	7 (5.1)	8 (2.5)
Back	4 (1.4)	2 (4.5)	3 (1.7)	3 (2.0)	1 (0.5)	5 (3.6)	6 (1.9)
Upper limbs	66 (23.6)	5 (11.3)	39 (22.6)	32 (21.3)	46 (24.8)	25 (18.2)	71 (22.0)
Shoulder	11 (3.9)	1 (2.3)	5 (2.9)	7 (4.7)	7 (3.8)	5 (3.6)	12 (3.7)
Upper arm	2 (0.7)	0 (0.0)	0 (0.0)	2 (1.3)	0 (0.0)	2 (1.5)	2 (0.6)
Elbow	14 (5.0)	0 (0.0)	9 (5.2)	5 (3.3)	9 (4.8)	5 (3.6)	14 (4.3)
Wrist/forearm	30 (10.8)	2 (4.5)	20 (11.6)	12 (8.0)	23 (12.4)	9 (6.6)	32 (9.9)
Hand/fingers	9 (3.2)	2 (4.5)	5 (2.9)	6 (4.0)	7 (3.8)	4 (2.9)	11 (3.4)
Lower limbs	190 (68.1)	35 (79.6)	122 (70.5)	103 (68.6)	129 (69.3)	96 (70.1)	225 (69.7)
Pelvis	8 (2.9)	1 (2.3)	5 (2.9)	4 (2.7)	7 (3.8)	2 (1.5)	9 (2.8)
Thigh	3 (1.1)	0 (0.0)	1 (0.6)	2 (1.3)	1 (0.5)	2 (1.5)	3 (0.9)
Knee	41 (14.7)	4 (9.1)	16 (9.2)	29 (19.3)	22 (11.8)	23 (16.8)	45 (13.9)
Shank	16 (5.7)	1 (2.3)	6 (3.5)	11 (7.3)	6 (3.2)	11 (8.0)	17 (5.3)
Ankle	101 (36.2)	26 (59.1)	81 (46.8)	46 (30.7)	82 (44.1)	45 (32.8)	127 (39.3)
Foot/toes	21 (7.5)	3 (6.8)	13 (7.5)	11 (7.3)	11 (5.9)	13 (9.5)	24 (7.4)
Other <sup>b</sup>	2 (0.7)	0 (0.0)	1 (0.6)	1 (0.7)	2 (1.1)	0 (0.0)	2 (0.6)
Total <sup>c</sup>	279 (86.3)	44 (13.6)	173 (53.6)	150 (46.4)	186 (57.6)	137 (42.4)	323 (100.0)

<sup>a</sup>Data are reported as n (%).

<sup>b</sup>Included injuries to multiple limbs.

<sup>c</sup>Expressed as percentage of the whole population (n = 323).

a trend was observed between the experience groups ( $P = .051$ ). The typified residuals suggested that skateboarders with 3 or more years of experience suffered more head and trunk injuries than expected. The affected side of the body was not associated with skateboarders' preferred stance ( $P = .793$ ). Table 2 summarizes the anatomic location of the injuries.

In terms of severity, 16.2% of the injuries were minor (1-7 days), 29.6% were moderate (8-21 days), and 54.2% were considered severe (>21 days). No significant differences were found between the sex ( $P = .120$ ) and age ( $P = .253$ ) groups. There was a significant difference between the experience groups ( $P < .001$ ), and the typified residuals revealed a larger number of severe injuries than expected in the group of skateboarders with 3 or more years of experience and a greater number of minor and moderate injuries than expected within the group with less than 3 years of experience. Injured skateboarders did not follow any specific functional rehabilitation program before returning to practice in 67.1% of the cases. No significant differences were found between the sex ( $P = .600$ ), age ( $P = .179$ ), and experience ( $P = .207$ ) groups. Of the 272 injuries eligible to be considered as recurrent injuries, 67 were reported as such: 25.0% were classified as early recurrent, 64.7% as late recurrent, and 10.3% as delayed recurrent. The most common recurrent injuries were ligament sprains (68.7%; n = 46) and affected mostly the ankle (70.1%; n = 47). Comparisons of recurrent injuries between the sex, age, and experience groups were not made because of the limited number of recurrent injuries.

The skateboarding obstacles on which most of the accidents occurred were the following: gap including stairs or

any kind of jump from a higher level than the landing ground (25.7%); ramp including quarters, half-pipes, mini-ramps, and bowls, among others (23.5%); and flat (15.2%). All the obstacle options included in this survey and their results are shown in Table 3.

