*Original Article (short paper)*

# Injury Frequency in Handball Players: A Descriptive Study of Injury Pattern in São Paulo State Regional Teams

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**Abstract** — **Aim:** To assess the frequency of injuries among male and female handball athletes, identifying injured anatomic parts, injury diagnostics, their severity and type. **Methods:** The participants were composed of 122 handball players from São Paulo state teams, being 63 male (21.2±5.3 years) and 59 female (19.9±5.3 years) athletes who were interviewed using the "Champion Profile" questionnaire. The injuries were sorted by type: acute or overuse; and severity (major, moderate, slight, minor), given by the period of absence from team activities (training sessions and matches), and our results are presented as descriptive statistics. **Results:** The majority of injuries was found in the lower limbs, both in female (69.6%) and male (47.4%) players, as well as the knee was the most commonly injured anatomic part, representing 33.7% and 20.8% of the total number of injuries for the respective genders. We found a higher number of major injuries in female (35.8%) and male (20.8%) players when compared to the other severity categories. The acute injuries were more common among the total sample (48%) when compared to overuse injuries (22.7%), while a sprain was the most commonly diagnosed injury. **Conclusion:** It was observed that Brazilian handball players demonstrated an important number of major and acute injuries, forcing them to abstain from training sessions and matches, which can lead to both team and athlete performance losses. Furthermore, we suggest the inclusion of preventive training to reduce the frequency of injuries in handball athletes.

**Keywords:** Handball, sports injury, knee injury, ankle injury, ACL rupture.

## Introduction

Regular sports participation may greatly benefit the health, life quality, and welfare of the general human population, helping to prevent diseases and provide a healthier aging. However, besides the benefits, there is always the risk of injuries, inherent to any physical activity[1,2].

According to van Mechelen, Hlobil[3], injuries are damage occurring in body tissues, resulting from a physical trauma generated by intrinsic and extrinsic factors. The intrinsic factors are related to individual physical, cognitive, and performance characteristics; the extrinsic factors are related to external or environmental characteristics which may influence the risk of injuries[4]. The combination of intrinsic characteristics and injury related extrinsic factors may result in an increased risk of injury[3].

Handball is one of the most popular sports in Europe[5], considered a high-intensity sport, in which physical contact is common, as well as cuttings and feints during sprints[6,7], increasing the risk of injury and raising interest of the epidemiological area in this modality[8,9].

In particular, when it comes to injuries in handball, the lower limbs are more frequently affected[10-12], with the knee and ankle joints being the most commonly injured anatomic parts[7-10,13-15]. However, due to different study designs, injury definition, and populations investigated, it is difficult to understand and estimate the incidence of injuries in this sport[7,8].

In this sense, Olsen, Myklebust[8] and Wedderkopp, Kaltoft[14] describe the sprain as the most common injury in handball, and the predominant diagnostic as anterior cruciate ligament (ACL) rupture, with increased injury values for this anatomic part in epidemiological studies with male and female handball athletes[16-18]. An ACL rupture may occur with or without physical contact between players. However, in 70 to 84% of the cases the ACL is injured during non-contact game actions[19], it being important to emphasize that female athletes are twice as likely to injure this ligament than male athletes[7]. Hewett, Myer[20] affirm that women are more susceptible to ACL rupture during cuts, landings, and rotation movements due to three factors: hormonal, anatomical, and neuromuscular differences, only the latter of which can possibly be improved with training[21].

Moreover, the time of practice is also related to the incidence of injuries in handball athletes. Higashi, Santos[15] point out that athletes with more than 6 years of experience are more frequently injured, mainly knee and ankle joints, which together represent approximately 50% of the total trauma in handball players. Furthermore, Olsen, Myklebust[8]

report that 79% of the injuries in handball are acute. The same authors found a greater incidence of acute major injuries during matches than during training sessions, however acute injuries of lesser severities (Slight and Minor) were more frequently reported during matches when compared to those reported during training sessions.

