

Review paper

WRIST INJURIES IN GYMNASTS - SYSTEMATIC REVIEW¹

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Abstract: The aim of this research was to summarize the relevant literature on wrist injuries in gymnasts and to determine the prevalence of injuries based on a systematic review of previous research. In sports gymnastics, the upper extremities are the bearers of the whole body, which leads to consequences such as wrist injuries. The types of injuries are different, depending on its excessive use. The combination of a period of rapid growth and intensive training creates the conditions for gymnasts to be more prone to injuries, especially wrist injuries. Electronic search of papers was performed in databases: KoBSON, PubMed and Google Academic, and the studies were published in the period from 2010 to 2020, while a descriptive method was used to analyse the obtained data. Based on the database search, 14 studies met the criteria. Subjects who participated in questionnaires and experiments and different types of corrective treatment, sought to prevent further progression of the injury, and most subjects made major progress in suppressing or completely regressing their wrist injury. Raising awareness of the existence of this injury is of great importance in sport gymnastics, so early detection and prevention of injury is crucial.

Keywords: *gymnastics injuries, wrist, pain*

INTRODUCTION

Sports gymnastics consists of dramatic body transformations that take place at a very early period of life. It also consists of a process of mastering both simple and complex gymnastic elements (Nattiv & Mandelbaum, 1993). There is an increasing number of children who get involved and stay in this sport, in order to become top, i.e. elite athletes, over the years. Consequently, the performance of severe elements at an early age may be associated with an increased risk of injury (Meeuwisse, 1994). Most top gymnasts have not gone through childhood and adolescence without an injury, where the risk of injury increases with the duration of training and the severity of

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the elements performed (Toffler et al., 1996). The high demands of this sport can lead to an injury, if the athlete's body is exposed to excessive effort, and corrective treatment is not introduced at the right time. As the skill level itself increases, the incidence of acute injuries increases, and thus the load during exercise increases (Ashwell & Richardson, 2019).

Unlike some other sports, sports gymnastics uses the upper extremities to control the whole body. For this reason, wrist activity is exposed to many types of stress, including repetitive movements, high impact loads, and axial compression (Wolf et al., 2017). Compared to most other sports, wrist injury is the second most commonly injured region of the body (Caine & Nassar, 2005). According to some authors, (Daly et al., 2001; Westermann et al., 2015) in order for gymnasts to be able to successfully perform elements on gymnastic equipment, complete control of the body is required. Then a gymnast is put at a high risk of joint injury. In 50% of cases, joint pain has been reported in young gymnasts, and in the initial period of training, the wrist is the most often injured part of the body compared to the rest of the skeletal system (DiFiori et al., 2002), where the average age of gymnasts feeling pain in the wrist, with repetitive loading, is 9-14 (Kox et al., 2015).

When we talk about the types of injuries, they usually vary depending on gender (Stracciolini et al., 2015), sports modality, training intensity, current years and years of training (Burt et al., 2013). The frequency varies, so coaches should pay attention to the intensity and load, especially during puberty. Injuries can be of acute (macrotrauma) and chronic (microtrauma) type, which are associated with load and overuse. Changes caused by overuse, such as scaphoid bone injuries or ulnar carpal tunnel syndrome, can jeopardize athletes' careers (Koh & Dietz, 2005), so early diagnosis is necessary for the injury to heal properly, allowing the athlete to function, both in sports and later, in everyday life. Although the frequency of this injury is different, it should be kept in mind that the trainings are of high intensity and load, in the period between 10 and 14 years of age. Using this type of injury as a definition of overuse, risk identification is recommended, in order to prevent further complications (Kox et al., 2015). In the event of an injury, coaches generally recommend that their athletes avoid any gymnastic activities that require the use of wrists, but also other leisure activities outside the gym (Cornwall, 2010; Daly et al., 2001; Pengel, 2014; Webb & Rettig, 2008). On the other hand, the most commonly reported interventions include conservative methods, such as braces and immobilization, or even more invasive methods, such as surgical interventions (Daly et al., 2001; Pengel, 2014; Webb & Rettig, 2008).

