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Pre-participation medical evaluation in rink hockey players

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ABSTRACT

The aim of this study was to describe the medical findings and the physical imbalances during pre-participation screenings among rink hockey players. A cross-sectional study was conducted on 773 rink hockey players (645 males and 128 females, 14 to 43 years old) from different teams participating in regional competitions. The pre-participation screening included: a) medical history, b) anthropometrical data, c) physical examination, d) baseline 12-lead ECG, and e) an extensive orthopedic evaluation. A total of 773 pre-participation evaluations were included. Anthropometry evaluation showed 20.2% were overweight and 4.1% classed as obese. The prevalence of previous injuries related to rink hockey was 24,4% (CI 95% 21.5-27.5). The lower limb was the most affected area, and fractures were the most frequent injuries. Four (0.05%) life-threatening cardiopathies were found and treated. Regarding musculoskeletal examination, 29 athletes (4%) presented spine alignment alterations, 69 (8.9%) presented lower leg dysmetria, and 150 (19.4%) feet misalignment. Pre-participation screening is essential in detecting medical conditions and physical imbalances affecting athletes' health. These medical evaluations must be recommended for athletes of all levels.

KEYWORDS

Prevention; Medical Exam; Roller Hockey; Sports Medicine

1. INTRODUCTION

The sports pre-participation evaluation (PPE) is an integral component of many sports medicine practices. Although the health benefits of physical activity are well known, evidence about a significant percentage of cardiac events and sudden death among athletes has been described. Some physical conditions or anatomical imbalances can also lead to a higher risk of injuries (Smith & Laskowski, 1998).

The rising rates of sports participation across all age groups in developed countries is increasing the number of PPEs and creating constant research among the scientific community to find cost-effective protocols for a higher number of athletes (Lehman & Carl, 2017; Smith & Laskowski, 1998). Early detection of any condition that can lead to injuries or cardiovascular events is the primary goal of the PPE, allowing immediate treatment of these conditions and preventing possible long-term complications (Lehman & Carl, 2017). Screening of these features is crucial in order to avoid further problems in children's future health, other than possible impairments in the carrier of an athlete (Adami et al., 2019).

Rink hockey (RH) is a skating discipline with a big tradition in Latin countries (Spain, Portugal, Italy and France). In Spain, the largest number of RH licenses are centralized in Catalonia. The Spanish federation ("Real Federacion Española de Patinaje") registers annually 3000 licenses for athletes over 15 years old (levels with mandatory PPE) (Real Federación Española de Patinaje, n.d.).

RH is a team sport consisting of two teams of 5 people (4 field players and one goalkeeper) (Moreno, 2019). Goalkeepers have different technical and biomechanical requirements than field players and they have a crucial incidence in RH games (Trabal et al., 2020; Trabal Tañá, 2016), so they should be studied separately. RH is a complex and dynamic sport, played with classic skates (2 pairs of parallel wheels) and a wood stick that propels a round and solid ball. It is considered a contact sport due to the presence of dynamic (players, ball, stick) and static (fences, goals, floor) elements (de Pablo B et al., 2022).

The aim of the study is to determine and describe the pre-participation screening findings in RH regional athletes; this includes identifying if any specific conditions may lead to a higher number of adverse medical events among these populations.

2. METHODS

A cross-sectional study was carried out using a non-probabilistic sampling that included 1552 PPE in RH athletes from 15 clubs in the Barcelona region (Cataluña-Spain). The PPE was conducted between 2014/2015 and 2019/2020. Only the first PPE of every athlete was included in the analyses, excluding subsequent evaluations. PPE in non-mandatory categories (under 15 and master athletes) were also excluded. A total of 773 pre-participation evaluations were finally included (Figure 1).

