Musculoskeletal injuries in young handball players: a cross-sectional study

Lesões musculoesqueléticas em jovens atletas de handebol: um estudo transversal
Lesiones musculo esqueléticas en jóvenes atletas de balonmano: un estudio transversal

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ABSTRACT | This study aimed to describe the population, training features and history of musculoskeletal injuries in young female handball players and to investigate possible associations between these features and previous musculoskeletal injuries related to handball. The subjects of this cross-sectional study were 220 athletes who completed a self-reported questionnaire about personal data, training features and previous injuries related to handball in the last 12 months. Data were analyzed using descriptive statistics and logistic regression models. The results showed that most of the athletes were approximately 15 years old, had a body mass index was classified as normal, worked out at an average of 3 times a week and their weekly workload was approximately 8 hours and 30 minutes. The main injuries found were sprains and tendinopathies, with the ankle and knee being the most affected regions. Only the sport practice of over 6 years showed statistical relationship with previous injuries (p=0.032). The prevalence of injuries in the last 12 months in this population was 53.60%.

Keywords | Athletic Injuries/epidemiology; Risk Factors; Athletes.

RESUMO | O objetivo deste estudo foi descrever a população, as características do treinamento e o histórico de lesões musculoesqueléticas em atletas de handebol do gênero feminino e investigar possíveis associações entre as características de treinamento com lesões musculoesqueléticas relacionadas ao handebol. Participaram deste estudo transversal 220 atletas, que responderam a um questionário autorreportado que abordava dados pessoais, características do treinamento e lesões prévias relacionadas ao handebol nos últimos 12 meses. Os dados foram analisados por estatística descritiva e modelos de regressão logística. Os resultados demonstram que a maioria era constituída de atletas com idade aproximada de 15 anos, com índice de massa corpórea classificado como normal, que realizavam 3 treinos por semana, com carga horária semanal de aproximadamente 8 horas e 30 minutos. As principais lesões encontradas foram as entorses e as tendinopatias, sendo o tornozelo e o joelho as regiões mais acometidas. Somente a experiência no esporte acima de 6 anos mostrou relação estatística com lesões prévias (p=0,032). A prevalência de lesões nos últimos 12 meses nesta população foi de 53,60%.

Descritores | Traumatismos em Atletas/epidemiologia; Fatores de Risco; Atletas.

RESUMEN | Este estudio tuvo los propósitos de describir la población, las características de entrenamiento y el historial de lesiones musculo esqueléticas en atletas de balonmano del género femenino y de investigar posibles asociaciones entre las características del entrenamiento a este tipo de lesiones relacionadas con la práctica del balonmano. Han participado de este estudio transversal 220 atletas, que contestaron a un cuestionario auto reportado que contenían datos personales, características del entrenamiento y lesiones previas relacionadas con la práctica del balonmano en los últimos 12 meses. Se han evaluados los datos por estadística descriptiva y modelos de regresión logística. Los resultados muestran que la

mayoría se constituía por atletas de edad cercana a los 15 años, con índice de masa corporal clasificado como normal, que hacían entrenamiento 3 veces por semana, con carga horaria semanal de cerca de 8 horas y 30 minutos. Se han encontrado las principales lesiones: esguinces y tendinopatías, en que el tobillo y la rodilla eran los más afectados. Se ha mostrado relación estadística con lesiones previas (p=0,032) solamente la experiencia de más de 6 años en la práctica del deporte. El 53,60% fue la prevalencia de lesiones en los últimos 12 meses en la población investigada.

Palabras clave | Traumatismos en Atletas/epidemiologia; Factores de Riesgo; Atletas.

INTRODUCTION

Recent years have seen the number of young athletes considerably growing[1]. However, there are some adverse effects that accompany increased participation in sports, such as musculoskeletal injuries[3-5]. The International Handball Federation (IHF) has 167 national federations and approximately 800 thousand players in 183 countries[2]. Handball is a high intensity team sport that is characterized by repetitive accelerations, shots, jumps, changes in direction, goal kicks and involves a high degree of contact between the athletes involved[3]. Previous studies have shown that the number of injuries sustained through handball can range from 2.5 to 108 injuries for every 1,000 playing hours[4,5] and reach 0.8 injuries per year for each player[6]. Generally speaking, the lower limbs suffer the most injuries, however studies differ in terms of the most affected regions: some authors point to the upper limbs, while others point to his head, others distinguish themselves from the those previously mentioned by highlighting the back. There is not as of yet consensus regarding the matter, nevertheless, studies have shown that the ankle and knee joints are the that are most affected by injuries[5,7]; however, hand injuries have also appeared as being among the first[4]. Post-sprain ligament injuries (ankle, knee, fingers) are very frequent and generally prevent the athletes from participating in the activity. In addition to these, muscle injuries from stretching also seem to have a relevant incidence[2,4,5,7].