A study conducted in Denmark via electronic questionnaire[22], found that handball is one of the sport's most likely to provoke injuries to children and adolescents (7 to 15-year-old), representing almost 14% of the total injuries reported between several sports. Therefore, according to van Mechelen, Hlobil[23], studies that focus on sports injuries are necessary to understand the risk factors and mechanisms which lead to the occurrence of injuries in handball players.

Therefore, sports injury epidemiological investigations are of indubitable importance to achieve better understanding regarding the studied population, i.e.: Brazilian handball players. However, we observed that there are a lack of data and research concerning handball in Brazil[12,24], highlighting the need for more studies with the purpose of determining real and solid values in this science field, especially when comparing physical, tactical, and game characteristics between European and South American handball athletes.

Thus, the present study aimed to investigate the frequency of injuries among São Paulo State handball players of both genders, specifying the most commonly injured anatomic parts, the injury diagnostics, their severity and type.

## Methods

### *Design*

A transversal retrospective study with elite handball players defending teams from São Paulo State. Female and male athletes agreed to participate in this research.

### *Sample*

The sample included 122 handball athletes, from São Paulo state leagues, which have great representation and prominence in the national scenario. Regarding the categories investigated, according to the International Handball Federation – IHF (2007), junior (under-21 for male and under-20 for female) and adult categories (≥ 22 years for male and ≥ 21 years for female) were included, of which 63 belong to male teams (21.2 ± 5.3 years) and 59 to female teams (19.9 ± 5.3 years).

All athletes were participants in systematized training sessions with a minimum frequency of three sessions/week with a duration between 90 and 120 minutes each. In addition, all participants had a minimum of three years training experience. The average age at which the participants started to practice handball was 12.8 ± 2.6 and 12.2 ± 2.9 years for male and female groups, respectively.

The participants agreed to answer the proposed questionnaire and signed the informed consent and agreement term approved by the institutional Ethics Committee (protocol 1490/2012).

### *Questionnaire*

To gain information on injury frequency, injured anatomic parts, and diagnostics, the Champion Profile questionnaire, from the National Center of Sports Excellence (CENESP, Brazil Sports Ministry) was implemented[25,26]. This instrument was applied during the team training sessions, individually with each athlete, by the researchers of the institution concerned. From the collected data it was possible to identify results concerning injury frequency, injured anatomic parts, diagnostics, and severity, and classify injuries between acute and chronic[8,27]. The classifications of injury type and severity are presented in Table 1.

Table 1. Adopted injury definitions and classifications regarding type (Yang, Tibbetts[27]) and severity (Olsen, Myklebust[8]).

| Injury | | Description/Definition |
|---|---|---|
| Type | Acute | Result from a singular trauma. |
| | Overuse | Outcome of multiple and repeated stresses in the same location or incomplete or inadequate recovery of an old injury. |
| Severity | Minor | No absence from practice. |
| | Slight | Absence of 1-7 days from practice. |
| | Moderate | Absence of 8-21 days from practice. |
| | Major | Absence > 21 days from practice. |

### *Statistical Analysis*

The results were analyzed by descriptive statistics (percentage, mean and standard deviation) and are presented in tables and graphics. Relative frequency of groups (male and female) and subgroups (anatomic part, severity, and type) were compared using Pearson chi-square tests. The statistical analysis was performed using SPSS.20 and the statistical significance level was set at $\alpha = 0.05$.

## Results

High numbers of injuries were found for both genders in this study, with a total value of 218 injuries, of which 120 were in male athletes and 98 in female (Table 2). Injuries to the lower limbs represented 47.4% of total male injuries and 69.6% of female injuries. The most commonly reported injured anatomic part was the knee (20.8% and 33.8% for male and female athletes, respectively). Concerning the upper limbs, the shoulder joint was reported as the most frequently injured, accounting for 19.2% of total injuries in male participants and 5.1% in female participants (Table 2). The injury severities reported by both genders and total values are presented in Figure 1.