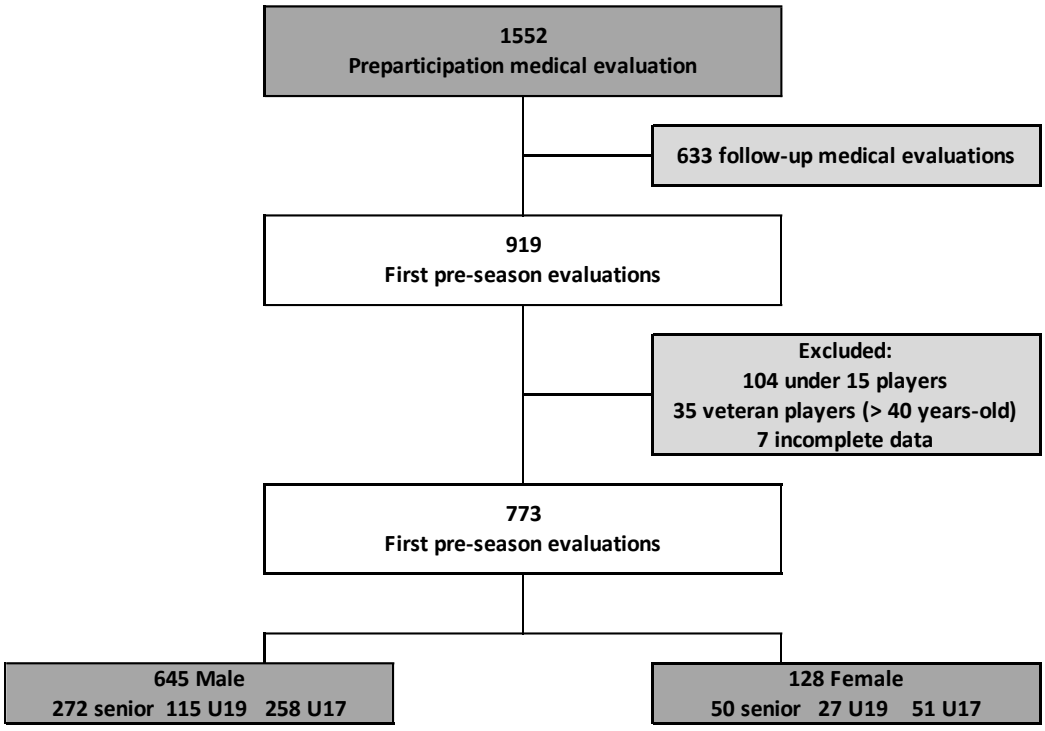

Figure 1. Flowchart of the sample selection

The PPE was conducted following the recommendations of the Catalan Sports Medicine society (9) and the Spanish Cardiology society (Grazioli et al., 2017). The tests and the tools used to conduct them are included in every PPE, as described in Table 1.

Table 1. Pre-participation evaluation tests

Clinical history
- First-degree relatives with cardiovascular conditions - Medical history - Traumatological history related with rink-hockey practice
Physical exam
Anthropometry
- Height (Stadiometer Seca®) - Weight (Scale Omron®) - Body mass index (BMI=weight/(height)^2)
Cardiovascular examination
Cardiac and respiratory auscultation 12-lead Resting electrocardiogram 12 (Cardioline®)
Musculoskeletal examination
- Axis: Asymmetries, scoliosis - Knee: Varum, valgum - Ankle/feet: Static podoscopy: Flat, cavum, valgum - Flexibility - Hypermobility

The study was approved by a local Ethics Committee (Catalan Sport Council, ref. 014/CEICGC/2021). The results of this observational study are reported following the standards established by the Declaration of Helsinki and its later amendments ("World Medical Association Declaration of Helsinki," 2013).

Medical data was collected using specific software (App2u®, Barcelona). Regarding statistical analysis, categorical variables were described with absolute and relative frequencies. We calculated the summary measures of central tendency (mean) and dispersion (standard deviation (SD) and range (Minimum- Maximum) for anthropometric variables. Additionally, we calculated proportion incidences of obesity or injuries according to the formula i=n/e, where n is the number of incident cases during the study period and e is the respective number of exposed (participating) athletes ("Athlete-Exposures", AE), with incidence proportions presented as injuries per 100 athletes per season. To calculate incidences, we used the 'pois.exact' function from the epitools library in R, which estimates incidence and 95% confidence intervals under a Poisson distribution. All analyses were performed using SPSS v21 and R statistical package (The R Foundation for Statistical Computing, Vienna, Austria), version 4.0.2.

