Hand injuries in sports – a retrospective analysis of 364 cases

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Abstract

Background

Hand injuries are common in sports and associated with high drop-out rates and costs. Considering the multiplicity of health benefits of regular physical exercise, efforts should strive for rising the safety of sports. This implies knowledge of sports injury risk profiles. So far, major surveillance programs exist mainly in the Anglo-American countries, reflecting the specific concerns of sports in this part of the world. Data on sports injuries within Europe are scarce. As sports behavior appears to vary demographically, we hypothesized that risk injury profiles differ as well.

Methods

To assess, whether the described sports injuries of the hand, published internationally, are applicable to the German population, we performed a five-year retrospective, single-center analysis of sports-related hand injuries, using the data of the Enterprise Clinical Research Warehouse of Hannover Medical School.

Results

Notable differences in comparison to other data were observed. Ball sports, cycling and equestrian sports caused most of the recorded hand injuries, which were predominantly fractures of the wrist and hand. Hand injuries in equestrian sports were associated with significantly higher operation and hospitalisation rates as well as a significantly longer inpatient treatment.

Conclusion

National as well as European registry studies are needed in order to better estimate the risk patterns of sports injuries and reduce the sequelae.

Background

The benefits of sports on physical and mental health are globally evident and recognized [1]. Regular physical activity improves social skill development and self-esteem in children while contributing strongly to psychological health and stress-compensation in adults and is associated with an enhanced quality of life in young and old [2–5].

However, the omnipresent risk of injury still accounts for the major drawback within the life of every athlete, in both professional or amateur sports [6]. Previous prevention measures, such as rule changes or the introduction of protective clothing, managed to increase safety in many sports [7–9]. Rule changes made by the Amateur International Boxing Association (AIBA) in 2013 for example, resulted in a

substantial decrease of boxing-related upper extremity injuries between 2012–2016, shown most impressively in a decline of hand injuries by 33% [7, 10]. Nevertheless, sports injuries still occur with high incidences, showing varying risk profiles within the different types of sport [11, 12]. Injuries of the hand account for approximately 25% of all sports-related injuries [13–22]. Hence, the hand is at high risk for injury during sportive activities. Within the National Football League Scouting Combine from 2009–2015 the hand, with 33.5%, was among the top five of the affected body regions [22]. The dimension of direct and indirect costs of hand and wrist injuries goes along with a great economic burden of these trauma entities. So far evidence of risk profiles in sports is mainly based on data from large surveillance programs of the Anglo-American region, including the USA [18, 22, 23], Canada [24] and Australia [25–27]. In order to investigate the most common sports injuries of the hand and wrist [21, 28] in an European population and to contribute to the establishment of sports injury risk profiles, the following epidemiological study, based on data of a large hand trauma center in northern Germany, was performed.

Methods

Data acquisition

All collected data were automatically exported and manually post collected into Microsoft Excel spreadsheets and analysed with IBM SPSS Statistics (Version 26, released 2019). The relevant cohorts were automatically identified and extracted by the Enterprise Clinical Research Warehouse (ECRDW), which comprises clinical data of >2.3 million patients for data collection and data preprocessing [29]. This was accomplished using both, sport specific keyword search (Additional file 1) as well as ICD 10 GM (International Statistical Classification of Diseases and Related Health Problems 10th Revision German Modification) codes for hand injuries (Table 1). Physician Discharge letters and operation reports of the Department of Plastic, Aesthetic, Hand and Reconstructive Surgery of the Hannover Medical School were used, which were captured in the period from February 2013 to February 2018. A keyword list with 147 different relevant terms (named entities) was used to identify equivalent entities in the medical documents (Named-Entity-Recognition approach) [30], which yielded in a total of 1530 cases. Each of these cases was further screened manually to verify the textual findings of a sports-related injury to the hand. Finally, 364 patients with an ICD-10-GM diagnosis for a hand injury and a sports-related injury aetiology, regardless of gender or age, could be included in the analysis. No patient was counted more than once.

Table 1: ICD-10-GM codes used in the data extraction process.