It has become difficult to establish a clear pattern in these injuries as a result of the differences in injury definitions, study designs, study populations, evaluation forms, observation periods and analyzed sporting levels[2,4,5,8-10]. Despite scientific literature including some studies performed with teenage athletes, it can be noticed that the information from these are not yet clear or well defined, thereby showing the need for research in an attempt to standardize those injuries that are most frequent and prevalent during handball, this so as to design a compatible approach to this sport's main problems and eventually allow preventive programs to be developed which can minimize the frequency and impact of sports injuries on young athletes, such as being excluded from the activity or becoming discourage to participate. Thus, this study's objectives were to describe the population, training characteristics and musculoskeletal injury history in female handball athletes and to investigate possible associations between the training characteristics and musculoskeletal injuries.

METHODOLOGY

Study design

This is transversal-type study performed in the city of São Paulo. The study's participants were young female handball players, these individuals answered a questionnaire which included their personal data, training characteristics and injury history, all in reference to their involvement in the sport. This project was approved by the Committee for Ethics and Research at the Federal University of São Paulo (UNIFESP), Protocol no. 02289812.2.0000. The participants signed a term of assent and the evaluators signed a term of free and clarified consent.

Participants

300 female handball players were verbally invited to participate in the study from a training center in the city of São Paulo. Women aged between 12 and 18 years, who had played this sport for a minimum period of 12 months were considered eligible for the study. Any participants who reported any medical restriction to play the sport and/or those who had any

musculoskeletal injuries (muscles, tendons, joints, ligaments and/or bones) at the data collection time were excluded[11].

Evaluation

After the participants had consented to participate in the study and informed the evaluators that they did not have any sport-related musculoskeletal injury at that time, each individual was asked to fill out the form entirely by themselves, the form consisted of three parts: a) questions relating to the participants' personal data, such as age, weight, height, playing position in the sport; b) questions about their history playing sport (training frequency per week, number of hours training per day and sporting experience) and c) history of prior handball-related musculoskeletal injuries. The question regarding prior injuries was put in the following way: "Have you suffered any handball-related injuries in the last 12 months? If yes, please describe below." The adopted definition for musculoskeletal sporting injury in this study was based on previous studies that considered it to be "any sport-related incident that has been severe enough to keep the athlete out of action for at least a training session or game[5].

Data analysis

This study's sample calculation was performed in accordance with that as described by Hosmer and Lemeshow[12], in which 7 to 12 cases of injury are required in order to evaluate each risk factor of interest. Considering the fact that approximately 50% of handball athletes have suffered some kind of injury at some time in their lives and that this study evaluated 4 risk factors in a categorized way, totaling 6 dummy-type variables, approximately 60 injury-carrying athletes were needed, i.e. 120 athletes in total. Descriptive statistics were used in order to present the characteristics of the participants and their training workloads. The participants were divided into two groups, one group with a history of injury and one without. The Student's t-test was used in order to compare the age and body mass index (BMI) among the practitioners from the different groups, while the Mann-Whitney test was used for the training characteristics. The Chi-square test was used for the categorical variables. In order to estimate the associations that these variables have with the presence of injury, an odds ratio was calculated with a 95% confidence interval.

Multiple logistic regression analysis was performed with variables independently associated with prior injuries and which presented p≤0.20. Multiple analysis was adjusted for time involved in the sport and age. In order to verify the prediction quality of the logistic regression model, the Hosmer and Lemeshow goodness-of-fit test was used. The results were presented in odds ratio (OR) and their respective 95% confidence intervals. All analyses were performed using the SPSS version 17.0 software.

RESULTS

236 athletes were selected for the study, 220 of these were deemed eligible following the inclusion and exclusion criteria being applied; 16 participants were excluded due to the fact that they did not have six months experience in the sport. The participants' descriptions of their demographic characteristics were separated into two groups, one referring to athletes "with a history of injury" and the other "with no history of injury". The data comparing the groups, in terms of age, number of training sessions per week and weekly workload presented a statistical difference (p≤0.05) which can be effectively seen in Table 1. The prevalence of handball-related sporting injuries occurring during the last 12 months was 53.60% (n=118), with sprains (23.6%, n=37) and tendinopathies (15.9%, n=25) being the main types of injuries suffered. In regards to the anatomical location of such, the ankle and the knee were afflicted with the same prevalence, both representing 25.5% (n=40) of the injuries suffered, followed by the hand (14.6%, n=23). Data regarding the characteristics of the injuries and the afflicted regions are described in Table 2.