3. RESULTS

Seven hundred and seventy-three pre-participation exams were included: 645 (83.4%) in male athletes and 128 (16.6%) in female athletes. 332 PPE were conducted in senior athletes (272 male and 50 female), 142 in U19 athletes (115 male and 27 female), and 309 in U17 athletes (258 male and 51 female).

3.1. Anthropometry

The age, height, weight, and body mass index (BMI) are shown in Table 2. The prevalence of being overweight in male athletes was 18.1 (CI 95% 15.4-21.4) per 100 individuals and 20.3 (14.4-28.6) in female athletes. The prevalence of obesity in males was 4.5 (3.1-6.4) and 2.3 (0.7-7.1) in females.

Table 2. Anthropometry measures classified by gender and category

	Male			**Female**		
	Senior	**U19**	**U17**	**Senior**	**U19**	**U17**
Total (N=773)	**n=272**	**n=115**	**n=258**	**n=50**	**n=27**	**n=51**
Age	24.4 ± 5.2 (18.2-42.3)	17,7 ± 0,6 (16.9-18.9)	15.8 ± 0.6 (14.5-16.9)	23.3 ± 4.1 (18.1-44)	17.7 ± 0.5 (17-18.9)	15,8 ± 0,06 (14.5-16.8)
Height	1.76 ± 0.06 (1.6-1.96)	1.73 ± 0.07 (1.54-1.9)	1.72 ± 0.07 (1.52-1.97)	1.64 ± 0.07 (1.5-1.77)	1.64 ± 0.06 (1.52-1.68)	1.61± 0.06 (1.47-1.81)
Weight	76.9 ±12.2 (53.7-117)	68.2 ± 11.3 (48-102.9)	65.4 ±11.1 (41-102)	63.4 ± 8.7 (48-92)	61.8 ± 9.9 (44.9-90.3)	57.6 ± 7.3 (45.5-81.2)
BMI	24.8 ± 3.4 (18.4-37.5)	22.5 ± 3.2 (17.2-33.9)	21.9 ± 3.1 (15.9 -36.1)	23.5 ± 3.1 (17.5-34.6)	22.9 ± 3.2 (19.8–29.8)	22.1 ± 2.6 (18.4-32.7)
Field player (n)	**n=227**	**n=105**	**n=229**	**n=43**	**n=23**	**n=46**
Age	24.4 ± 5.3 (19-39.8)	17.7 ± 0.6 (16.9-18,9)	15.7 ± 0.6 (14,5-16.9)	22.9 ± 2.8 (19-29)	17.7 ± 0.6 (17-18-9)	15.8 ± 0.06 (14.6-16.8)
Height	1.75 ± 0.06 (1.61-1.96)	1.73 ±0,07 (1.54-1.9)	1.72 ± 0.07 (1,52-1,97)	1.64 ± 0.06 (1.51-1.77)	1.64 ± 0.06 (1.55-1.75)	1.61 ± 0.06 (1.47-1.81)
Weight	76.1 ± 12 (53.7-117)	67.5 ± 10.2 (48-97.5)	65.1 ±11.1 (41-102)	62.3 ±8.7 (48-92)	62 ± 9.8 (51.5-90.3)	57.8 ± 7.4 (46-81.7)
BMI	24.6 ± 3.2 (18.5-37.5)	22.3 ± 2.8 (17.6-31.9)	21.8 ± 3.1 (15.9-36.1)	23,3 ±3,2 (17.5-34.6)	22.9 ± 3.3 (16.9-29.8)	22.1 ± 2.6 (18.4-32.7)
Goalkeepers (n)	**n=46**	**n=10**	**n=29**	**n=7**	**n=4**	**n=5**
Age	24.5 ± 5.6 (18.2-42.3)	18.1 ±0.6 (17.3-18.9)	15.7 ± 0.07 (14.5-16.7)	25.2 ± 8.7 (18.1-44.3)	17.8 ± 0.5 (17.1-18.2)	16 ± 0.06 (15.1-16.6)
Height	1.77 ± 0.07 (1.6-1.89)	1.71 ± 0.07 (1.54-1.77)	1.72 ± 0.87 (1.62-1.84)	1.65 ± 0.08 (1.5-1.7)	1.61± 0.06 (1.52-1.68)	1.59 ± 0.06 (1.51-1.67)
Weight	80.5 ±12.8 (56.7-115)	75.8 ± 18 (56.2-102.9)	67.9 ±1.3 (49.6-94.2)	69.8 ±5.9 (62.7-77.3)	60.9 ± 12.3 (44.9-71.2)	55.3 ± 7.4 (45.5-65.7)
BMI	25.8 ± 3.9 (18.5-37.5)	25.9 ± 5.5 (18.2±33.9)	22.5 ± 3.2 (17.9-30.8)	24.8 ± 2.7 (17.6-34.6)	23.3 ± 3.2 (19.4 – 26.6)	21.8 ± 2.6 (19.8-25.6)