S60.	Superficial injury of the wrist and hand
S61.	Open wound of the wrist and hand
S62.	Fracture of the wrist and hand
S63.	Luxation, sprain and strain of joints and ligaments at height if the wrist and hand
S64.	Injury of nerves at height of the wrist and hand
S65.	Injury of blood vessels at height of the wrist and hand
S66.	Injury of muscles and tendons at height of the wrist and hand
S67.	Crushing injury of the wrist and hand
S68.	Traumatic amputation of the wrist and hand
S69.	Other not further specified injury of the wrist and hand

Statistical Analysis:

For further statistical analyses, sports were assigned to different subgroups (ball sports played with an assistive device such as a bat, racquet or stick – collectively referred to as ”ball sports with a bat”, ball sports played without a bat, racquet or stick – collectively referred to as “ball sports without a bat”, “gymnastics”, “martial arts”, “climbing”, “outdoor sports”, “precision sports”, “cycling”, “equestrian sports”, “skating”, “water sports”, “winter sports” and “miscellaneous”) (Table 2). Equestrian sports were defined as injuries that occurred during horse riding itself, as well as the horse handling in course of equitation, such as leading the horse by the rein or bridling a horse.

Insert Table 2

Demographic data, as well as treatment type, hospitalisations, length of hospital stay (LOS) and ICD-10-GM codes were assessed of every included patient. We performed a Kolmogorov-Smirnov test to assess the distribution of continuous data. For the comparison of non-parametrically distributed data, the Mann-Whitney-U test was applied. In case of parametric distribution, the data were compared with the Student’s two-sided t-Test. Categorical variables were analysed with the Pearson’s chi-squared test.

Results

A total of 364 hand injuries, caused by 42 different types of sport, were treated (Fig. 1, Table 2).

Insert Figure 1

The sport leading to most of the hand injuries was cycling (n=101, 28%), followed by football (n=66, 18%) and equestrian sports (n=46, 13%). According to subgroup categorisation the majority of sports-related hand injuries occurred in “ball sports without a bat” (n=114, 31%), again followed by cycling (n=101, 28%) and equestrian sports (n=46, 13%) (Fig. 2).

Insert Figure 2

Gender

Overall, males were affected more often than females (females n=118, 32%; males n=246, 68%). Significant gender-dependent differences were observed in equestrian sports and football. 84% (n=39) of the equestrian-related hand injuries affected the female study population (p<0.001). With 33% equestrian sports accounted for most of the female sports injuries of the hand. Significantly more male patients suffered hand injuries during plain ball sports (n=101, 89%; p<0.001), which is mainly due to the large part of football-associated injuries. Statistical analysis revealed no significant difference between gender and LOS or the need for operation respectively (p=0.306; p=0.703). Half of the study population was aged between 19 and 45 years, with a mean patient age of 32 ± 17 years (range 3–89).

Age

There was no significant difference between the age of female and male patients (p=0.343). Patient’s age was further not correlated with the necessity of an inpatient or operative treatment (p=0.648; p=0.556 respectively). However, the analysis revealed significant differences between patient’s age distribution and sports groups (p=0.015). Ball sports without a bat, climbing and gymnastics affected significantly more younger people (p<0.001; p=0.044; p=0.015), while sports-related hand injuries occurred significantly more often among the elderly study population (p<0.001).

Operation, Hospitalisation, LOS

218 (60%) patients received an operative treatment, while 166 patients (46%) were hospitalised due to sports-related hand injuries. 76% (n=35) of all equestrian-related hand injuries were treated operatively (p=0.017), while 63% (n=29) of these injuries required hospitalisation (p=0.011). The mean length of

inpatient stay was 3.7 ± 4.47 days (range 1–27). Equestrian Sports led to a significantly longer LOS (Equestrian sports mean 3.2 ± 5.2 days vs. total study population mean 1.7 ± 3.5 days; p=0.003). There was only one case where a patient was hospitalised without receiving surgical therapy, as the patient refused operation during the course of treatment.

