Participation habits, physical complaints and injuries in a sample of Portuguese female artistic roller skaters

Hábitos de participación, quejas y lesiones físicas en una muestra de patinadores artísticas portuguesas

Carolina Alexandra Cabo[1*], João Paulo Sousa[1, 2], Jorge Bravo[1, 2]

[1] Department of Sport and Health, School of Health and Human Development, University of Évora, Portugal

[2] Comprehensive Health Research Centre (CHRC), University of Évora, Portugal

* **Correspondence:** Carolina Alexandra Cabo, carolinaacabo@gmail.com

Short title:
Participation habits, physical complaints and injuries in a roller skaters

How to cite this article:
Cabo, C.A., Sousa, J.P., & Bravo, J. (2022). Participation habits, physical complaints and injuries in a sample of Portuguese female artistic roller skaters. *Cultura, Ciencia y Deporte, 17*(54), 87-96. https://doi.org/10.12800/ccd.v17i54.1879

Received: 22 february 2022 / Accepted: 26 october 2022

Abstract

Educators and health professionals need to gain knowledge of the special needs of artistic roller skaters if they seek effective training and preventing physical complaints or injuries. In the absence of epidemiological studies on artistic roller skaters, it is useful to characterize the participants, their participation habits, and the occurrence of physical complaints or injuries. A web-based survey was designed to collect epidemiological information on female artistic roller skaters. The self-report questionnaire included information about the participant, her participation habits, injury history, and physical complaints in the past 12 months. A total of 143 female artistic roller skaters were included in the study. Sixty-seven [46.9%] of the participants had 175 physical complaints in the past 12 months, for an average of 2.61 complaints per skater. The physical complaints mainly affected the lower limbs (53.1%), followed by the trunk (24.0%) and upper limbs (22.9%). The most affected sites were the knee (16.6%), back (10.9%) and wrist (10.3%). Our results suggest that physical complaints are common in artistic roller skating. It becomes crucial to study the etiology of physical complaints and/or injuries. Preventing physical complaints and injuries is crucial for athletes' well-being. Our study results may draw attention and help coaches and educators implement adequate preventive measures.

Keywords: Artistic roller skating, injuries frequency, participation rates, physical complaints, web-based questionnaire.

Resumen

Los educadores y profesionales de la salud deben conocer las necesidades especiales de los patinadores artísticos sobre ruedas si buscan un entrenamiento eficaz y previenen quejas o lesiones físicas. En ausencia de estudios epidemiológicos sobre patinadores artísticos, es útil caracterizar a los participantes, sus hábitos de participación y la ocurrencia de quejas o lesiones físicas. Se diseñó una encuesta basada en la web para recopilar información epidemiológica sobre patinadoras artísticas femeninas. El cuestionario de autoinforme incluía información sobre la participante, sus hábitos de participación, historial de lesiones y quejas físicas en los últimos 12 meses. Se incluyeron en el estudio un total de 143 patinadoras artísticas femeninas. Sesenta y siete [46,9%] de los participantes tuvieron 175 quejas físicas en los últimos 12 meses, con un promedio de 2,61 quejas por patinador. Las quejas físicas afectaron principalmente a los miembros inferiores (53,1%), seguido del tronco (24,0%) y miembros superiores (22,9%). Los sitios más afectados fueron rodilla (16,6%), espalda (10,9%) y muñeca (10,3%). Nuestros resultados sugieren que las quejas físicas son comunes en el patinaje artístico sobre ruedas. Se vuelve crucial estudiar la etiología de las molestias y/o lesiones físicas. La prevención de molestias y lesiones físicas es crucial para el bienestar de los atletas. Los resultados de nuestro estudio pueden llamar la atención y ayudar a los entrenadores y educadores a implementar medidas preventivas adecuadas.

Palabras clave: Patinaje artístico sobre ruedas, frecuencia de lesiones, tasas de participación, quejas físicas, cuestionario basado en la web.

Introduction

Skating is a fitness sport for life, suitable for both children and adults. It helps improve cardiovascular fitness as well as balance and coordination. As a sport, it requires efficient speed, balance, power, strength, endurance, coordination, and agility (Ferrara & Hollingsworth, 2007; Sehgal & Esht, 2019). It can also promote social adaptability in children and adolescents (Zhao et al., 2020).

Most skaters are female and start skating at the age of 5 to 8 years. Usually, they reach the peak of their career at puberty before they are 20 years old (Porter et al., 2007). In terms of disciplines, there are four aspects of the sport: free skating, pairs skating, show and precision, and figure skating (Moreira, 2013; Porter et al., 2007).

Training young children helps them develop from beginners to champions. The athlete would improve his performance from the beginning if he adapted to the exercises, which will lead to his success (Alcaraz-Ibáñez et al., 2022; Sehgal & Esht, 2019).

Artistic roller-skating is considered an evolving sport that is gaining more and more followers in recent years (Lime Survey, 2013), especially children and teenagers. Although it has little recognition at both national and international levels, the increasing number of active athletes, which doubled between 2010 (3268 active athletes) and 2018 (7760 active athletes), has ensured that artistic roller-skating has become a highly competitive sport. High performance demands, rigorous and intense training are usually associated with this sport, which can lead to an increased risk of injury (Porter et al., 2007).

As a significant number of young people experience increased training intensity, the stresses on the dynamics of skeletal growth and muscle development are issues that may arise and deserve investigation (Stricker et al., 2020). Some studies have shown that skating can stimulate muscles and smaller joints and play a positive role in the balanced development of different body parts (Zhao et al., 2020).

However, skating helps to improve the health of athletes through exercise and puts children at particular risk of injury (Knox et al., 2006). Future injuries may be associated with recurrent problems, such as acute or chronic, and appear to be common in artistic roller skating. Therefore, training hourmay increase the prevalence of injuries and physical complaints, either in a regular training regime or in the specific preparation phases for specific events or championships (Porter et al., 2007).

The main objective of this study was to describe the participation habits and physical complaints in a sample of Portuguese female artistic roller skaters within the last 12 months.

Materials and Methods

Sampling frame

A cross-sectional observational study was conducted to collect self-reported data using a web-based questionnaire in the Portuguese language. Data were collected between August and December 2018 by recruiting participants in artistic roller-skating who were members of the Federação Portuguesa de Patinagem (FPP).