The overweight and obesity prevalence, studied by gender, age, and playing position, are described in Table 3.

Table 3. Prevalence of overweight and obesity

	Male						Female					
	n	**Prevalence (CI 95%)**	**n**	**Prevalence (CI 95%)**	**n**	**Prevalence (CI 95%)**	**n**	**Prevalence (CI 95%)**	**n**	**Prevalence (CI 95%)**	**n**	**Prevalence (CI 95%)**
Total	**Senior (n=272)**		**U19 (n=115)**		**U17 (n=258)**		**Senior (n=50)**		**U19 (n=27)**		**U17 (n=51)**	
Overweight	86	31.6 (26.5-37.6)	14	12,2 (7,5-19,9)	30	11,6 (8,3-16,3)	12	24 (14,6-39,3)	8	29,6 (16,5-52,9)	6	11,8 (5,5-24,8)
Obesity I	17	6,2 (3,9-9,9)	5	4,3 (1,8-10,2)	4	1,5 (0,6-4,1)	1	2 (0,1-13,9)	0	-	1	
Obesity II	2	0,7 (0,1-2,9)	0	-	1	0,4 (0,1-2,7)	1	2 (0,1-13,9)	0	-	0	-
Field players	**Senior (n=227)**		**U19 (n= 105)**		**U17 (n=229)**		**Senior (n=43)**		**U19 (n=23)**		**U17 (n=46)**	
Overweight	71	31,3 (25,8-37,9)	13	12,3 (7,4-20,5)	25	10,9 (7,5-15,8)	8	18,6 (9,9-34,7)	6	26,1 (13,1-51,9)	5	10,9 (4,7-24,8)
Obesity I	12	5,3 (3-9,1)	2	1,9 (0,4-7,5)	3	1,3 (0,4-4)	1	2,3 (0,1-16,1)	0	-	1	2,2 (0,1-15,1)
Obesity II	1	0,4 (0,1-3,1)	0	-	1	0,4 (0,1-3)	1	2,3 (0,1-16,1)	0	-	0	-
Goalkeepers	**Senior (n=46)**		**U19 (n=10)**		**U17 (n=29)**		**Senior (n=7)**		**U19 (n=4)**		**U17 (n=5)**	
Overweight	15	32,6 (21,5-49,4)	1	10 (1,5-64,2)	5	17,2 (7,7-38,2)	4	57,1 (30,8-108,5)	2	50 (18,7-133,2)	1	20 (3,4-115)
Obesity I	5	10,9 (4,7-24,8)	3	30 (11,6-77,3)	1	3,4 (0,1-23,7)	0	-	0	-	0	-
Obesity II	1	2,2 (0,3-15,1)	0	-	0	.	0	-	0	-	0	-

3.2. Clinical history

Most athletes (59.9%, n=463) did not report previous medical conditions. 77 (10,1%) were from families with a history of cardiovascular conditions (first-degree relatives with ischemic cardiopathy, valvopathy, arrhythmia, or sudden death). The most frequent previous conditions were related to the respiratory system: 25 athletes reported previous asthma or bronchitis. Fourteen athletes reported previous cardiovascular conditions (valvopathy, arrhythmia, or congenital heart malformations). Among senior athletes, 5 reported a personal history of hypertension. The previous conditions found in clinical history are reported in Table 4.