ICD-10-GM

According to the principal diagnoses codes, the most frequent injury type was “Fractures of the wrist and hand” S62.- (n=141, 39%), followed by “Open wounds of the wrist and hand” S61.- (n=86, 24%) and “Luxations, sprains and strains of joints and ligaments at the height of the wrist and hand” S63.- (n=62, 17%) (Fig. 3).

Insert Figure 3

There was no significant difference between patients sex and injury type (ICD-10-GM diagnosis) (p=0.595). Fractures accounted for most hand injuries in ball sports without a bat (p=0.007; n=53, 47 %) and equestrian sports (n=15, 32.6%; p<0.001). Among the cycling cohort there was a trend towards more S61.- (n=34, 34%) and S62.- (n=35, 35%) injuries. 64% (n=9) of all amputation injuries of the hand and wrist (S68.-) occurred during equestrian sports, which is significantly more than in any other sports group (p<0.001).

Discussion

Besides the proven health benefits, the risk of injury represents the major drawback of sportive activities. Injury risk profiles may parallel demographic patterns, as well as social trends [1, 31–33]. In opposite to the United States, where a vast majority of sports-related hand injuries occur during American football, gymnastics, wrestling and basketball [31], we identified cycling, football and equestrian sports as the major causes of hand injuries in our cohort. Most of the observed injuries occurred in males and within the first two age quartiles, which is in line with previous reports [4, 34]. Ball sports played without an assistive device, climbing and gymnastics were predominantly responsible for hand injuries in the younger population, while a shift towards more cycling-related hand injuries could be observed in the elderly population. Equitation-related hand injuries do not only represent one of the most common sports injuries in our analysis but were also associated with a significantly higher operation and hospitalisation rate. The need for an operative treatment is mostly due to the increased rate of fractures in this sub-cohort. Furthermore, this sub-cohort accounted for 9 out of a total of 14 traumatic finger amputations in this study population. These findings support our clinical notion that complex injury patterns are common in equitation sports. Interestingly, equestrian sports seem to be underrepresented in the current literature, thus these findings might well add relevant information for clinical practice. The 2018 German examination regulations in equestrian sports specify mandatory gloves only in dressage and horse

driving sports [35]. Regarding the high incidences of trauma and their severity, a broadening of this rule to all disciplines in equestrian sports, on the basis of the current results, should be discussed.

According to previous studies men represent the greater risk group for sports injuries. These observations can be confirmed by the presented results, where men are affected more than twice as often as women. Younger people, representing the physically most active population group, are at highest risk for sports injuries. 50% of the study population was aged between 19 and 45 years. Participation of young individuals in organized sports and high-frequency trainings are of increasing popularity, especially in the western world [2, 20, 36]. Simultaneously, a rising competitiveness, in terms of force and speed, is observable. Sport is one of the main causes of injuries in adolescents [37], with an increased risk for complicated injuries and long-term damage [36]. However, risk profiles appear to be dynamic, depending on demographic and social trends. Taking in account rising life expectancy and increasing sports activities throughout life time in developed countries, an increased incidence of sports injuries among the elderly population has to be expected [31]. The dynamics of sports injury risk profiles raises the demand for injury prevention measures. This, however, requires knowledge of sport specific injury risks and injury patterns respectively.

An analysis of injuries occurring in German club sports from 1987 to 2012, without specification on the hand, showed high injury risks in ball sports such as football, handball, basketball or volleyball [38]. These data, however, did not comprise the non-organized leisure sports, such as cycling, which proves to be a major risk sport in our patient population. Further major epidemiologic and demographic surveys about sports injuries in Germany go back to the years 1986 and 1999, already indicating differences of injury-causing sport types between Germany and the USA. Previous national surveys, seeking to assess sports injuries in Germany, are rare and mainly based on questionnaires [39–41]. According to our knowledge, this is the first study analysing sports injuries specifically in the hand in the German population.

A clear limitation of this study is the retrospective character, which does not allow more detailed information about the injury mechanism. Previous operations or re-operations in other hospitals were not reported in the current database and thus cannot be taken into account. As there is no coding for sports injuries available, we utilized an extensive keyword analysis for data collection. Although performed with great care, this approach bears the risk of missing cases of sports-related hand injuries.