Regardless of age, gender, category or discipline, a group of Portuguese artistic roller skaters who are members of the FPP were invited to participate in this study. Normative data were collected from the FPP online platform to ensure that our study sample differed significantly from the Portuguese artistic roller-skating community (FPP, 2019). No additional restrictions were imposed to ensure representativeness.

A total of 1840 artistic roller-skating participants registered in the FPP and their regional association were invited to participate in the web-based survey. Of these, we received responses from 368 individuals (346 women and 22 men). Due to incomplete responses, 212 were excluded. Of the remaining sample of 156 participants, we excluded 13 men based on the study objective. In this way, we were able to obtain complete responses from 143 female artistic roller-skating participants (Figure 1).

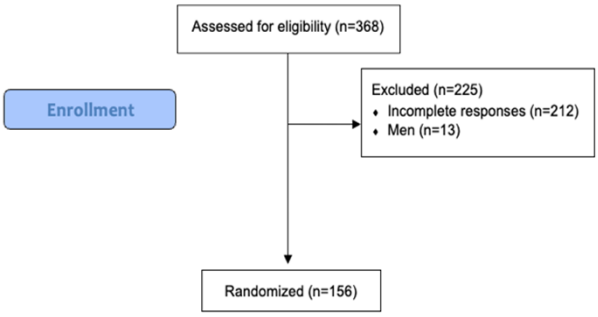


Figure 1. Flow Diagram

Although a substantial proportion (82.5%) were minors, more than half (58.7%) completed the questionnaire without assistance, while the remainder sought help from their parents or guardians. No duplicate responses were detected when monitoring each participant's IP address and email. The web-based survey took an average of eight minutes to complete.

The sample intended to integrate the largest number of female figure skating practitioners in Portugal. Thus, as inclusion criteria were defined: [1] being a federated figure skating practitioner and/or being exposed to training and/or National or International competitions; [2] be a skater in Portugal including the Azores and Madeira archipelagos; [3] be a skating practitioner of any technical level (District, National and/or International); [4] be a skating practitioner of any skating style (free skating, mandatory figures, solo dance, show and precision); [5] be a female skater; and (4) be a skater of any age group.

All 143 skaters were divided into two groups. About 124 (86.7%) children and adolescents who were under 20 years of age were included in the first group (G1), while 19 (13.3%) young adults who were over 20 years of age formed the second group (G2).

Initially, we performed an anthropometric and body composition assessment, through the analysis of weight and height. For 19 female G2 participants, we calculated BMI index using the Centers for Disease Control and Prevention (CDC) adult calculator.

The CDC calculators were used to calculate height, weight, and body mass index (BMI) for children and adolescents (girls). The calculated z-scores and percentiles were adjusted to the Portuguese population (DGS, 2006). For weight <55 kg (percentile >5 and <50 underweight), 60-65 kg (percentile >50 and <75 healthy weight), 70-75kg (percentile >85 and <95 overweight) and >80 kg (percentile >95 obesity). For stature <150 cm (percentile <5 short stature), 155-170 cm (percentile ³5 and <95 normal stature) and ³172 cm (percentile ³95 tall stature). For people < 20 years old, obesity > 95th percentile and overweight > 85th percentile and < 95th percentile.

For adults 20 years old and older, BMI is interpreted using standard weight status categories. For weight status, if the BMI is below 18.5 (124 pounds or less) it is underweight, if it is between 18.5-24.9 (125 pounds to 168 pounds) it is healthy weight, if it is 25, 0-29.9 (169 pounds to 202 pounds) is overweight, and 30.0 or above (203 pounds or more) is obese.

The variables analyzed within the participation habits and training characteristics were initiation and years of practice, associations, categories, disciplines, number of coaches, floors, equipment, participation in tournaments, training area and weekly training hours.

The questions that were used to answer the variables were: What is your category distribution: Iniciation (3 to 7 years old), tot (8 and 9 years old), minis (10 and 11 years old), espoir (12 and 13 years old), cadet (14 and 15 years old), youth (16 years old), junior (17 and 18 years old) and senior (19 or more years old) - for the category variable; Which Figure Skating discipline do you practice: Free, Figures, Show and Precision, Solo Dance or Mixed - for the discipline variable; Which floor do you train on: cement, wood or synthetic - for the floor variable; How many coaches did you have: 1, 2, 3, 4 or more - for the coaches variable; How often do you change the material (boots, chassis, bearings, wheels): every use, weekly, monthly, yearly or when there are problems - for the equipment variable; In the last 12 months did you participate in tournaments, what kind of tournaments did you participate: district, national, international or others - for the variable participation in tournaments; On average, how many hours per week did you skate, in the last 12 months: up to 2h, from 2 to 5h, from 5 to 10h or more than 10h for the variable hours of training.

Web-based questionnaire

The web-based questionnaire was specifically designed to collect information about participants' details, participation habits, and physical complaints related to the practice of artistic roller-skating in the past 12 months. This instrument was made available on the servers of Limesurvey (Lime Survey, 2013).

Before distribution of the final version of the questionnaire, a preliminary version was created and distributed to a representative group of female artistic roller skaters (n=25) to assess instrument's reliability and identify potential complications in its use. The preliminary version was then adapted, and the resulting questionnaire was used in this study.

The final version consisted of five groups of questions: (1) personal data; (2) general details of participation; (3) participation within the past 12 months; (4) injury history; and (5) physical complaints within the past 12 months.

Definition of outcomes

Well-established definitions of 'chronic health conditions', 'previous injuries', and 'physical complaints' were required for some outcomes. A chronic health condition (CHC) was defined as "a heart condition, respiratory disease, osteoarthritis, or the like that might limit the practice of artistic roller skating." A previous injury (PI) was defined as "an injury related to participation in artistic roller-skating that occurred more than 12 months ago." Physical complaints (PC) related to artistic roller-skating participation was defined as "a simple complaint such as complaints or more disturbing symptoms such as pain or complaints, regardless of the need for medical treatment, effect on performance, or absence from artistic roller-skating participation."