Table 2. Absolute and percent values of injuries by anatomic part reported by handball players (male, female, and both genders (total)).

| Anatomic Parts | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| | Injuries | % | Injuries | % | Injuries | % |
| Knee | 25 | 20.8 | 33 | 33.8 | 58 | 26.6 |
| Ankle | 25 | 20.8 | 33 | 33.8 | 58 | 26.6 |
| Shoulder | 23 | 19.2 | 5 | 5.1 | 28 | 12.8 |
| Elbow | 9 | 7.5 | 6 | 6.1 | 15 | 6.9 |
| Hand/Fingers | 9 | 7.5 | 4 | 4 | 13 | 5.9 |
| Spine | 3 | 2.5 | 4 | 4.1 | 7 | 3.2 |
| Calf | 4 | 3.3 | - | - | 4 | 1.8 |
| Thigh | 3 | 2.5 | 2 | 2.0 | 5 | 2.3 |
| Other | 19 | 15.8 | 11 | 11.2 | 30 | 13.8 |
| **Totals** | 120 | 100 | 98 | 100 | 218 | 100 |

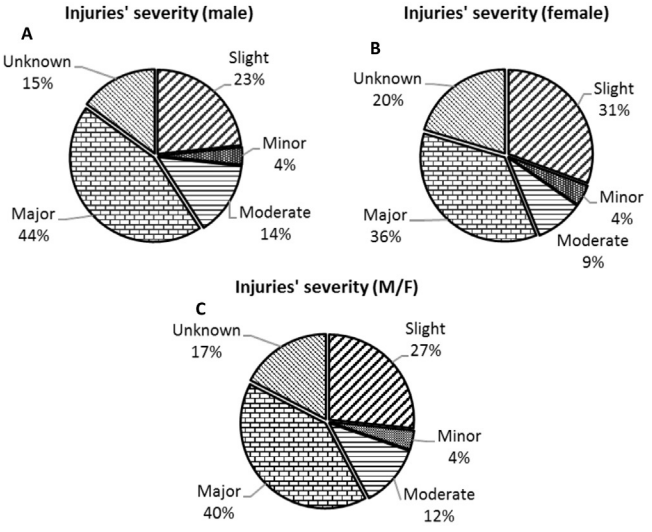


Figure 1. Severity of injuries reported by handball players: male (A), female (B), and both genders (C).

According to Olsen, Myklebust[8] who identified injury severity classifications, from total values, 40.3% were major injuries (Figure 1c), being more frequently reported by male (44.1%) than female players (35.7%) (Figure 1a), while slight injuries were more often reported by women (30.6%) than men (23%) (Figure 1b).

Acute injuries were more common (48%), with overuse injuries representing 22.71% of the total (Figure 2). A similar frequency of acute injuries was found between men and women (53.1% versus 41.4%). Furthermore, the male sample reported higher values of overuse injuries, with statistical difference (21.7% versus 16.2%, p = .001).

Interactions were found between gender and injured anatomic part, while male athletes reported a higher proportion of injuries to upper limbs (39.2% versus 21.4%; p = .015), female athletes presented a greater proportion in the lower limbs (73% versus 55%; p = .015). No statistical differences were found for injury severity between genders.

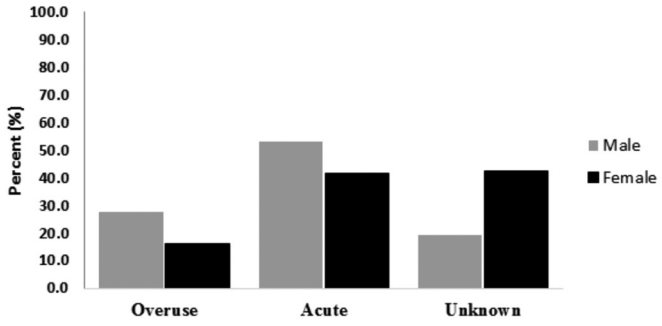


Figure 2. Injury types reported by handball players (male and female).

In total, 229 diagnostics were observed, this number being greater than the total number of injuries as some presented multiple diagnostics. Of the 229, 130 (57%) were reported by male and 99 by female teams. A total of 39 different diagnostics were found, with sprains being the most common in both genders (21.2% in female and 13.1% in male athletes – Table 3). Following sprains, tendinitis was reported as the second most frequent diagnosis, representing 10% and 12.3% for male and female genders, respectively.