These data represent the basic stage within the Translating Research into Injury Prevention Practice framework (TRIPP) [42]. This gradual injury prevention model comprises six stages, leading from injury surveillance up to the implementation of developed prevention measures, and should give researchers support in the successful establishment of injury prevention measures in sports. Given that, a comprehensive monitoring of sports injuries is crucially needed in order to successfully guide and promote injury prevention programs. Supplemental support in this intent can be provided by apps or user friendly computer tools, enabling broadly accessible surveillance participation [25, 26].

The high costs associated with hand and wrist injuries are underlining the economic importance of maximal safety in sports [43]. In addition, the financial burden of these injuries can reach great extent also at individual level. Drop-out rates as well as high direct costs, which might not be covered by insurances, increase the barrier to sports participation among the population. While surveillance programs for road injuries or occupational injuries are already well-established, the only available tool for injury monitoring on a national as well as an European level is the EU Injury Database (EU IDB) [44, 45]. However, a little more than half of the EU member states are contributing to this database. The free accessible EU IDB recorded a total of 235 sports-related hand and wrist injuries for Germany in the year 2016 only, suggesting a significant missing of data [45]. Another obstacle is the difficulty of monitoring hospital discharges due to sports injuries. As hospital statistics are mainly based on the ICD codings, which do not include sports injuries, a reliable monitoring is almost impossible at the moment [44].

Conclusion

Reliable surveillance programs, recording sports-related injuries at national but also on European level, are necessary in order to achieve maximum safety during sports all over Europe, remove barriers to sports participation and hence promote a healthy, physically active population.

Abbreviations

ECRW	Enterprise Clinical Research Warehouse
EU IDB	EU Injury Database
ICD-10-GM	International Statistical Classification of Diseases and Related Health Problems 10th Revision German Modification
LOS	Length of stay
TRIPP	Translating Research into Injury Prevention Practice framework

Declarations

Ethics approval and consent to participate

The study was approved by the Ethics Committee of the Hannover Medical School (Nr. 7840 BO K 2018).

Consent for publication

All patients consented for the scientific evaluation of their anonymized data.

Availability of data and materials

The anonymized datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

VAS, AK and PMV conceived the idea for the study and PMV is leading the trial. VAS, AK, HL and PMV designed the study. VAS and HL extracted the data from patient files. VAS performed a manual data quality check. VAS and AK drafted the manuscript with input from HL and PMV. All authors read and approved the final manuscript.

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None.

Table 2

Table 2: Absolute (n) and relative (%) numbers of patients with hand injuries and the associated type of sport and sports super group respectively.

Sports group/sports	Numbers (%)
Ball sports without a bat	114 (31 %)
Football	64
Handball	24
Volleyball	14
Basketball	8
Rugby	2
American Football	2
Ball sports (not further specified)	1
Cycling	101 (28 %)
Equestrian sports	46 (13 %)
Winter sports	24 (7 %)
Skiing	12
Ice skating	8
Snowboarding	3
Tobogganing	1
Martial arts	21 (6 %)
Boxing	11
Martial arts	10
Ball sports with a bat	13 (4 %)
Hockey	4
Ice hockey	4
Tennis	3
Cricket	1
Squash	1
Precision sports	11 (3 %)
Skittles	6
Bowling	4
Darts	1

Skating	8 (2%)
Skateboarding	4
Inline Skating	4
Water sports	7 (2%)
Water Skiing	2
Sailing	1
Surfing	1
Rowing	1
Canoe Polo	1
Swimming	1
Climbing	7 (2%)
Gymnastics	5 (1 %)
Trampolining	2
Turning	1
Bench Press	1
Fitness Training	1
Miscellaneous	4 (1 %)
Archery	2
Ballet Dancing	1
School sports (not further specified)	1
Outdoor sports	3 (1%)
Hiking	1
Fishing	1
Jogging	1
Total	364 (100 %)