Table 4. Clinical history findings

Total, N (%)	773 (100%)
No previous conditions, n (%)	463 (59.9%)
Family history CV events, n (%)	77 (9.9%)
Previous conditions, n (%)	74 (9.6%)
Respiratory, n (%)	25 (3.2%)
Asthma and bronchitis, n	23
Spontaneous pneumothorax, n	2
Neurological, Psychiatric, n (%)	14 (1.8%)
Attention Deficit Hyperactivity Disorder, n	9
Epilepsy, n	4
Guillain Barré, n	1
Endocrine, metabolic, n (%)	5 (0.6%)
Diabetes Mellitus, n	2
Hypothyroidism, n	1
Celiac disease, n	2
Cardiovascular, n (%)	14 (1.8%)
Valvular disorders, n (%)	3
Arrhythmias, n	5
Malformations, n	1
Hypertension, n	5
Other pathologies, n (%)	6 (0.1%)

Previous injuries

A total of 24.4% (IC 95% 21.4-27.5) of the athletes referred to previous injuries related to RH (Figure 2). The most-reported injury location was the lower extremity with 109 episodes, followed by the upper extremity (n=74), head and neck (n=14), and trunk (n=25). The most-reported type of injuries were fractures (n=90), followed by muscle strains (n=48), sprain (n=30), dislocations (n=20) and tendon injuries (n=9).

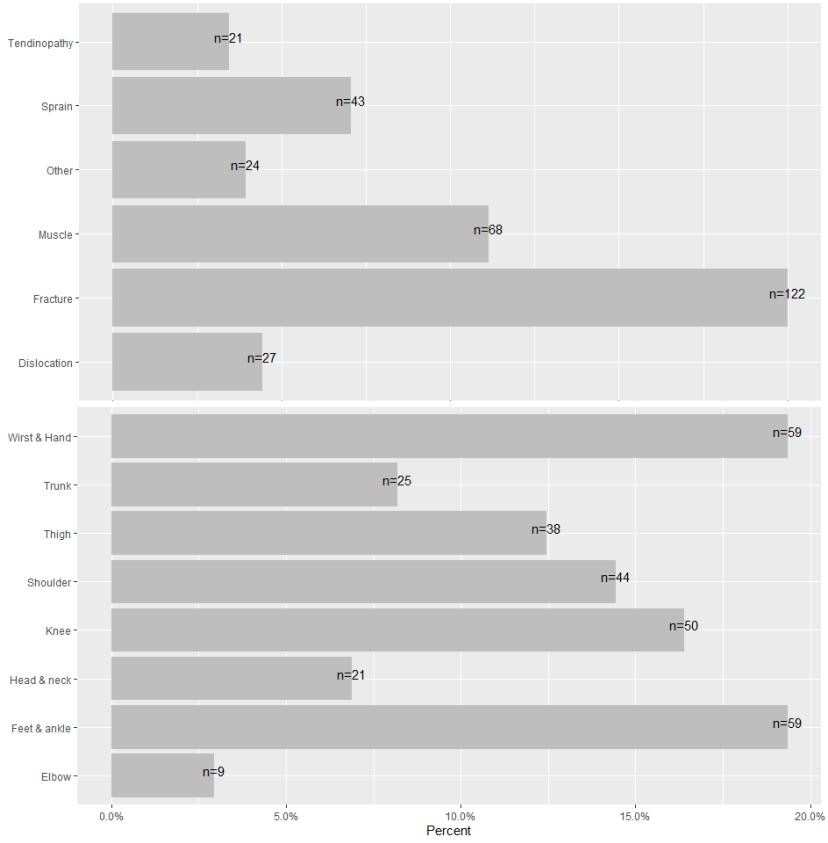

Figure 2. Frequency distribution (absolute and relative) of type of injury and injury location among rink hockey players