Ethical Considerations

Ethical approval for this study was obtained from the Ethics Committee of the Universidade de Évora (CEICASHBE/UE/18032). Although identifying parameters were recorded, they were used only to exclude duplicate responses. After this procedure, each participant was given a code that precluded further identification at any study stage, thus ensuring complete anonymity. A written informed consent form was also signed by each participant for their participation in this study. For those younger than 18 years of age, the consent form was signed by their legal guardian, who assisted in completing the questionnaire and understanding it.

Statistical analysis

Responses to the questionnaire were summarized in the web-based data set and exported to a syntax/data file. The files were then imported into IBM® SPSS® Statistics version 26 (IBM Corp. Released 2019. Armonk, NY), providing descriptive statistics.

The univariate analysis focused on summarizing and describing the results of each question. For categorical variables, we counted frequencies of responses using percentages. For continuous questions, we used measures of central tendency (mean, median) and dispersion (standard deviation, range).

Results

Participant details

The general descriptive elements of the sample are presented in Figure 2.

Categorizing 124 G1 women by percentiles, we found that 103 (83.1%) had normal stature, 14 (11.3%) were tall, and 7 (5.6%) were short.

After classifying weight status into percentiles in 124 G1 women, we found that 105 skaters (84.7%) were at a healthy weight, 14 (11.3%) were overweight, 3 (2.4%) were underweight, and 2 (1.6%) were obese.

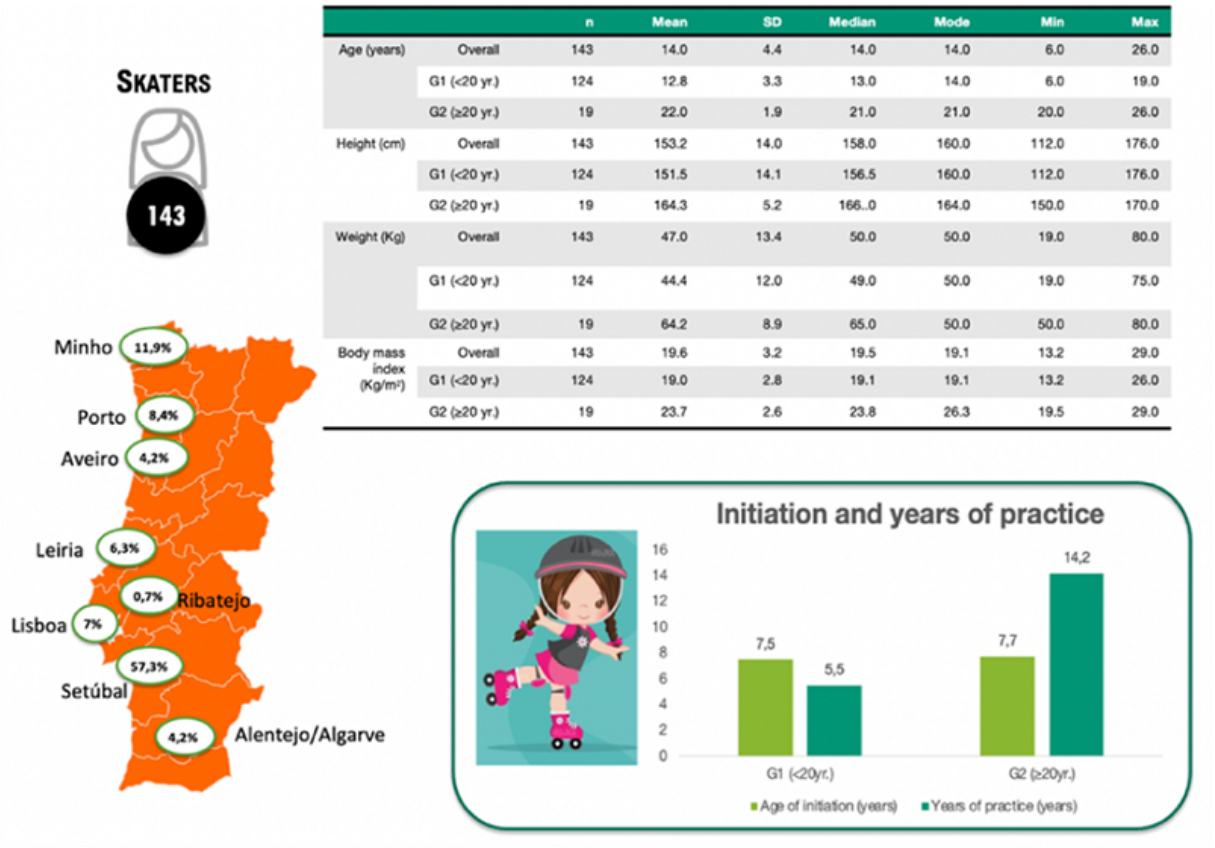
In addition, female skaters frequently reported being right-handed (89.5%) and right footed (86.7%). However, 4 right-handed skaters preferred to use their left foot as the leading side during training.

Participation Habits

About 88.1% of the participants were active out of admiration for artistic roller skating.

A much smaller percentage (11.9%) began training out of a need to engage in physical activity regularly. The most represented regional association was the *Associação de*

Patinagem de Setúbal, with 82 (57.3%) artistic roller skaters, as shown in Figure 2.



		n	Mean	SD	Median	Mode	Min	Max
Age (years)	Overall	143	14.0	4.4	14.0	14.0	6.0	26.0
	G1 (<20 yr.)	124	12.8	3.3	13.0	14.0	6.0	19.0
	G2 (≥20 yr.)	19	22.0	1.9	21.0	21.0	20.0	26.0
Height (cm)	Overall	143	153.2	14.0	158.0	160.0	112.0	176.0
	G1 (<20 yr.)	124	151.5	14.1	156.5	160.0	112.0	176.0
	G2 (≥20 yr.)	19	164.3	5.2	166..0	164.0	150.0	170.0
Weight (Kg)	Overall	143	47.0	13.4	50.0	50.0	19.0	80.0
	G1 (<20 yr.)	124	44.4	12.0	49.0	50.0	19.0	75.0
	G2 (≥20 yr.)	19	64.2	8.9	65.0	50.0	50.0	80.0
Body mass index (Kg/m²)	Overall	143	19.6	3.2	19.5	19.1	13.2	29.0
	G1 (<20 yr.)	124	19.0	2.8	19.1	19.1	13.2	26.0
	G2 (≥20 yr.)	19	23.7	2.6	23.8	26.3	19.5	29.0

Figure 2. Participant´s details

Initiation and experience

On average, initiation in artistic roller-skating began at age 7.5 (± 2.8) years. The youngest skater started practicing at the age of 2 years. The longest practice time was 23 years and involved a skater who started at age 3. Overall, the average experience was 6.5 (±4.9) years. Skaters younger than 20 years had an average experience of 5.31 (±3.8) years. For those over 20 years of age, the average experience was 14.21 (±4.6) years. The overall skater onset and experience data are presented in Figure 2.