The athletes' BMI were calculated based on the data obtained during the initial evaluation. Only athletes who had BMI classifications of normal (73.6%), overweight (21.4%) and obesity (5%) were found. Most of the athletes (58.2% of the total sample) reported that they had experience in the sport of less than three years. Workloads higher and lower than 360 minutes per week were similar, corresponding to 51 and 49% of the sample, respectively. Athletes aged up to 14 years accounted for 53.6% of the total sample, while those over this age were the remaining sample which represented 46.4%. These data are given in Table 3.

The personal and training characteristics that were reviewed and tested as being possibly associated with

Table 1. Description of the participants involved in the study and their training characteristics

Variables	Total (n=220)	With a history of injury (n=118)	With no history of injury (n=102)	p
Age (years)	14.7 (±1.53)	14.9 (±1.46)	14.4 (±1.57)	0.014*
BMI (kg/m²)	20.6 (±5.12)	20.6 (±5.4)	20.6 (±4.8)	0.699
Experience in the sport (months)	39.8 (±22.8)	43.1 (±25.3)	36 (±19.1)	0.056
Number of training sessions per week	3.2 (±0.5)	3.3 (±0.5)	3.1 (±0.5)	0.021*
Minutes spent training per week	495.6 (±180.2)	526.5 (±198.9)	459.5 (±148.5)	0.042*

Results expressed as a mean (standard deviation); BMI: body mass index; *p<0.05

Table 2. Injury description and location as reported by the athletes

Type of injury	% (n)	Injury location	% (n)
Sprains	23.6 (37)	Ankle	25.5 (40)
Tendinopathies	15.9 (25)	Knee	25.5 (40)
Fractures	11.5 (18)	Hand	14.6 (23)
Muscular injuries	8.9 (14)	Shoulder	10.8 (17)
Dislocations	8.9 (14)	Thigh	7 (11)
Lumbago	3.8 (6)	Lumbar	3.8 (6)
Traumas	2.5 (4)	Leg	3.2 (5)
Meniscal injury	2.5 (4)	Foot	2.5 (4)
PFPS	2.5 (4)	Wrist	1.9 (3)
MTSS	2.5 (4)	Hip	1.9 (3)
ACL Injury	1.9 (3)	Nose/Head	1.3 (2)
Subluxations	1.9 (3)	Forearm	0.6 (1)
Osgood-Schlatter	1.3 (2)	Arm	0.6 (1)
Bursitis	0.6 (1)	Elbow	0.6 (1)
Did not know	11.5 (18)		

PFPS: patellofemoral pain syndrome; MTSS: medial tibial stress syndrome; ACL: anterior cruciate ligament

sporting injuries were BMI, experience in the sport, weekly workload and age (Table 3). From the univariate logistic regression, experience in the sport and age presented a statistical correlation. However, when subjected to multiple logistic regression analysis, only experience in the sport remained in correlation with injury prevalence. After jointly setting all the variables that influence injury, experience in the sport of over 6 years remained statistically significant (p=0.032) when compared to that of 3 years or less, even controlling the age

variable, with the chance of injury from those athletes being 4.20 times the chance an athlete being injured with less than 3 years experience (Table 4).

Table 3. Univariate logistic regression model

Variable	% (n)	OR (95% IC)	p
Age group			
< 15 years	53.6 (118)	1	-
15 years or more	46.4 (102)	2 (1.16 to 3.43)	0.01*
BMI classification			
Normal	73.6 (162)	1	-
Overweight	21.4 (47)	1.04 (0.54 to 2)	0.9
Obese	5 (11)	0.48 (0.14 to 1.71)	0.26
Experience in the sport			
Up to 3 years	58.2 (128)	1	-
3 to 6 years	34.1 (75)	1.48 (0.83 to 2.62)	0.18*
Over 6 years	7.7 (17)	5.13 (1.41 to 18.7)	0.01*
Weekly workload			
Up to 360 minutes	49 (108)	1	-
Over 360 minutes	51 (112)	1.55 (0.91 to 2.63)	0.11

OR: odds ratio; CI: confidence interval; BMI: body mass index; *variables that were included in the multivariate logistic regression model

Table 4. Multivariate logistic regression model

Variable	OR (IC 95%)	p
Age group		
15 years or more	1.73 (0.99 a 3.03)	0.054
Experience in the sport		
3 to 6 years	1.34 (0.74 a 2.4)	0.335
Over 6 years	4.2 (1.13 a 15.61)	0.032*

OR: *odds ratio*; IC: intervalo de confiança; *variável que apresentou associação com lesões prévias

DISCUSSION

This is a descriptive study that evaluated female handball athletes, the mean age of the sample being approximately 15-years-old, mostly with a healthy BMI rating, who averagely performed three training sessions per week and had an approximate weekly workload of 8 hours and 30 minutes. There was a 53.6% (n=118) prevalence for injury in this group's athletes, with most types of injury being sprains and tendinopathies, and with the most afflicted regions being the ankle and the knee, equally representing 25.5% (n=40) of the injuries. From all the analyzed variables, only handball experience showed a correlation with previous handball-related injuries.