3.3. Physical examination

3.3.1. Cardiovascular findings

Regarding cardiovascular screening, 37 athletes (4.8%) were recommended to perform other complementary tests (stress test or echocardiography) before receiving the medical aptitude certificate. Fifteen athletes presented ECG criteria of ventricular hypertrophy, 9 presented previously unknown heart murmurs, 9 presented ECG alterations of the PR interval (4 first degree AV block, 5 short PR), and 4 presented ECG criteria of atrial alteration (low atrial rhythm, enlarged p-wave). None of them referred to cardiac alarm signs during exercise (palpitations, chest pain, or fainting).

Seventy-eight cases of high blood pressure were detected (after three consecutive readings). None of them referred to symptoms during exercise (headache or chest pain); all cases were referred to their doctor to confirm the diagnosis. The incidence proportion of high blood pressure in male athletes was 11.6% and in female athletes 2.3%. Four cases (0.05%) were remitted to cardiology due to potentially life-threatening cardiac conditions. One athlete presented ECG criteria of preexcitation

(Wolff-Parkinson-White syndrome) with a history of palpitations during exercise, two athletes presented ECG criteria of preexcitation without symptoms, and one athlete presented a second-degree AV block (Mobitz II) (Table 5).

3.3.2. Musculoskeletal findings

Regarding the musculoskeletal examination, 29 athletes presented spine alignment alterations (24 scolioses and 5 kyphoses) and 69 cases of lower leg dysmetria. Ninety-one cases of knee misalignment (66 genu varum and 25 genu *valgum*) and 150 feet misalignment (63 cavum, 60 flat, and 27 *valgum*) were reported. Eleven athletes presented articular hypermobility criteria, and two presented *pectus excavatum*. When studying the popliteal angle, 166 athletes were diagnosed with low hamstring flexibility (Table 5).

Table 5. Cardiovascular and musculoskeletal findings

		Male			Female		
	Total	**Senior**	**U19**	**U17**	**Senior**	**U19**	**U17**
CARDIOVASCULAR							
Hypertension	78	41	9	25	1	2	0
Cardiac murmur	9	2	0	2	3	1	1
ECG							
Sinus bradycardia	92	42	15	16	6	5	8
Right branch blockade	121	43	14	48	3	5	8
1rst degree AV block	4	1	0	2	1	0	0
Low atrial rhythm	4	1	0	3	0	0	0
Hypertrophy criteria	15	8	1	5	1	0	0
Preexcitation	3	1	0	2	0	0	0
2n degree AV block	1	1	0	0	0	0	0
Short PR interval	5	2	1	2	0	0	0
P wave alterations	4	1	1	1	0	1	0
MUSCULOSKELETAL							
Spine							
Scoliosis	24	6	4	7	3	2	2
Kyphosis	5	1		3			
Dysmetria	69	25	11	25	6	0	2
Low hamstring flexibility	166	53	30	70	4	5	4
Hypermobility criteria	11	1	3	2	3	0	2
Genu							
Varum	66	34	8	19	2	2	1
Valgum	25	5	3	7	2	4	4
Podoscopy							
Cavum	63	21	8	21	5	4	4
Flat	60	19	13	24		1	3
Valgum	27	7	3	11	3	1	2

4. DISCUSSION

4.1. Anthropometry

Body composition affects not only global health but also athletes' performance. Several studies described a linear correlation between anthropometry with sports success, increasing the athletes' ability to perform a sporting gesture, time of reaction, speed, decision making, and post-exercise recovery (Ackland et al., 2012; Barbieri et al., 2017; Meyer et al., 2013). Therefore, it is a relevant variable to consider when evaluating athletes.

As expected, height and weight were higher in male athletes than in female athletes. Compared with previous studies (Romero et al., 2020; Sousa et al. ,2022; Monginho, 2018; Moura et al., 2016; Romero et al., 2020; Stephan et al., 2018) goalkeepers were confirmed to be taller and heavier than field players. The results in U19 (14.15) and U17 (16) were equivalent to previous studies, despite our sample being more prominent than any study ever published in RH. Studies in U17 goalkeepers published by Monginho et al. (2018) were similar to our sample.