Training characteristics

The variables analyzed within the training characteristics were categories, disciplines, number of coaches, floors, equipment, participation in tournaments, training area and weekly training hours.

Categories

Participants in artistic roller-skating are categorized according to the age reached in each sport during the calendar year. Each age group represents a specific category. The distribution of our sample by category is shown in Figure 3. The figure shows that the most frequently observed category in our sample was cadets (21.0%).

Disciplines

A total of 108 (75.5%) skaters mastered free skating. They were followed by 16 (11.2%) in mixed disciplines, with the remainder distributed among solo dance (7.0%), show and precision (3.5%), and figures (2.8%). The distribution of skaters per discipline is shown in Figure 3.

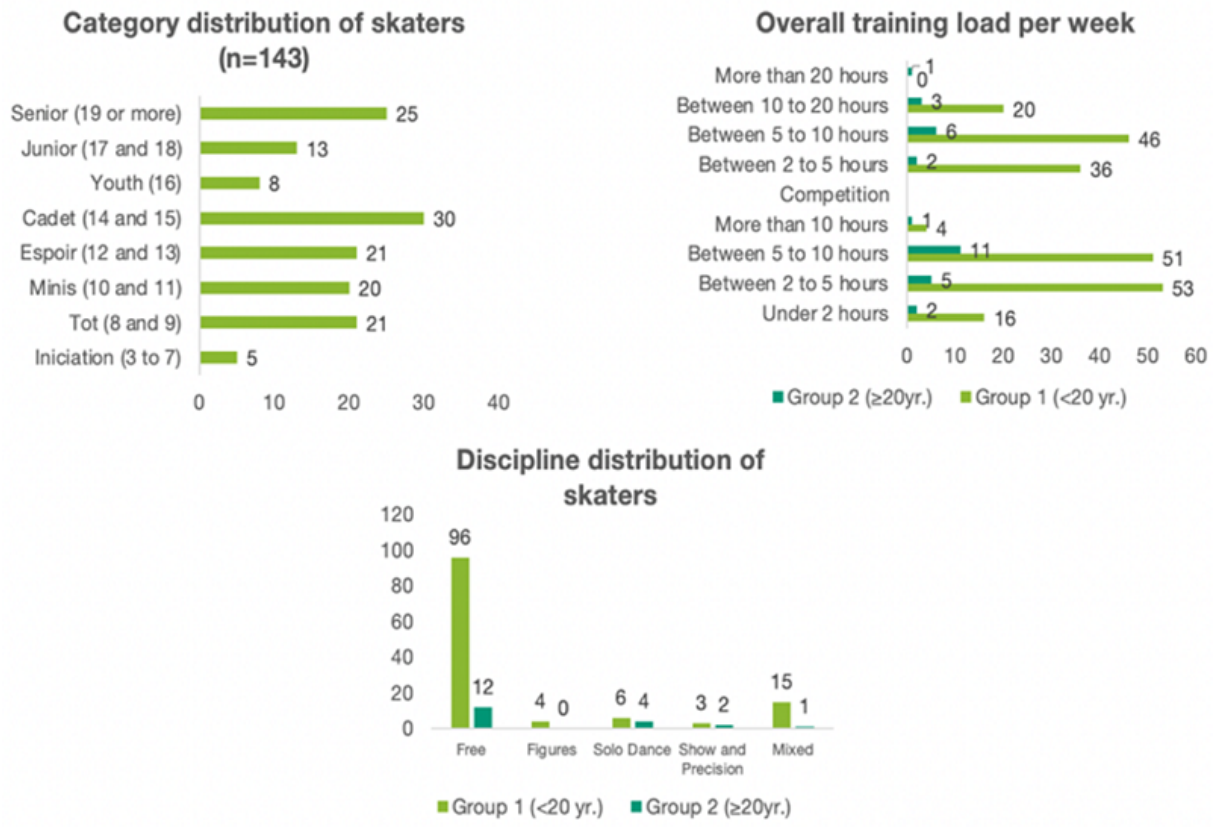


Figure 3. Habits and training characteristics

Coaches

A total of 129 (90.2%) skaters had a coach since they started artistic roller skating. In terms of the number of coaches over the years, most reported having one coach (n=45; 31.5) and 4 or more coaches (n=44; 30.8%). The percentage of those who had 2 or 3 coaches was lower at 21.7% and 16.1%, respectively.

Floors

In the last 12 months, most of the respondents exercised more frequently on wooden floors (79.2%). Only 31 individuals exercised on other floors such as cement (n = 21; 14.1%) or synthetic (n = 10; 6.7%).

On synthetic and wooden floors, skating is mainly "free" (60% and 74.6%, respectively). On cement floors, the "free" and "other" styles were equally distributed, 47.6% and 42.9%, respectively.

Equipment

Skaters maintained their wheels and bearings monthly (44.8%) or whenever they exhibited problems (32.9%). A smaller percentage (13.3%) was found among those who used a weekly maintenance schedule. The most common time periods for skate replacement were over 3 years (48.3%) and within 1 to 2 years (38.5%).

Fewer skaters replaced their artistic roller skates annually (13.3%).

Most skaters replaced their roller plates within 3 or more years (65.7%), followed by those who replaced every 1 to 2 years (32.9%). Only 2 skaters (1.4%) replaced their plates annually. General descriptive details of equipment behavior can be found in Figure 4.