The authors believe that there is a need to summarize the results in one place, or the need for a systematic review. Based on the author's cognition, there is no systematic review research concerning wrist injuries in gymnasts, so the aim of this research was to summarize the relevant literature on wrist injuries in gymnasts and to determine the prevalence of injuries based on a systematic review of previous research.

METHOD

Electronic search of papers was performed in the following databases: KoBSON, PubMed, Google Academic. The papers were published in the period from 2010 to 2020. The search was limited to the following keywords: "gymnastics injuries", "wrist pain", "children and adolescents".

A descriptive method was used to analyse the obtained data. All titles and abstracts were reviewed for potential papers to be included in the systematic review. Also, the lists of references of previous review and original research were reviewed. Relevant studies were obtained after a detailed review, if they met the inclusion criteria.

The search strategy was modified and adapted to each database and search, where possible, in order to increase search sensitivity.

Inclusion criteria

The criteria for inclusion of the study were:

1. Type of study: controlled studies, where the sample of subjects was intentionally or randomly divided, were included in further analysis, while uncontrolled studies were excluded. Papers published in English were included in the study;
2. Sample of respondents: males and females, aged 7 to 28;

3. Type of results obtained: the primary result obtained for the purposes of systematic examination were wrist injuries in gymnasts.

Exclusion criteria

The criteria for excluding papers were:

1. Studies written in a language other than English;
- 2 Duplicates;
3. Studies which involved subjects under 7 years of age.

RESULTS

After a general search of the database, 53 papers were identified. Based on titles and duplicates, 32 studies were eliminated. The remaining papers were reviewed in detail. Three more studies were eliminated because they were written in a language other than English and additional four studies were excluded because of abstracts. A total of 14 studies met the defined criteria and were included in the systematic review. All of the studies examined wrist injuries in gymnasts, and the research was conducted in the following countries: the United States of America, Brazil, Japan, Iran, the Netherlands and Australia.

A detailed overview of the process of collecting adequate papers based on predefined criteria can be found in Diagram 1 and researches that are included in the systematic review can be found in Table 1.