Table 3. Injury diagnostics reported by handball athletes (male, female, and both genders (total)).

| Diagnostics | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| | Injuries | % | Injuries | % | Injuries | % |
| Sprain | 17 | 13.1 | 21 | 21.2 | 38 | 16.6 |
| Tendinitis | 13 | 10.0 | 6 | 6.1 | 19 | 8.3 |
| Strain | 11 | 8.5 | 4 | 4.0 | 15 | 6.6 |
| Joint Dislocation | 9 | 6.9 | 1 | 1.0 | 10 | 4.4 |
| Bone Fracture | 9 | 6.9 | 4 | 4.0 | 13 | 5.7 |
| ACL Rupture/ Tear | 5 | 3.8 | 3 | 3.0 | 8 | 3.5 |
| Meniscus Wear | 5 | 3.8 | 1 | 1.0 | 6 | 2.6 |
| Ligament Laxity | 2 | 1.5 | 5 | 5.1 | 7 | 3.1 |
| Tendinopathy | 4 | 3.1 | - | - | 4 | 1.7 |
| Bone Wear | 3 | 2.3 | 1 | 1.0 | 4 | 1.7 |
| Partial Ligament Tear | 3 | 2.3 | 3 | 3.0 | 6 | 2.6 |
| Stress Fracture | 1 | 0.8 | 2 | 2.0 | 3 | 1.3 |
| Meniscus Tear | 2 | 1.5 | - | - | 2 | 0.9 |
| Bursitis | 2 | 1.5 | - | - | 2 | 0.9 |
| Traumatic Arthritis | 2 | 1.5 | - | - | 2 | 0.9 |
| Ligament Tear | 2 | 1.5 | - | - | 2 | 0.9 |
| Others | 15 | 11.5 | 6 | 6.1 | 21 | 9.2 |
| No Diagnostic | 25 | 19.2 | 42 | 42.4 | 67 | 29.3 |
| **Totals** | 130 | 100 | 99 | 100 | 229 | 100 |

## Discussion

Handball is a contact sport with high potential for the occurrence of injury, due to its characteristics and the interaction between intrinsic and extrinsic factors of the players. This high

potential is especially observed among female players, with a focus on the lower limbs. Thus, the objective of the present study was to investigate the injury frequency among São Paulo State handball players, which was described as high, especially in the lower limbs, with acute injuries as the most common injury type and sprains as the most commonly reported diagnostic.

The majority of injuries occurred, for both genders, to the lower limbs, with the sprain being the most common injury, corroborating findings in the literature[8,10-12,14]. This finding is likely to be specific to the investigated sport, as continuous direction changes and cuts, repeated landings, floor type, and intensity of the game result in excessive loads on lower limbs. Moreover, Giroto, Hespanhol Junior[12] found similar results with Brazilian athletes: increased levels of traumatic/acute injuries, in which the lower limbs were the most affected anatomic part.

Likewise, a predominance of acute in comparison to chronic/overuse injuries was observed, as reported in some reviewed studies[8,27]. This might be due to the lack of follow up performed by a medical/physiotherapist committee, and the absence of early diagnostics for chronic injuries in the population of this study, as the majority of participating teams do not have sports physicians and physiotherapists accompanying the athletes daily. Furthermore, the high number of different diagnostics can be explained by the influence of previous injuries[5]. Wedderkopp, Kaltoft[14] and Van Mechelen, Twisk[28] pointed out the relationship between new and previous injuries, especially ankle sprains. The same can be applied to overuse injuries, since Giroto, Hespanhol Junior[12] showed that handball players with previous injuries presented a 2.5-times increased risk of reporting a new overuse injury; this type of injury being more common in adult than young athletes, due to several factors, such as accumulated residual trauma and more injuries sustained over time[29].

Specifically regarding the lower limbs, knee and ankle joints were the most frequently injured, as found by Giroto, Hespanhol Junior[12], Olsen, Myklebust[8], Seil, Rupp[10], Wedderkopp, Kaltoft[14], and the main mechanisms responsible for susceptibility to these injuries, were identified as tibia anterior rotation, due to knee valgus collapse[18,30], as well as dorsiflexion strength and amplitude, muscular reaction, and coordination, when considering the ankle[31,32], since a sprain was identified as the most common injury for these participants.