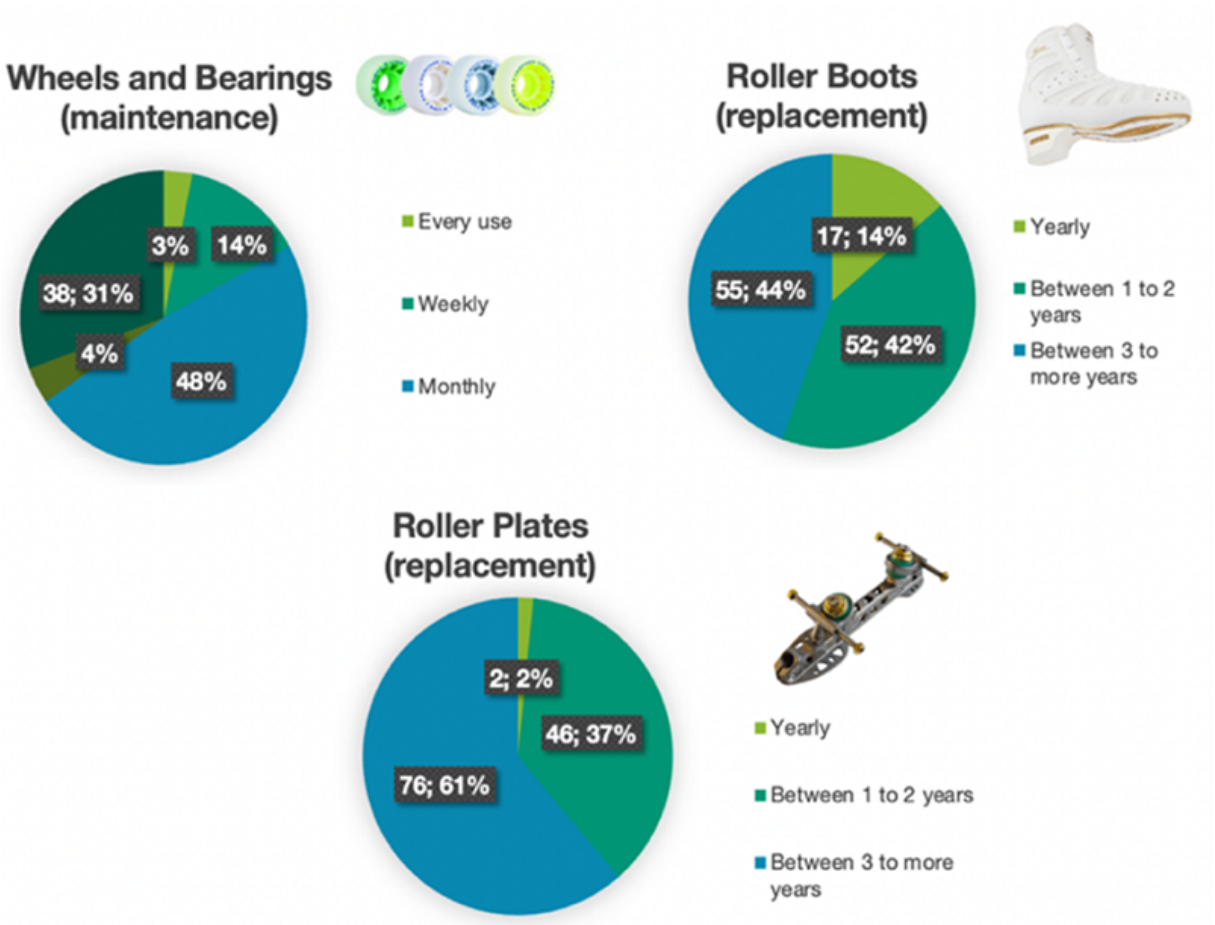


Figure 4. Equipment changes

Participation in tournaments

Participation in tournaments was reported by 114 skaters (79.7%). Seventy-five (52.4%) skaters participated at the district level, 22 (15.4%) at the national level, and 12 (8.4%) at the international level. Only 5 (3.5%) skaters competed at all levels.

Training area and Weekly Training hours

In terms of training load per week, most skaters trained between 2 and 10 hours in the past 12 months [84.0%]. Within this interval of training hours, 62 (43.3%) trained between 5 and 10 hours, while 58 (40.6%) trained between 2 and 5 hours per week.

Eighteen (12.6%) reported training less than 2 hours and 5 (3.5%) more than 10 hours per week.

During the preparation for a tournament, the training hours were adjusted. We analyze the behavior within each category and find that 60 (52.6%) skaters maintained their training load despite preparing for a competition, while 46 (40.4%) skaters followed the opposite approach and increased their training load.

The larger percentages of increase were found in the junior (63.6%) and senior (55.6%) categories. Maintaining training volume was more pronounced in the minis (78.6%) in terms of percentage. Only 8 skaters (7.0%) apparently, decreased their training load in preparation for a competition. The categories in which we did not observe any tendencies to reduce training load were the beginning and the minis. Details of pre-competition training load compared to normal training habits can be found in Figure 5.

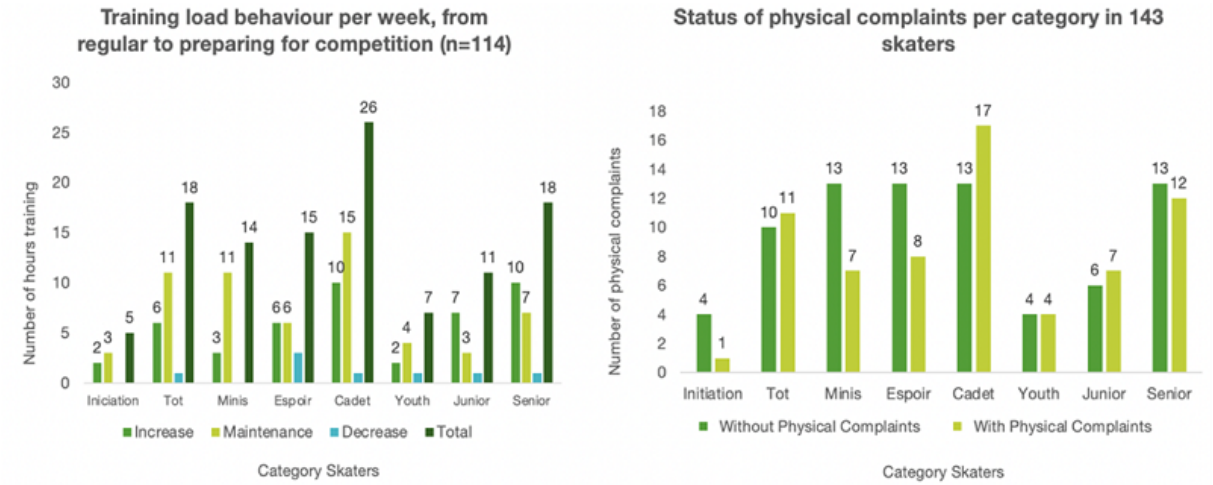


Figure 5. Weekly hours of training and number of physical complaints considering the category of skaters

