

SHOULDER INJURIES IN WHEELCHAIR BASKETBALL PLAYERS: A SYSTEMATIC REVIEW**Małgorzata Jekielek¹, Angelika Sosulska¹, Grzegorz Mańko^{1,2}, Jarosław Jaszczur-Nowicki³**¹*Faculty of Health Sciences, Department of Biomechanics and Kinesiology, Collegium Medicum Jagiellonian University in Kraków, Poland*²*ORNR "Krzyszowice, Rehabilitation Center, Daszyńskiego 1, 32-065 Krzyszowice", Poland*³*University of Warmia and Mazury in Olsztyn; Department of Tourism, Recreation, and Ecology, Poland*

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Review paper

Abstract

Sport of the disabled has been becoming more and more popular for several years, and wheelchair basketball is one of the most popular disciplines among the disabled. However, playing sports is connected with the possibility of injuries and pain in people training a given discipline. The aim of this study is to determine the occurrence of injuries and to identify most commonly injuries in athletes practicing basketball in wheelchairs. A literature review was conducted in Embase and Medline PubMed databases. Basic search terms are: shoulder injury OR shoulder pain OR upper limb disease OR upper limb disorders OR upper limb pain AND basketball OR basketball player OR wheelchair sport OR wheelchair user OR wheelchair athlete OR wheelchair basketball OR disabled sport OR disabled persons. Results: 511 non-duplicate results were found. At the stage of the analysis of titles and abstracts, 483 were rejected and 28 were qualified for the analysis of full texts. The review included 2 that met all the criteria. The topic is not discussed in large numbers in the literature and requires further research specifically focused on the prevention of shoulder injury as well as assessment of the risk of damage to individual elements that make up the shoulder joint and surrounding structures.

Key words: *shoulder joint, disability, wheelchair, disabled sports, wheelchair sports, shoulder injuries***Introduction**

Wheelchair basketball is a very popular sport among people with disabilities. There are about 30,000 players in the world associated in the International Federation of Wheelchair Basketball (Yıldırım et al., 2019). It is also one of the disciplines played during the Summer Paralympic Games (Derman et al., 2013). It is a sport characterized by a very dynamic course, high, intermittent intensity associated with maneuvering the wheelchair and ball (Wang et al., 2005). The use of a wheelchair is already a burden on the shoulder joint, in addition, playing sports such as wheelchair basketball may predispose for increased overloading of the shoulder joints, which results in dysfunctions and pain in this area (García-Gómez et al., 2019). The main cause of pain and overload of shoulder joints in wheelchair athletes is irritation of the tendons building the rotator cuff located under acromion. There are several factors that can additionally cause an increased risk of damage to the shoulder joint. Lack of properly performed warm-up, lack of muscular balance within the shoulder and scapulothoracic joint together with a lack of posture control in the lumbar spine and pelvis, poor muscle elasticity within the arms and repetitive movements overhead (Nyland et al., 1997). Wheelchair athletes have twice higher risk of injuries within the rotator cuff due to these repetitive movements compared to people with no disabilities. An additional factor negatively affecting the shoulder joints is the need to drive the

wheelchair during competitions, which multiplies the overloads that already occur when driving the wheelchair during everyday activities. During this activity, there is an increased internal rotation in the shoulder joint, as well as anterior tilt and internal rotation of the shoulder blade increasing the risk of damage to the shoulder joint (Wilroy et al., 2018). The need to drive the wheelchair causes excessive growth and overloading of the internal rotators in the shoulder joint, such as the latissimus dorsi, subscapularis muscle, pectoralis major, teres major and serratus anterior muscles. The constant necessity of lifting the body with the use of arms both in everyday life and during sports is also of considerable importance. In the literature, it is believed that the coherence of the shoulder complex work determines the degree of functional independence of athletes using wheelchairs. An additional factor that may adversely affect the shoulder joint is the abnormal position of the body during sitting resulting from muscular imbalance (Nyland et al., 1997). The purpose of this work is to determine the occurrence of pain and injuries in wheelchair basketballers and to identify those most common within the shoulder joint of athletes practicing wheelchair basketball.