Two studies on adult female players have been published previously (Romero et al., 2020; Stephan et al., 2018) in national-level athletes. The subjects were slightly taller than our sample in both studies, with similar weights. We must consider that our sample studied regional-level players as a possible explanation for the differences.

We also differentiated the first-time field players from goalkeepers in female athletes. In contrast with male athletes, female goalkeepers were shorter than field players. Concerning weight, goalkeepers were heavier than field players. Differences in body composition according to the player position have been described in other sports (Boone & Bourgois, 2013).

Athletes constitute a differential group inside the general population, mainly because of higher muscle development. Nevertheless, our results showed a similar prevalence of being overweight compared with the general Spanish population (*Instituto Nacional de Estadística*, n.d.) (the prevalence in our sample was 31.6% in senior male players and 24% in senior female players, while prevalence in Spanish general population between 25 and 34 years was 35.7% and 21.8% respectively). The prevalence in youth players was lower than in the general Spanish population (*Instituto Nacional de Estadística*, n.d.).

Concerning obesity, the prevalence in our sample was also lower than the general Spanish population (*Instituto Nacional de Estadística*, n.d.), but 26 male athletes and 2 female players

presented grade I obesity (BMI between 30 and 34.9), and 3 male athletes and 1 female athlete presented grade II obesity (BMI between 35 and 39.9).

Despite body composition effects on performance being less significant in team sports, these rates of being overweight and obese can negatively affect athletes' health, as seen in the general population. Weight control must be targeted as a potential concern in RH athletes.

4.2. Clinical history

The previous conditions reported in our study were consistent with similar samples among Spanish athletes (Pi-Rusiñol et al., 2022) The most frequently reported condition was asthma, with 23 cases (prevalence 2.8%, CI 95% 2 - 4.4). The prevalence is lower than in the general Spanish population between 18 and 44 years-old (7.3%, CI 5.9 – 9) (Lopez et al., 2017)

Previous studies showed the highest prevalence of asthma among endurance athletes (Thomas et al., 2010) but not among team sport athletes (except for ice hockey) (Leuppi et al., 1998)

Attention Deficit Hyperactivity Disorder (ADHD) was also declared by 9 athletes, mostly youth players. The number of athletes diagnosed with ADHD has increased in the last decade, likely due to better knowledge. As most ADHD medications are listed on the World Antidoping Agency (WADA) Prohibited List, it is relevant that coaches/medical staff are aware of this condition, mainly if the athlete follows particualar medical treatment and competes at a national/international level. The prevalence of cardiac conditions, such as arrhythmias or valvular disorders, was similar to Pi-Rusiñol et al. (2022) study.

Previous injuries

Previous injuries related to RH were detected in 24.4% of the sample. The result is slightly smaller than other studies (Pi-Rusiñol et al., 2022) The most-reported injuries were fractures, followed by muscle injuries. Fractures are always treated, but muscle injuries are often underdiagnosed, especially at regional levels, where the availability of medical staff is less frequent (Caine et al., 2008). This can lead to underdiagnose muscle injuries, described as the most frequent cause of time-loss injuries in RH (de Pablo, in press). Another explanation for these differences can be the age of the sample. All previous studies about RH injuries were focused on senior players: the high rate of fractures can be explained by the presence of youth players, in whom bone injuries are more frequent than muscle injuries (Hamilton et al., 2015)

The most frequently injured region was the lower extremity, followed by the upper extremity and head. Previous studies on RH players have also described the lower extremity as the most frequently affected (Reverter J et al., 2018). In contrast, a questionnaire conducted among amateur RH players in Germany reported the head as the most frequently injured, followed by hand and thigh (Husen et al., 2021).

We should consider that the report of previous injuries was created following the declarations by athletes of their clinical history. A bias with mild injuries might be present because the athletes may not recall them or were not diagnosed because of the absence of medical staff.