Figures

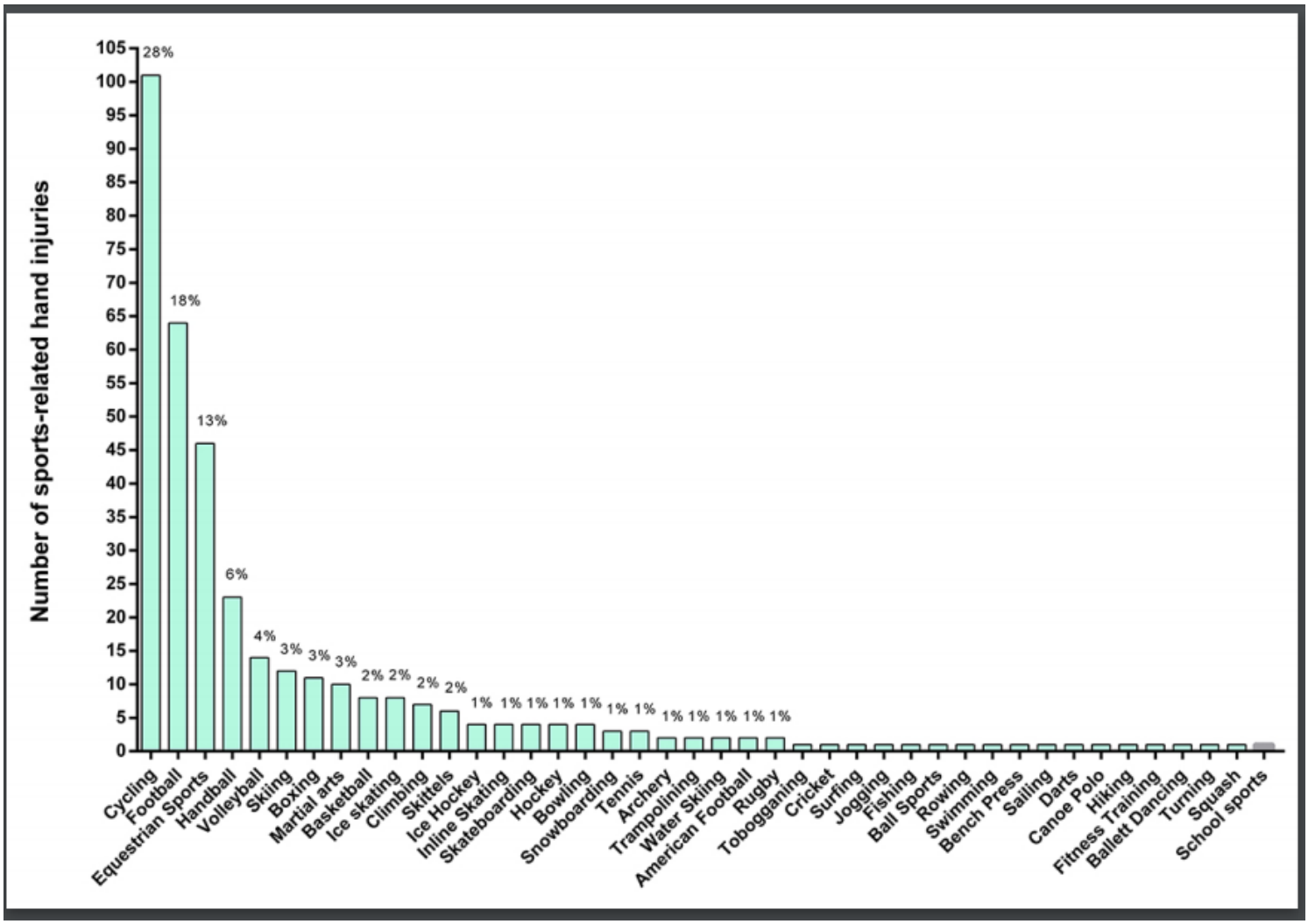

Figure 1

Absolute and relative numbers of hand injuries according to different types of sport.