Diagram 1. *Presentation of the process of collecting adequate papers*

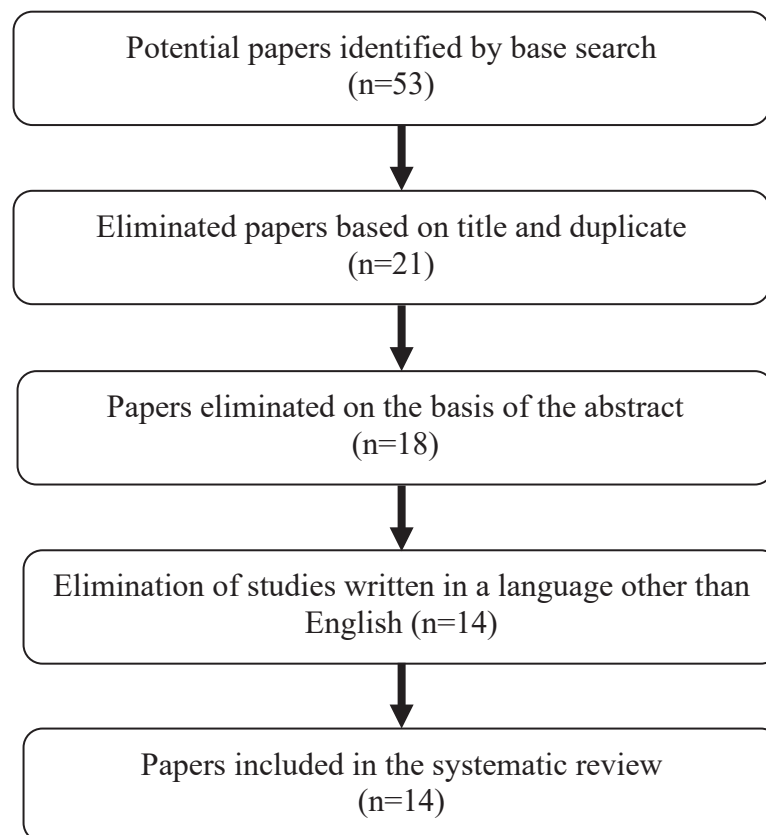


Table 1. *Research overview*

First author and year of publication	Respondents		Variables	Results
	Number	Age		
Nakamoto et al. (2011)	M=1	18	FP, HT	At the final assessment, 6 months after the surgery, the athlete competed without any problems
O'Kane et al. (2011)	F=96	7-17	Up	Upper limb injuries are the second most common type of injuries (21.6%)
Poletto et al. (2012)	F=1	13	FP, MR, R	The only solution is to stop creating cause-and-effect stress, although pain will always be present on the radial pineal gland
Sathyendra et al. (2013)	M=1	24	R	The subject returned to gymnastics after 8 months, without pain. At the final examination, the subject was able to fully extend all the fingers, with the load, in the neutral position of the wrist
Ghasempour et al. (2014)	M=41	16-28	Up, In	Body weight is the only anthropometric characteristic that had a significant relationship with wrist injury
Westermann et al. (2014)	N=119 M=64 F=55	18-22	Up	The anatomical region of the most commonly injured part of the body in men is the wrist (24%)
McLaren et al. (2015)	F=50	8-15	Up	The angle of impact when moving backwards was 95°. Wrist pain was reported by 15 subjects. The angle in the shoulders and the years of training correlate with the impact angle of the joint during the performance of the element
Guerra et al. (2016)	M=19	9-18	R, Up, FP	The prevalence of pain is 82%, and 53% is bilateral. Of these, 47% were limited in performance, 82% on a horse with grips, 17% on the parterre and 12% on a parallel loom
Boucher et al. (2017)	M=1	10	SFP	Significant improvement of power and motor control of the body. The programme enabled a return to gymnastic activities
Trevithick et al. (2018)	N=399	10-18	Up	Gymnastic braces were recommended as the primary method of preventing joint pain
Kox et al. (2018)	-	-	Up	17 signals and 3 limiting factors were detected, which indicate excessive joint injury
Ashwell et al. (2018)	F=1	12	FP, MR, R	Joint immobilization, rest, return to sports delayed
Trevithick et al. (2019)	M=48	8-22	ST	Significant reduction in pain while wearing braces, on a pommel horse, on parterre and parallel development
Fujioka et al. (2019)	M=1	11	MR, R, Im	After eight weeks of immobilization with plaster, the subject was allowed to gradually return to regular activities, and, after 4 months from the first visit to the doctor, to return to gymnastic activities at the same level, without any complications

Legend: N- total number of respondents, M- male, F - female, MR- magnetic resonance, R- radiography, Q- questionnaire, In- interview, PA- physical assessment, SPA- specific physical assessment, B- brace, Im- immobilization, ST- surgical treatment

DISCUSSION

The aim of the study was to identify and summarize the relevant literature on wrist injuries in gymnasts and its prevalence. The age of the respondents ranged from seven years, in a study by O'Kane et al. (2011), up to the age of 28, in a study by Ghasempour et al. (2014), while the total number of respondents encompassed by this study was 778.

The combination of an underdeveloped postural system and intensive training can be key to the occurrence of an injury, and since the entire body weight is controlled by the upper extremities, including the wrists, a problem can occur if the load is high (Ashwell & Richardson, 2018). DiFiori et al. (2014) also concluded that serious wrist injuries can occur between the ages of 10 and 14, proving a high risk of overuse of the wrist in young gymnasts during growth and development. Also, Dobyns & Gabel (1990) came to the conclusion that between the ages of 10 and 12 gymnasts enter a phase of rapid growth, and have a greater tendency to injure the distal radial pineal gland.

Sathyendra et al. (2013) had a subject who had a wrist fracture due to a complication that occurred during a bar grip. Twelve months after his surgery, the subject actively returned to gymnastics without any problems. The examinee of the study by Nakamoto et al. (2011) returned to regular gymnastic activities 6 months since the scaphoid bone fracture. Wolf et al. (2017) concluded that gymnastic equipment intended for the bars should be checked more frequently, because it is of crucial importance for the safety of gymnasts, while old equipment should be discarded immediately. The authors also conclude that almost all respondents return to active sports gymnastics after they undergo a surgery.