Methods

A literature review was conducted in the Medline-PubMed and Embase databases. Basic search terms were: Shoulder injury OR shoulder pain OR upper

limb disease OR upper limb disorders OR upper limb pain AND basketball OR basketball player OR wheelchair sport OR wheelchair user OR wheelchair athlete OR wheelchair basketball OR disabled sport OR disabled persons.

Search strategy

The article review followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyzes) principles. Inclusion and exclusion criteria were specified for the analysis of titles, abstracts and full texts. The review included papers published in the last 25 years in English. (20 articles older than 1995). After obtaining files containing all searches from both databases, the authors began qualifying articles for review based on titles and abstracts taking into account the following inclusion criteria:

- the studies concerned adults (people over 18 and under 65 were supposed to constitute at least 70%),
- the study group were people practicing basketball in wheelchairs, professionally or amateur,
- articles containing an assessment of pain or trauma within the shoulder, shoulder or elbow joint.

The analysis excluded texts older than 25 years, systematic reviews as well as those containing the study group with additional diseases.

Results and discussion

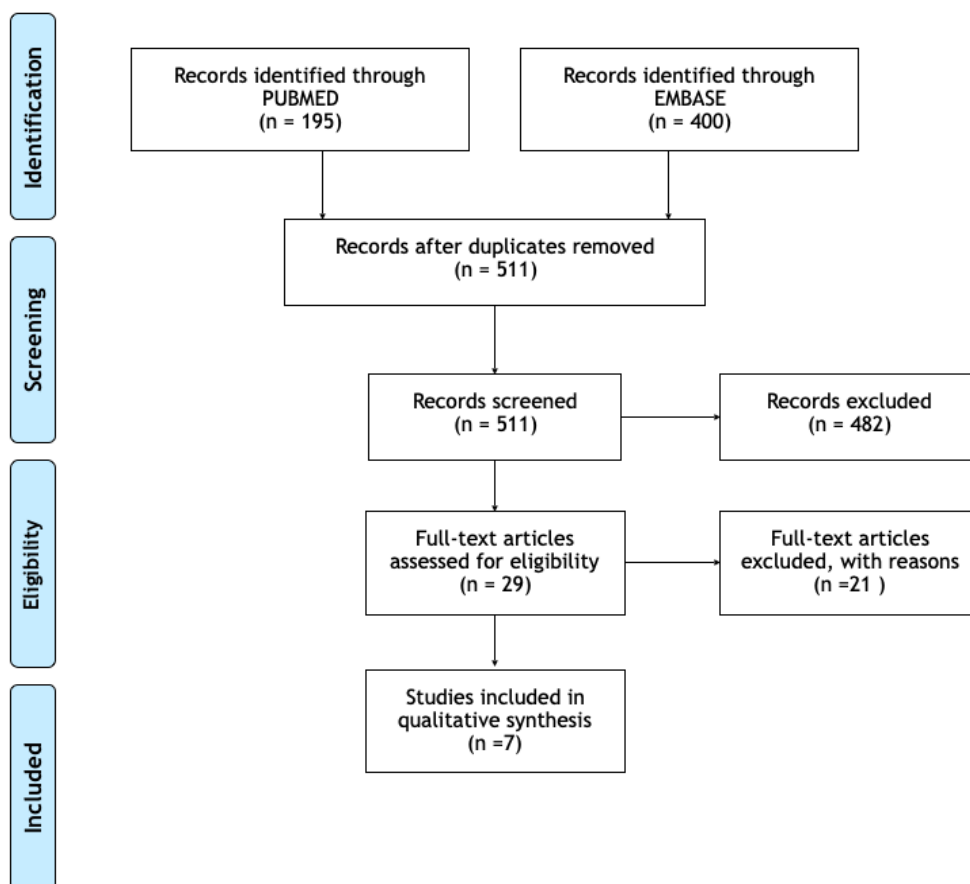
A total of 400 and 195 references were found in Embase and PubMed; after removing duplicates (n = 511), 483 articles were rejected based on the analysis of titles, abstracts and language of the publication. 28 articles were qualified for full-text analysis. The reasons for exclusion at the stage of analyzing titles, abstracts and language are:

- articles older than 25 years: 2,
- systematic reviews and case reports: 22,
- examination on healthy people or people using wheelchairs but not involved in sports: 419,
- research involving a group of athletes other than basketball players: 18,
- other language than English: 3.