Despite this study having characteristics that are similar to some cohort studies found in the scientific literature, such as the adopted definition for sporting injury, the population evaluated and the period investigated, it was not possible to establish direct comparisons as a result of the study's design. Most studies found in the literature are of prospective or retrospective cohort design, and to the best of our knowledge, only one study performed by Jørgensen[13] in 1984 evaluated the prevalence of injuries in handball athletes, in which it was found to be 0.71 per player. During this study, while analyzing the prevalence of injuries in the same way, a result of 0.53 per player was found, which is a comparatively lower figure. Despite both studies adopting similar injury definitions, this difference can be attributed to that fact that this study including on-court sessions, which required bandages or medical attention[13]. Based on the incidence and prevalence of injuries found in the studies from the literature and in this study, it was possible to observe that sprains continue to predominate among the leading types of injury found[1,2,4,14], regardless of the type of study, population evaluated or sports injury definition used. A high incidence of tendinopathies was found during this study, which confirms some of the findings in the scientific literature[4,15]. There were few studies that evaluated or considered injuries resulting from overload. One possible explanation for this is that some studies assessed injuries that happened during tournaments, in which the majority of injuries recorded were traumatic and acute. There was only one study found in literature, performed by Seil, et al.[4], which took injuries from overload into account and divided them into regions; however, it was not possible to compare this data, because the objective of this study was not to establish the incidence of this type of injury by region. Clarsen, et al.[16] reported there to be a low number of studies that address preventing overload injury, and suggest that this is due to the difficulty in developing epidemiological studies that focus on these types of injury, since athletes continue to train and compete without the evaluators being there, which in turn makes it difficult to obtain reliable data. Other types of injury, whose inclusion is very frequent in studies and which do not match the results from this study, are bruises and muscle pulls[2,7,13,14]. It is our belief that this difference is also due to the time of evaluation, as it is well established that the number of trauma injuries is greater during games and tournaments, this is because at this time there are more intense situations that involve contact[4,5]. In addition to this justification, it is important to consider that the questionnaire used in this study was completed by the athletes themselves, thereby enabling these individuals to omit the type of muscle injury that, depending on the seriousness of such, often does not result in their exclusion due to its low impact on performance.

This is similar to the way that sprains continue to be the most common type of injury, where the ankle and the knee are cited by some authors as the most frequent regions for injury[1,4,5,13,15], and these data agree with those obtained during this study. Other regions that are often afflicted are the hand and fingers[1,5,7,13], in addition to the head, which are more frequently included in studies in which the subjects were participating in tournaments, due to traumas caused by direct contact[2,14].

In spite of the fact that handball is characterized as a throwing sport, shoulder lesions were less evident in this study, which is also in agreement with other studies[2,4,5,13,14,17]. One possible explanation for this is that the shoulder is usually the focus of chronic injuries and overload, and athletes often put up with this complaint due to the fact that they consider it to be culturally normal[16].

According to the discussion by Ms Habelt, et al., sport-related locomotor system injuries in children are not greatly understood, which is reason enough for epidemiological studies such as this to be performed[1]. This study only found a correlation between experience in the sport with more than 6 years and injury. To our knowledge, there are no existing studies that directly compare personal data and handball training characteristics in adult, adolescent and child athletes. However, Latz[17] considers obesity and being a young athlete as factors for orthopedic injuries, while Dirx, et al.[7] found athletes older than 20 years to be a risk factor in terms of injuries. In contrast, this study showed no correlation between injury and BMI nor age in both groups.

There were some some limitations found during this study that need to be addressed, such as age group. Younger athletes in particular, while completing the questionnaire, may not have reported certain injuries due to forgetfulness, in addition to the fact that some injuries could have been incorrectly identified. Thus, a prospective cohort study would be the best alternative so as to better characterize the injuries. In any case, this cross-sectional study serves as a basis for encouraging other studies to be developed and for obtaining surface parameters regarding what the major injuries that occur

during handball are, thereby leading to more specific research projects to prevent them.

CONCLUSION

The handball-related prevalence of injuries in the evaluated subjects over the previous 12 months to the study was 53.60%. Sprains and tendinopathies were the most common types of injury found, with the knee and ankle regions being the most afflicted. Experience in the sport was the only variable, among those analyzed in the study, which showed a correlation with injury prevalence.

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