## DISCUSSION

The purpose of this study was to describe skateboarders' sports habits and skateboarding practice habits, the most common types of injury in this sport, their location, severity, and the obstacle on which they occurred. The influence of different risk factors found in previous literature (ie, sex, age, and experience at the time of injury) was also assessed. The characteristic data showed that the respondents of this survey were predominantly male. This is similar to recent studies in other countries<sup>19,26,29</sup> and to older studies,<sup>9,33,43</sup> suggesting that the sex distribution of skateboarders has not changed in recent decades. The mean age, skateboarding experience, and preferred stance of the skateboarders were also comparable with those in previous studies.<sup>19</sup>

There was a relatively low number of competitors among the participants of this survey, suggesting that most practiced skateboarding as a recreational activity. This seems to be further reinforced by the small number of respondents who reported completing skateboarding-specific physical training programs and the high number of skateboarders taking part in other sports. The number of sessions per week and their duration seem to be low when compared with previous work.<sup>19</sup> However, these features were self-reported in both studies, which may explain the

TABLE 3  
Skateboarding Obstacles on Which Injuries Occurred<sup>a</sup>

Obstacle	Sex		Age		Experience		Total
	Male	Female	<18 y	≥18 y	<3 y	≥3 y	
Gap or stairs	63 (22.6)	20 (45.5)	49 (28.3)	34 (22.7)	46 (24.7)	37 (27.0)	83 (25.7)
Ramp	63 (22.6)	13 (29.5)	32 (18.5)	44 (29.3)	40 (21.5)	36 (26.3)	76 (23.5)
Flat	43 (15.4)	6 (13.6)	31 (17.9)	18 (12.0)	32 (17.2)	17 (12.4)	49 (15.2)
Ledge	44 (15.8)	0 (0.0)	21 (12.1)	23 (15.3)	26 (14.0)	18 (13.1)	44 (13.6)
Bank	10 (3.6)	1 (2.3)	8 (4.6)	3 (2.0)	8 (4.3)	3 (2.2)	11 (3.4)
Pyramid	11 (3.9)	0 (0.0)	5 (2.9)	6 (4.0)	3 (1.6)	8 (5.8)	11 (3.4)
Hubba	5 (1.8)	0 (0.0)	3 (1.7)	2 (1.3)	3 (1.6)	2 (1.5)	5 (1.5)
Rail	7 (2.5)	1 (2.3)	4 (2.3)	4 (2.7)	3 (1.6)	5 (3.6)	8 (2.5)
Rail down	7 (2.5)	0 (0.0)	7 (4.0)	0 (0.0)	7 (3.8)	0 (0.0)	7 (2.2)
Manual pad	2 (0.7)	1 (2.3)	3 (1.7)	0 (0.0)	3 (1.6)	0 (0.0)	3 (0.9)
Other <sup>b</sup>	24 (8.6)	2 (4.5)	10 (5.8)	16 (10.7)	15 (8.1)	11 (8.0)	26 (8.0)
Total <sup>c</sup>	279 (86.3)	44 (13.6)	173 (53.6)	150 (46.4)	186 (57.6)	137 (42.4)	323 (100.0)

<sup>a</sup>Data are reported as n (%).

<sup>b</sup>Included other urban furniture (n = 15), downhill (n = 6), and car accidents (n = 3).

<sup>c</sup>Expressed as percentage of the whole population (n = 323).

discrepancy in the answers. There were also differences among the respondents of this survey regarding the inclusion of warm-up and cool-down routines in the sessions. This may be because of the current nonorganized nature of skateboarding. It is important to further understand what is involved within skateboarding sessions, as their length was reported to be greater than that of other conventional sports. While the time point within the session at which injuries occurred could not be determined, it is well known that fatigue promotes a reduction in proprioception and a subsequent increase in the risk of injuries.<sup>42</sup>

The estimated risk of skateboarding injuries in the current population was 0.31, or stated in another way, 1 in every 3 respondents were injured over the 12-month period before this study. Contrary to popular opinion,<sup>6</sup> skateboarding has been classified before as a relatively safe sport.<sup>21,33</sup> In this survey, the estimated risk of injuries among the respondents was comparable with that of similar sports such as surfing.<sup>12</sup> Indeed, the estimated frequency of injuries per unit of exposure (0.55 per 1000 hours) in the current sample was lower than that in recreational surfing<sup>12</sup> and in other popular sports in Spain such as soccer.<sup>16</sup>