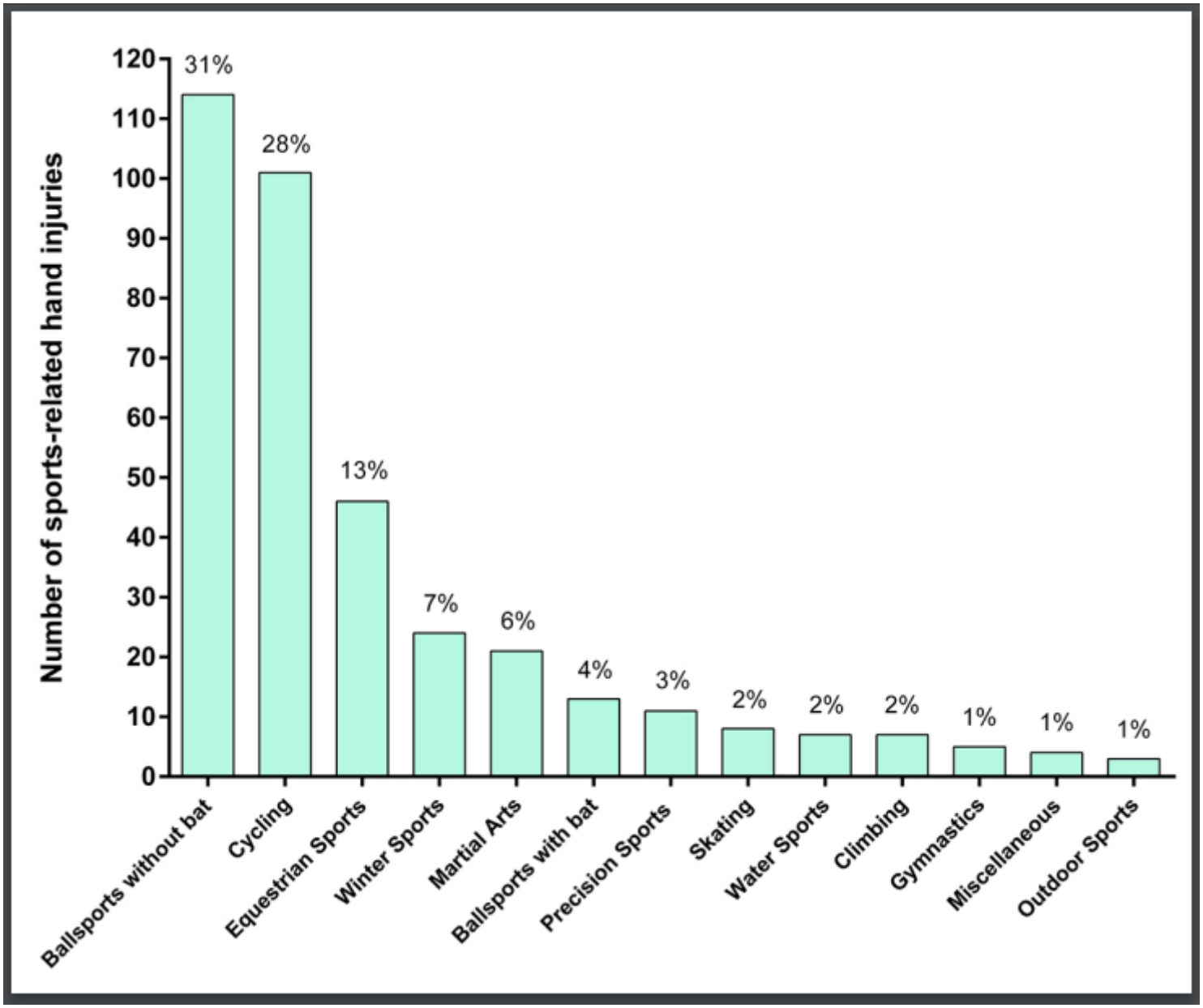

Figure 2

Absolute and relative numbers of hand injuries according to different sports groups.