Health-related results

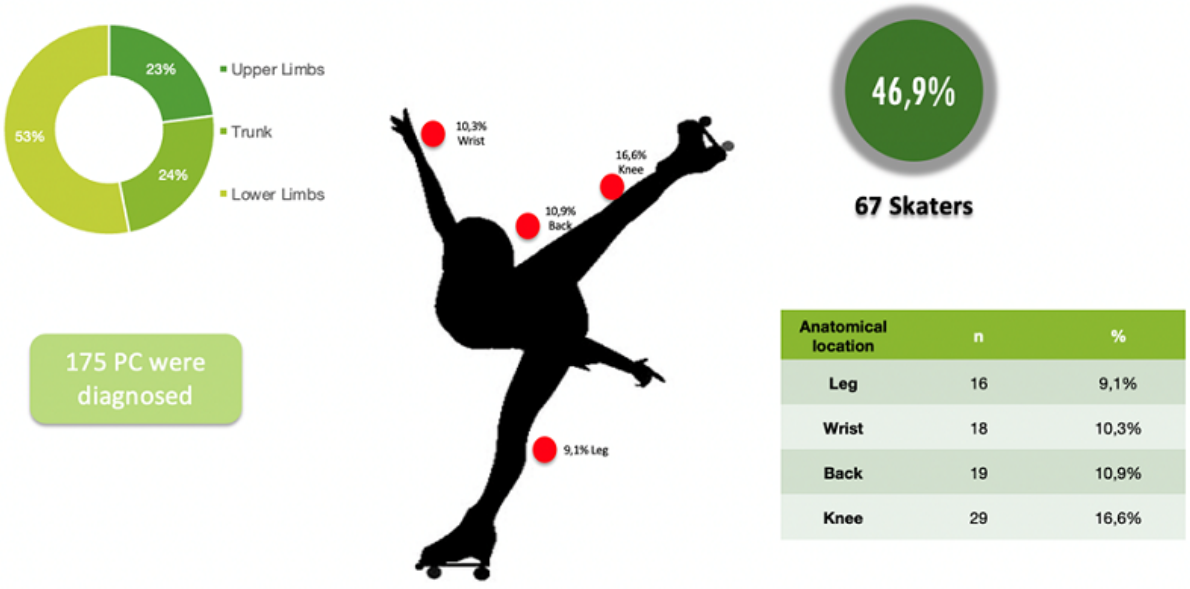
Physical complaints

Sixty-seven (46.9%) skaters had PC in the past 12 months. Their mean age was 14.2 years (range, 7 to 24 years). The anatomical distribution of 175 PC per 67 skaters is summarized in Figure 6. Physical complaints were most reported in the lower limbs (53.1%), followed by head and boot (24.0%) and upper limbs (22.9%).

When looking at 143 skaters, on the status of PC during the past 12 months per category, we found that only three categories (Tot, Cadet, and Junior) had more skaters reporting complaints (Figure 6). The numerical difference between absence and presence of PC was found in the cadet category (n=4).

As mentioned earlier, there were 67 skaters with a total of 175 PC, which is an average of 2.6 complaints per person. When broken down by category, the highest rate was found in the adolescent category (4.0 PC). The lowest rate was found in the minis (1.86 PC). Except for the former category, the average rate for each level was over 2.0 complaints per skater. The separate PC rates for each level of play are shown in Figure 6.

Of the 67 skaters who reported physical complaints, 67.2% described multiple episodes. The highest number of multiple episodes (n=10) was found in a 21-year-old (senior) female skater.



Anatomical location	n	%
Leg	16	9,1%
Wrist	18	10,3%
Back	19	10,9%
Knee	29	16,6%

Figure 6. Distribution of physical complaints per anatomical distribution of physical complaints

Discussion

This study aimed to investigate the participation habits and physical complaints in a sample of Portuguese female artistic roller skaters within the last 12 months. To the best of our knowledge, this is the first study to analyze training characteristics and the distribution of physical complaints in the Portuguese artistic roller-skating population.

Since there are no epidemiological studies in Portugal, we discussed our results using previous epidemiological information from other countries. In America, inline sports

such as roller hockey, speed skating, roller skating, and roller dancing have become very popular. In addition, millions of Americans have taken up in-line Skating to get around or exercise. Unfortunately, in-line Skating injuries and deaths have increased, especially given the increase in in-line Skating (Schieber et al., 1996).

The study population was categorized using the CDC calculator. When we analyzed the height and weight of the study participants, we found that most were of average height and weight, with a small percentage of overweight and obese (CDC, 2019). Body composition is a critical determinant of athletic performance in various sports and requires safe, practical, and valid instruments to determine body composition and identify changes that occur during the training season (Ackland et al., 2012).

The high-intensity mechanical efforts imposed by existing training loads indicate that there must be musculoskeletal responses to hyperfunction, and if body gestures are asymmetrical from the standpoint of laterality or due to biomechanical factors, adaptations will behave asymmetrically (Massada, 2000). Most participants in this study have homogeneous dominance on the right side, but four have dominance on the right side but use the left lower limb as dominant. In the latter case, it is ambidextrous laterality. They can use both the right and left sides to perform a task efficiently (Faquin et al., 2015).

According to our study, the average age at the onset of practice was 7.5 years, which is consistent with the findings of Porter et al. (2007) that young people start practicing this modality very early, at the age of 5-8 years, and reach the peak of their competitive career in adolescence or early adolescence (Porter et al., 2007). According to our data those who started earlier had longer experience.