Most injuries involved joints and ligaments and affected the lower limbs, with no apparent relationship between the leading leg and the injured side, in contrast with previous findings.<sup>19</sup> Overall, an ankle ligament sprain was the most common injury. Although several studies have found similar results,<sup>7,9,19</sup> bone fractures, especially wrist fractures, seem to have received greater attention in the skateboarding literature.<sup>26,39,43</sup> The older profile of the current population may explain these differences, as the high number of bone fractures typically observed in children and adolescents has been related to incomplete bone maturation.<sup>8</sup> Furthermore, considering that most previous studies have used hospital records, it seems that the exclusive use of this methodology may overlook numerous skateboarding injuries.<sup>9,43</sup> For instance, more than 20% of the injuries

recorded in the current survey did not receive any medical attention, highlighting the contribution of athlete-level self-reported information to better understand sports injuries. Nonetheless, these cases, including contusions, wounds, joint and ligament injuries, and muscle and tendon injuries, were presumably self-diagnosed. It is important to raise awareness of the potentially harmful consequences of not visiting a health care professional when injuries occur. This is stressed by the relatively high number of recurrent ankle sprains reported, which could be indicative of poor rehabilitation practice. Exploration of specific strength and conditioning and proprioception programs may help address this issue and prevent the development of chronic conditions.<sup>4,40</sup>

Regarding injury severity, 83.8% of the injuries required more than 7 days of recovery, and more than 50% were classified as severe. This clearly highlights the importance of injury surveillance in skateboarding, which is currently nonexistent in Spain and challenging because of skateboarding's nonorganized nature. Additionally, identifying skateboarding obstacles on which injuries occur is difficult because this sport is practiced in multiple settings (eg, skate parks, streets). In this survey, most of the reported injuries occurred when skateboarding a gap or set of stairs and ramps (eg, quarter-pipe, mini-ramp, bowl). Skateboarding gaps or stairs requires initial speed to overcome the length of the obstacle and involves a difference in height from the take-off to landing surfaces. Similarly, skateboarding ramps involve speed and a high level of balance. Skateboarders are exposed to these challenges that result in high biomechanical loads when a fall occurs and a subsequent higher risk of injuries. A reduced number of injuries were also reported when practicing downhill, more typically observed in longboarding,<sup>18,23</sup> and in some cases also involving motor vehicles. Previous studies reporting on this type of accident<sup>9,10</sup> suggested limiting the practice of skateboarding to designated areas.

## Risk Factors

The greater number of female respondents taking part in other sports suggests that this group was more likely to practice skateboarding as a recreational activity. As found in previous studies, a greater relative number of injuries were reported by male participants.<sup>25,29,30</sup> Although injuries affected the same anatomic locations and were of the same severity for males and females, the type of injury seemed to be different. A greater number of joint and ligament injuries alongside a reduced number of contusions and bone fractures were observed in the female group. Greater joint laxity in women may explain these results, as previous studies have related this characteristic with diminished proprioception and a higher risk of joint injuries.<sup>35</sup>

Skateboarders of different ages showed different sports habits and skateboarding practice habits: Respondents younger than 18 years reported having longer sessions than those 18 years or older. Also, this group participated in competitions more, which may be explained by the evolution of skateboarding into a more conventional competitive sport. On the other hand, respondents 18 years or older reported performing other sports more than those younger than 18 years, suggesting that skateboarding was mostly practiced as a recreational activity in this group. They also seemed to be more organized in their sessions by being more likely to include a warm-up. As age increases, so does awareness of the consequences of an injury, making safe practice a fundamental concern.<sup>6,20</sup> The type, location, and severity of injury were however similar in both age groups, which seems to contrast with previous findings.<sup>25</sup>

Like younger skateboarders, participants with less experience reported longer sessions. More experienced skateboarders seemed to be more organized in the practice of their sessions, as they usually performed a warm-up and cool-down. A greater number of injuries to the head and trunk and of greater severity were reported in the more experienced group. As previously suggested, the development of skills on the skateboard could prompt skateboarders to try harder maneuvers and at faster speeds, exposing themselves to more severe consequences.<sup>10,19,20</sup> Although no concussions were reported, the use of protective gear, especially of a helmet, is encouraged to prevent severe brain damage, as this has been a major concern in previous related literature.<sup>6,23,37,38</sup>

## Limitations and Future Recommendations

Several limitations must be considered when interpreting the results of this study. First, although the sample size of this survey was similar to those of previous studies,<sup>9,19</sup> the lack of an official Spanish register of skateboarders makes it unclear to what extent the current number of respondents is representative of the Spanish skateboarding population. It must be noted that the injury risk and incidence rate estimated in this study are only approximations that have been calculated retrospectively and may not be representative of the entire skateboarding population in Spain. The questionnaire was distributed electronically, and potential respondents decided to participate, which might have conditioned our results, as skateboarders who have

had injuries may be more likely to complete the survey.<sup>13</sup> Response rates could not be calculated, as we did not have access to the number of visitors of each website that shared the survey. Web-based surveys also lack an interviewer to clarify and probe the responses, potentially leading to limited reliability.<sup>15</sup> Also, caution is advised when interpreting some of the comparisons, as the number of female participants, those younger than 18 years, and participants with less than 3 years of skateboarding experience was limited. The number of skateboarders who took part in competitions was limited as well, and whether these results apply to the competitive skateboarding population needs to be clarified in future work. Last, it must be noted that injury data were collected relying on participants' memory and that 23.2% of the injuries may have not been diagnosed by a clinician, which clearly introduces room for error. Further, studies have shown that the rate of recall declines as the detail of the injury increases.<sup>14</sup>