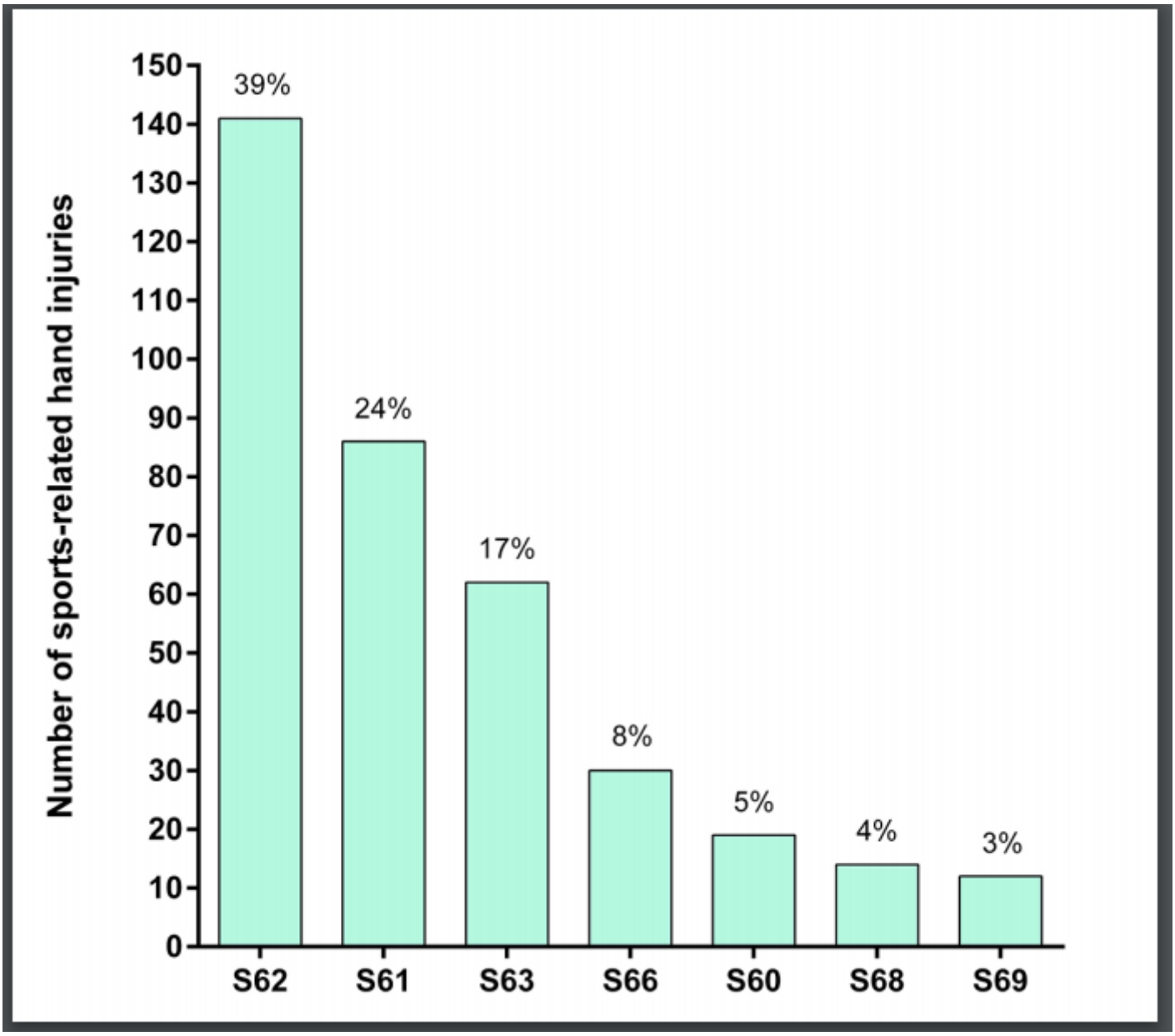

Figure 3

Absolute and relative numbers of sports-related hand injuries according to ICD-10-GM codes.

Supplementary Files

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- AdditionalFile1.pdf