Our study's most frequently observed category was that of cadets (14 and 15 years old), one of the categories with the highest number of athlete entries (FPP, 2019). Consequently, it was the second most important category reporting physical complaints. The senior category had the highest number of reported physical complaints. This is consistent with Albaladejo-Saura et al., (2022) and AAOS (2013) data that adolescents are more susceptible to sports injuries because they participate in sports earlier and more intensively and are in the process of rapid growth and neurobiological maturation while navigating an increasingly competitive and selective psychosocial environment.

The pattern of onset of physical complaints in young adolescents is like that of adult athletes (Micheo & Figueroa, 2006). Fortin and Roberts' (2003) study also found that the category with the highest prevalence was seniors (64%). The authors attributed this to pre-existing and overuse injuries and their exacerbation in seniors (Fortin & Roberts, 2003).

Changes in the number of coaches are common. Most of our sample reported changing coaches at least once during their athletic careers. Replacing leaders outside of their natural periods is undoubtedly one of the most important decisions an organization can make. When circumstances lead to mid-cycle changes, there is evidence of a negative correlation between the number of coaching changes and team results (Silvestre, 2011). Coaches are interested in knowing and finding suitable training venues and the safest ones to maintain the athletes' training. In addition, they are equally interested in monitoring the development of equipment and other training materials because when used properly, they can help prevent injuries. Although it is almost always in the background, both the equipment used by the athlete and the location where the training or competition takes place are potential sources of traumatic injury (Massada, 2000). A large percentage of skaters exercised on wooden floors. However, half of the cadets practiced on a cement floor. Differences were found between the type of floor and the type of skating. More than half of the skaters trained on synthetic and wooden floors.

Maintenance of the material is fundamental to the technical quality/performance of the athletes. According to our study, almost half of the participants performed monthly maintenance on wheels and bearings. For boots and chassis, half of the participants usually replaced them within three years. Our results do not agree with those of Porter et al. (2007), in whom boots are usually changed every 6 to 12 months, depending on the care and maintenance that the skater gives to their equipment to prevent its deterioration. Boots have become increasingly rigid over the last 20 years. This situation seems to have contributed to skaters' ankles becoming more brittle (Porter et al., 2007). This could explain why the ankles were the second most affected by physical complaints in our study.

Regarding the training load per week in the last 12 months, most skaters trained between 2 and 10 hours. A much smaller percentage reported training less than 2 hours per week. Very few reported training more than 10 hours per week. During tournament preparation, training hours were adjusted, with half of the skaters maintaining their training load during this period, while the remainder went the opposite way and increased their training load. In youth, roller skaters typically spend 15 to 30 hours on the ice and another 5 to 15 hours doing off-ice activities. Training continues throughout the year to prepare for the competitive season (Ferrara & Hollingsworth, 2007).

Most skaters reported participating in tournaments, both nationally and internationally, although the latter was less common. It is hypothesized that the pressure of competition and the pursuit of success tend to lead the athlete to a higher level of risk, and they are more likely to have physical complaints and/or injuries. Thus, it is hypothesized that athletes who compete more regularly and at a higher level are more likely to suffer physical ailments and/or injuries (Porter et al., 2007).

According to our study results, half of the artistic roller skaters had physical complaints within the last 12 months. Most physical complaints were reported in the lower limbs, followed by the head, trunk, and upper limbs. The most common sites were the knees, followed by the back and wrists. In contrast, Tse et al. (1987), found that the wrist was the most affected region.

Although lower extremity injuries are common in individual skaters, pair skaters are at increased risk for the trunk, shoulder, and upper limb injuries, as well as concussions and lacerations (Ferrara & Hollingsworth, 2007).

According to data from American skaters, injuries wrist fractures were the most common. As we can see in our study, wrist physical ailments were the third most cited. Studies have shown that most of these injuries occurred in skaters who did not receive adequate skating instruction (Schieber et al., 1996).

Limitations

Our study presents limitations regarding the choice of material because it does not present the reason for the exchange of material, in this case if they were exchanged for technical reasons or because the athlete's foot grew.

In addition, our study has several limitations related to the chosen methodological design that may limit the generalizability of the results.

A major limitation of this study is that it was conducted retrospectively. Even with a shorter time of 12 months, the possibility of recall error must be considered. In addition, due to the study's retrospective nature, only a relationship between the variables and physical complaints could be established, not causality. Thus, in future studies, authors should consider the distinction between complaints and injuries due to falls and bumps, and position due to overuse (overtraining, among others), which allows results that can provide the technician with more practical information.

The self-report nature of the questionnaire and the reliance on respondents to answer truthfully should also be seen as a limitation. There was an implicit assumption that all tutors and respondents completed their survey honestly to reflect their actual attendance habits and status [with or without] physical complaints.

We were unable to validate self-reported physical complaints because we relied only on respondents' honesty. However, in CHC, self-reports are usually 90% valid, which increases the likelihood that they are accurate (Brener et al., 2003). The possibility of misinterpretation of the questions and incomplete responses should also not be ruled out.

In addition, we do not believe that any possible overrepresentation of incidents was due to the likelihood that skaters who experienced physical complaints participated in the survey. The web-based questionnaire was advertised as a tool to investigate participation habits. Therefore, response bias was not expected.

A low response rate and small sample size could affect the generalizability of the results. However, to ensure the sample's representativeness, we used normative data from the FPP to compare the study sample to the general skating population in terms of gender and category.

Finally, we suggest that you maintain good supervision of the skaters to avoid physical complaints.

Conclusions

Our results suggest that physical complaints are common in figure skating. Multiple episodes were common. Most reports of physical complaints were found at the knees, followed by the back (lower), ankles, and legs.

In addition, instructions and guidelines must be available to all athletes, groups of skaters must be formed according to their abilities and skills, and boots must be of a high standard and have sufficient leg length to support the ankle, as many of the fractures involve the lower part of the tibia and fibula.

Prevention of sport-related physical complaints is crucial, and epidemiological investigation is considered the first step. By studying the etiology of physical complaints and implementing effective preventive measures, we can reduce the number of cases and their recurrence, the duration of disability, and the associated economic burden.

Recommendations for future studies

More research is needed. Analyze a larger sample comparing athletes by level and specific sport. And finally, create associations between the variables studied so that we can understand how these variables influence each other.