The implementation of the Questionnaire of Sport Habits and Skateboarding Injuries in the present study has identified the sports and skateboarding habits and the most common injuries in a sample of skateboarders in Spain. This provides clinicians, coaches, and skateboarders with basic information for the development of training programs and injury prevention/rehabilitation strategies. The implementation of this questionnaire is encouraged in other countries to further our understanding of skateboarders' habits and injuries and to allow comparison between studies. However, investigating skateboarding injuries and practice habits is still challenging for researchers because of the current nonorganized nature of this activity. With its recent inclusion in the Tokyo 2020 Olympic Games, skateboarding is expected to develop professionally, similar to more conventional sports. This will involve the creation of national federations, schools, and clubs in different countries and will provide more controlled conditions for researchers (eg, an official register of skateboarders, access to consistent injury exposure data for the appropriate calculation of injury incidence rates) to conduct sound epidemiology studies on skateboarding. This is one of the current challenges in skateboarding-related literature.<sup>8</sup> Last, the present study has identified the most common obstacles on which skateboarding injuries occurred in the current group of respondents. Biomechanical studies are encouraged to describe injury mechanisms, especially those affecting the ankle, as an ankle sprain has not only been found to be the most common injury but also the most likely to recur.

## CONCLUSION

To our knowledge, this is the first study describing skateboarders' habits and most common injuries, their type, location, severity, and obstacle on which they occurred in a sample of skateboarders in Spain. Respondents were mostly young male adults who practiced skateboarding mainly as a recreational activity. The lower limbs were identified as more likely to suffer injuries, with a large number of cases affecting joints and ligaments. Ankle sprains were found to be the most common injury and also

the most likely to recur within the current sample of respondents. This information can be used to develop more effective prevention, treatment, and rehabilitation plans for skateboarding-related injuries.

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APPENDIX

Questionnaire of Sport Habits and Skateboarding Injuries

The questionnaire used in this survey included the following questions:

Personal Data

Questions	Possible Answers
Sex	Male, female
Age	Numerical
Stance	Regular, goofy

Sports Habits

Questions	Possible Answers
Years of skateboarding	Numerical
Sessions per week (maximum of 7)	Numerical
Length of each session in hours	Numerical
Do you participate in any type of physical training program for skateboarding?	Yes, no
Do you play any other sport?	Yes, no
If applicable, do you participate in any type of physical training program for it?	Yes, no

Skateboarding Practice Habits

Questions	Possible Answers
Do you perform any type of warm-up before skateboarding?	Yes, no
Do you perform any type of cool-down after skateboarding?	Yes, no
Do you participate in skateboarding contests?	Yes, no
If applicable, do you perform any specific physical training before competitions?	Yes, no

Injury Record

Questions	Possible Answers
Have you ever suffered any injury as a direct consequence of skateboarding?	Yes, no

If your answer to the previous question was “yes,” we would like to know about those injuries that obliged you to stop your usual skateboarding practice (maximum of 10). Please list those injuries and answer the following questions related to each of them:

Questions	Possible Answers
Year	Numerical
Injury type	Bone fracture, torn cartilage, ligament sprain, ligament rupture, dislocation, muscular injury, tendinous injury, contusion, laceration, graze, other
Anatomic location	Head/neck, thorax/abdomen, back, shoulder, upper arm, elbow, wrist/forearm, hand/fingers, pelvis, thigh, knee, shank, ankle, foot/toes, other
Side	Right, left, axial
Obstacle on which it occurred	Flat, ledge, hubba, manual pad, rail, down rail, pyramid, bank, gap/stairs/kicker, ramp, other
Time loss	1-7 d, 8-21 d, >21 d
Type of treatment	Clinician, clinician and physical therapist, physical therapist, none, other
Functional training rehabilitation	Yes, no
Did it recur?	Yes, no
If applicable, how long after did it recur?	Numerical

All the questions but those dependent on previous answers (ie, “if applicable”) were made mandatory in the online platform so a respondent would not be allowed to submit a questionnaire if  $\geq 1$  questions were not answered. Each question could have a single answer. If a question was answered with “other,” the respondent was provided with a box to write down a nonincluded answer.