As our medical team did not diagnose the reported injuries, we cannot know their influence on sports performance or the practices/games lost because of them.

4.3. Physical examination

Cardiovascular findings

Our PPE revealed 41 athletes with significant ECG findings that require further studies; the prevalence (5.3%, CI 95 3.9-7.1) was higher than in other studies. In the study of Pi et al., the prevalence was 1.4%, but the primary PPE also included echocardiography and a stress test. In a study by Vessella et al. (2020) the prevalence was 1.5%, and the PPE included stress tests. As 37 of the basal ECG abnormalities of our study were suggested to perform an echocardiography or stress test, we can assume that the prevalence will be similar.

The four athletes with potentially life-threatening ECG abnormalities received specific cardiac treatment. Three of them were able to keep their previous performance level, and one stopped sports practice.

Seventy-eight cases of high blood pressure were detected in our sample (10.1%), mainly among senior male (41 cases, 15% of senior male athletes). Hypertension is one of the most frequent cardiovascular findings among athletes (Leddy & Izzo, 2009). The prevalence among senior male in our study matches with the prevalence of hypertension in adults between 18 and 30 years-old in Spain (16.7%) (Menéndez et al., 2016). As well as overweight and obesity, the high blood pressure prevalence in our study coincides with Spanish general population data, rather than athletes' data.

Musculoskeletal findings

Musculoskeletal alterations may lead to increased injury risk (Neely, 1998) The findings in our study detected 29 spine alignment alterations, 69 cases of lower dysmetria, 91 cases of knee misalignment and 150 feet misalignments.

Musculoskeletal examinations in PPE are practical, acceptable and useful, especially in children/adolescent, in order to facilitate an earlier diagnosis of musculoskeletal conditions and improve their final outcome (Palermi et al., 2022)

We should consider that the risk of overuse injuries due to musculoskeletal alterations in RH can be lower than in sports with higher rates of vertical contact (running or jumping) due to the sports biomechanics itself. RH stride involves components of both linear motion forward and lateral (side-to-side) movement. On the other hand, running is done entirely linearly, so the impact is more significant. Despite these theories in ice hockey, no investigation regarding RH biomechanics and injuries has been performed (UPJOHN et al., 2008). Alternative, studies about the relation of neuromuscular asymmetries in RH players' performance have been conducted (Arboix-Alió et al., 2018, 2020). The relationship between structural asymmetries and neuromuscular asymmetries and the potential effect on the risk of injuries may be a future line of investigation.

5. LIMITATIONS

Pre-participation examinations are only mandatory for players over 15 years old. We cannot know if athletes under that age have conducted non-mandatory PPE that found medical conditions forcing the athlete to stop sports practice prematurely, causing an under-diagnosis bias. Although the sample in our study is the biggest in an RH study, it presents selection bias. Only some clubs accepted to perform the PPE with our professionals. Body mass index is being replaced with ISAK criteria anthropometry (13). Future investigations must integrate these tools to ensure an optimal evaluation of the athletes.

6. CONCLUSIONS

Pre-participation evaluations are essential in detecting early medical conditions and physical imbalances that may impact athletes' health. These medical evaluations must be recommended for athletes of all levels. RH regional athletes showed the highest number of low extremity injuries, primarily fractures and muscle strains. This result concurs with previous studies on elite RH players and anthropometry data in regional athletes were also equivalent to elite RH players. Being

overweight and obesity were detected in the sample; weight control must be a target in health advice among RH athletes. The incidence of medical conditions found was comparable to other sports.

7. PRACTICAL IMPLICATIONS

PPE is appropriate to identify latent pathologies or imbalances that may cause a future disease/injury. Early detection may prevent potential severe conditions such as cardiac pathologies and correct imbalances that may predispose to injuries. Regional RH athletes have a similar prevalence of clinical findings compared with other collective sports, and they also have a significant prevalence of overweight and obesity. Weight control strategies should be carried out to improve athletes' health and performance. Musculoskeletal injuries are frequent in RH athletes. Improving the knowledge of RH-related injuries may allow the creation of injury-specific prevention programs to improve athletes' health and performance.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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