Ashwell & Richardson (2018) and Poletto et al. (2012) suggested their respondents to rest i.e. to cease to create causal stresses, and they also recommended the immobilization of joints, and delayed return to sport. It can be said that some studies (Fujioka et al., 2019; Boucher et al., 2017; Wolf et al., 2017) applied identical solutions: recommending rest for a period of 3-6 months and immobilization for 6 weeks; after that, physical assessment and therapy, which enabled the return of the original strength and mobility.

Guerra et al. (2016) presented the percentage modality of wrist pain by devices, i.e. 82% pommel horse, 17% parterre and 12% parallel bars, while other studies (DiFiori et al., 1996; DiFiori et al., 2002) presented activities associated with wrist pain, and they included parterre and pommel horse. Injuries to the upper extremities, i.e. wrist represent the second most frequently injured region of the locomotor system, and studies by O'Kane et al. (2011) and Caine & Nassar (2005) justify that.

Kox et al. (2018) is a study where a group of sports doctors came up with a figure of 17 signals and three important limitations that may indicate excessive use of the wrist. According to the authors, the awareness of sports doctors has increased in recent years, because they are the ones who take care of athletes' injuries, including gymnasts' injuries. The base for recognizing excessive use of wrists has been created for more efficient injury assessment. Identical symptoms were also presented in the study by Wolf et al. (2017), starting from the fact that the wrist is a multiple and complex entity that is constantly burdened in the sport gymnastics. These two studies agree on the fact that a greater understanding of this injury and more effective prevention of premature termination of a gymnastic career is needed.

Wearing a brace reduces the risk of joint injury, rupture and stretching of the ligaments, during falls, by blocking the joint from going into the position of hyperextension. This is one of the ways to prevent injury, where due to the large number of repetitions of the elements, constant axial compressions can be alleviated, which are especially pronounced on pommel horse, because this equipment is generally known for the largest number of wrist injuries, then parallel bars, parterre and vault. (Trevithick et al., 2018; Trevithick et al., 2019). A similar conclusion was reached by Kox et al. (2015), who say that when taken into account that gymnasts can often strain their joints when they fall during normal gymnastic activities, any brace design is very important for prevention and protection.

As for the limitations, they are adaptations to the training program, the impact of sports performance on training and the impact of sports performance on competition. Depending on the nature of the injury, as well as the time period of its duration, the operative process can be a solution, but primarily the scope and intensity of training should be reduced and a rehabilitation process should be organized. Another limiting factor of this study is the impossibility of absolute access to all databases, which is reflected in the small number of studies included in this review.

CONCLUSION

Even at preschool age, the locomotor system is not strong enough to cope with the loads of the training process. These loads are constant, considering that there is a larger number of repetitions of elements, then compression and specific compression during exercise. Due to the nature of the sport, the combination of growth and intensive training creates conditions for gymnasts to be more prone to wrist injuries. Physical demands are higher among

elite gymnasts, which has led experts to say that chronic injuries should be more correctly cited as a consequence of participation in sports, emphasizing that injuries of this type are inevitable.

Early detection of an injury is crucial for the earliest possible implementation of the treatment phase, and if an athlete is injured again, after an acute injury, there may be a reduction in the rehabilitation process, so it is important to raise awareness among coaches about the existence of this injury, in order to come up with a proper response in terms of prevention and suppression of this type of injuries.

Based on the given facts, it can be concluded that the prevalence of this injury is high and that the type of wrist injury is individual for each gymnast individually. Therefore, dosing the extent and intensity, but also constant communication between coaches and practitioners is of key importance, in order to reduce the number of macro and microtraumas to a minimum, and thus create a faster process of reaching top results. The results of this paper can be used in future research to find adequate literature on wrist injuries in gymnasts, and this research can have practical application by helping coaches and gymnasts in terms of prevention, rehabilitation and proper action in case a wrist injury occurs.

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