Author Contributions

Conceptualization, Jorge Bravo and João Sousa; Data curation, Jorge Bravo and João Sousa; Formal analysis, Jorge Bravo and João Sousa; Investigation, Carolina Cabo; Methodology, Carolina Cabo; Resources, Carolina Cabo; Supervision, Jorge Bravo and João Sousa; Validation, Jorge Bravo and João Sousa; Visualization, Jorge Bravo and João Sousa; Writing – original draft, Carolina Cabo; Writing – review & editing, Carolina Cabo.

Acknowledgments

The authors would like to thank the Federação de Patinagem de Portugal and the Associação de Patinagem de Setúbal for their invaluable contribution in data collection.

Bibliography

Ackland, T. R., Lohman, T. G., Sundgot-Borgen, J., Maughan, R. J., Meyer, N. L., Stewart, A. D., & Müller, W. (2012). Current Status of Body Composition Assessment in Sport: Review and Position Statement on Behalf of the Ad Hoc Research Working Group on Body Composition Health and Performance, Under the Auspices of the I.O.C. Medical Commission. *Sports Medicine, 42*(3), 227–249. https://doi.org/10.2165/11597140-000000000-00000

Albaladejo-Saura, M., Vaquero-Cristóbal, R., & Esparza-Ros, F. (2022). Methods for estimating biological maturation indeveloping and growing athletes: A literature review. *Cultura, Ciencia y Deporte, 17*(53). https://doi.org/10.12800/ccd.v17i53.1925

Alcaraz-Ibáñez, M., Carrascosa-Ruiz, I., Martínez-Rosales, E., & Burgueño, R. (2022). Influencia de los contenidos de meta sobre la intención de práctica de ejercicio físico en adolescentes: La importancia de aspirar a desarrollar habilidades. *Cultura, Ciencia y Deporte, 17*(52). https://doi.org/10.12800/ccd.v17i52.1615

Brener, N. D., Billy, J. O. G., & Grady, W. R. (2003). Assessment of factors affecting the validity of self-reported health-risk behavior among adolescents: Evidence from the scientific literature. *Journal of Adolescent Health,* 436–457.

CDC. (2019). *Disability and Health Disability Barriers | CDC.* Centers for Disease Control and Prevention. Accessed 8 December 2020. https://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/index.html

DGS. (2006). *Normas e Circulares Normativas.* Serviço Nacional de Saúde. Accessed 14 March 2021. https://www.dgs.pt/directrizes-da-dgs/normas-e-circulares-normativas/circular-normativa-n-05dsmia-de-21022006.aspx

Faquin, B. S., Candido, C. R. C., Santos, A. G. I. G. dos, Oliveira, T. F. de, Porto, A. B., & Okazaki, V. H. A. (2015). Efeito da restrição espacial do ambiente na preferência manual em tarefa de alcance em adultos jovens. *Revista Brasileira de Ciências do Esporte, 37*(4), 407–412. https://doi.org/10.1016/j.rbce.2015.08.007

Ferrara, C. M., & Hollingsworth, E. (2007). Physical characteristics and incidence of injuries in adult figure skaters. *International Journal of Sports Physiology and Performance,* 282–291.

Fortin, J. D., & Roberts, D. (2003). Competitive figure skating injuries. *Pain Physician, 6*(3), 313–318.

FPP. (2019). *Arquivo 2019.* FPP PA - Plataforma. Accessed 14 March 2021. http://partistico.pt/Documentos/documentos1.php?dir=/Arquivo/2019

Knox, C. L., Comstock, R. D., McGeehan, J., & Smith, G. A. (2006). Differences in the Risk Associated With Head Injury for Pediatric Ice Skaters, Roller Skaters, and In-Line Skaters. *Pediatrics, 118*(2), 549–554. https://doi.org/10.1542/peds.2005-2913

Lime Survey. (2013). Lime Survey. Accessed 13 March 2013. http://www.limesurvey.org

Massada, L. (2000). *Lesões Típicas do Desportista* (4ª ed.). [Typical sportsman injuries]. Editorial Caminho.

Micheo, W. F., & Figueroa, C. (2006). Comparison of the pattern of injuries in children and adult athletes. The first 10 years experience at the Olympic Training Center. *Boletin De La Asociacion Medica De Puerto Rico, 98*(1), 7–14.

Moreira, C. (2013). *Caracterização de lesões na Patinagem Artística na época de 2011/2012.* [Dissertação de mestrado não publicada]. Universidade Fernando Pessoa.

Porter, E. B., Young, C. C., Niedfeldt, M. W., & Gottschlich, L. M. (2007). Sport-specific injuries and medical problems of figure skaters. *WMJ: Official Publication of the State Medical Society of Wisconsin, 106*(6), 330–334.

Schieber, R. A., Branche-Dorsey, C. M., Ryan, G. W., Rutherford, G. W., Stevens, J. A., & O'Neil, J. (1996). Risk Factors for Injuries from in-Line Skating and the Effectiveness of Safety Gear. *New England Journal of Medicine, 335*(22), 1630–1635. https://doi.org/10.1056/NEJM199611283352202

Sehgal, S., & Esht, V. (2019). Talent development of roller skating using an exercise program in young males: A study protocol for randomized controlled trial. *Physical Therapy Reviews, 24*(6), 308–313. https://doi.org/10.1080/10833196.2019.1648727

Silvestre, J. (2011). *Uma análise econométrica sobre o impacto de uma mudança de treinador no desempenho desportivo de uma equipa de futebol.* [Dissertação de mestrado não publicada]. Universidade Técnica de Lisboa - Instituto Superior de Economia e Gestão.

Stricker, P. R., Faigenbaum, A. D., McCambridge, T. M., & COUNCIL ON SPORTS MEDICINE AND FITNESS. (2020). Resistance Training for Children and Adolescents. *Pediatrics, 145*(6), e20201011. https://doi.org/10.1542/peds.2020-1011

Tse, P. Y., Shen, W. Y., Chan, K. M., & Leung, P. C. (1987). Roller skating—Is it a dangerous sport? *British Journal of Sports Medicine, 21*(3), 125–126. https://doi.org/10.1136/bjsm.21.3.125

Zhao, W., Wang, C., & Hou, L. (2020). Roller Skating Promotes the Physical Health of Children and Adolescents: A Systematic Review and Meta-analysis [Preprint]. In Review. https://doi.org/10.21203/rs.3.rs-85702/v1