Wedderkopp, Kaltoft[14] found a high incidence of injury among handball players (40.7 injuries/1000 hours of game), the majority in the lower limbs. Agreeing with these results, Olsen, Myklebust[8] identified the knee and ankle joints as the most injured anatomic parts in this sport, considering both genders. However, the findings of the present study are in agreement with those found by Seil, Rupp[10], which indicate that female players are more susceptible to suffer injuries to the lower limbs than male athletes. In the same way, the epidemiological study of Lindblad, Hoy[38] found women to be injured 2-times more than men in handball, which, according to Hewett, Torg[36], is due to hormonal, anatomic, and neuromuscular factors that, consequently, influences in the valgus (mechanism of injury), making female athletes more susceptible to sport injuries than their male counterparts.

The disparity in the frequency of knee injuries between genders may be related to anatomic (ACL thickness), biomechanical (*Q* angle and knee valgus)[33], hormonal (relation between female sex hormones peak and ligament laxity)[21], and neuromuscular divergences (differences between activation of quadriceps and hamstrings)[34]. It is important to emphasize that these factors, alone or together, mean female athletes are much more susceptible to sports injuries, especially when exposed to risky situations.

As our results show, the knee joint is the main focus of injuries, and this finding is corroborated by the studied literature[8,13,14,35], although it was not evident from our data that the ACL is the most injured knee tissue, as described by many works[7,17,36,37]. Concerning the ankle joint, which presented a high number of injuries, some authors have found an equally elevated number of injuries for this anatomic part[6,8,35,38], with a sprain being the most common injury reported by the athletes, once again, agreeing with the investigated studies[8,14]. As suggested by Aman, Forssblad[39], special attention should be given to preventing upper and lower limb injuries in handball, mainly at higher levels of practice, as they found an increased incidence of injuries in Swedish national leagues.

Although female athletes presented a greater prevalence of injuries to the lower limbs, the exact opposite was found for the upper limbs, as the male sample presented the highest number for this anatomic part, with the shoulder being the most commonly injured structure. A similar result was found in Brazilian athletes in a study that identified an increased injury risk for the shoulder[40]. Similar results were also found by Giroto, Hespanhol Junior[12], in which the shoulder was the anatomic part with greater values for chronic/overuse injuries, and by Myklebust, Hasslan[41] where handball athletes presented a history of shoulder pain, directly affecting training and competition performance. These types of results arise from game/training actions, as the large numbers of throws and passes, in addition to tackles and defensive actions, in many cases directly to the shoulder, increase the vulnerability of this joint to injuries[42-44]. In this way, it has been suggested that external rotation strength, scapular muscle strength, kinetic chain, and thoracic mobility are efficient to prevent shoulder injuries[45].

The most significant limitation of this study is the application of a retrospective questionnaire, as the athletes were required to remember all the aspects investigated regarding their past injuries, impairing the data collection regarding time if they could not specify all information needed (i.e., past events that led to injuries). Due to this fact a longitudinal approach is recommended to determine, in a more effective manner, the epidemiological scope of injuries and traumas coming from handball practice. In addition, it is also suggested that future studies aim to identify the mechanisms of injuries in handball via medical and coach reports, elucidating how they occur, how to avoid them, and how to decrease their severity, in the inevitable case of occurrence.

Through our results, it is possible to observe an increased risk of lower limb injuries, particularly among women, and an equally augmented danger of the occurrence of acute injuries in both male and female athletes. Furthermore, attention should be given to overuse and upper limb injuries, mainly between

male handball players, as, in the present research, they showed a higher proportion of injuries to this anatomic segment than their female counterparts.

These findings focus attention on the search for specific and efficient countermeasures, which aim to lower/prevent the occurrence of injuries, especially, but not uniquely, in the female population, decreasing individual and team losses. Finally, future studies may use the results of the present research to prepare and suggest injury prevention protocols (proprioception, neuromuscular, balance training, etc.) in order to assist coaches and physical trainers to reduce the risk of injuries.

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