21 were excluded from the analysis at the level of full texts:

- research, where it is impossible to single out a group of basketball players: 9,
- bad population: 5,
- studies on factors other than pain and trauma: 3,
- other type of research: 3,
- other language than English: 1.

Figure 1. PRISMA diagram



Three questionnaires were used to assess pain. The WUSPI (Wheelchair User's Shoulder Pain Index) questionnaire, which contains 15 questions about the pain of everyday functioning of patients in wheelchairs. Each question is rated on a scale of 1 to 10, where 1 means "no pain" and 10; "the highest pain a patient can imagine" (Cutris et al.). The VAS (Visual Analog Scale) also uses a subjective ten-point pain scale, in which the level of pain intensity is determined using an analog scale (Hawker et al., 2011). Numerical scale from 0 to 10, the NPRS (Numeric Pain Rating Scale) was used in the study by Ortega-Santiago et al., 2019; Aytar et al., 2014. They also used the LSST (Lateral Scapular Slide Test), which evaluates the resting position of the shoulder blade and the Q-DASH scale, which is a disability questionnaire (Gummesson et al., 2006). Summarizing the collected literature, data was collected on 364 wheelchair basketballers, including 142 women and 222 men. The data analysis was divided into two sections: the first concerning injuries in the examined athletes and the second concerning pain. Shoulder injuries were reported by 18 patients out of 157 cases. (Hollander et al., 2019; And Hoo et al., 2019). Among them, in the studies of Hollander et al. Shoulder injury were reported by 9 women and 5 men. In addition, in both studies, other upper limb injuries were recorded, such as shoulder (2 cases), elbow (13 cases), wrist (14 cases), hands (2 cases), fingers (6 cases) and hands and/or fingers 10 cases (Hollander et al., 2019). Hoo et al. pointed out that four cases of shoulder injuries were generally associated with damage to the rotator cuff structures (Hoo et al., 2019). Using the WUSPI scale, pain was assessed in 126 patients, including 67 women and 59 men. The average overall score on the scale used was 11.90 points, including 13.41 points for women and 10.19 points for men.

In the study by Tsunoda et al., the authors indicate a statistically significant correlation, where along with the increase in the number of years of basketball, pain was greater, while the opposite situation occurred in women; the more experience, the less pain was reported by the basketball players (Tsunoda et al., 2016). Ortega-Santiago et al. at work noted that wheelchair basketballers with shoulder pain had more trigger points than wheelchair basketballers with no shoulder pain or non-disabled players. The subject of resting position of the scapula in wheelchair basketballers (Ortega-Santiago et al., 2019) also appeared in the collected literature. Aytar et al. concluded that wheelchair sports have a higher percentage of incorrect shoulder position. The study also included table tennis players in wheelchairs and amputated soccer players using crutches. People practicing wheelchair sports have a higher percentage of patients with incorrect shoulder position: in basketball players 77.3%, in table tennis players 54.5% (n = 22) than in athletes with crutches amputee footballers 15.8% (n = 19) (Aytar et al., 2014). It was noted in the patients examined by Yildirim et al. that on the WUSPI scale, 60% of players in the trunk control group (group 1) and 51.72% of players with trunk control (group 2) reported shoulder pain when using

the wheelchair. Also 56.17% of players in group 1 and 62.07% of players in group 2 reported pain in the elbow and wrist while using the wheelchair. To summarize the result, the authors noted that Group 1 players reported twice as much pain than patients in Group 2. Basketball players without trunk control felt pain mainly when moving, driving the wheelchair for 10 minutes or longer, as well as climbing ramps and sleeping. In the second group, players with trunk control reported shoulder pain when moving, while pushing the wheelchair in the ramp and sleeping. The conclusion of the study is that stabilization of the trunk is an important factor affecting shoulder function (Yildirim et al., 2019). In the last study considered study Cutris et al. Upper arms pain affected 41 out of 46 basketball players (89%) participating in the study. Shoulder pain was poorly associated with levels of activity, such as transfers made during the day and time spent driving during the week. There was no relationship between shoulder pain and age or years of wheelchair use. 32 women reported a history of pain or injury to the shoulder, elbow or arm since the beginning of wheelchair use, 24 women reported continuous shoulder pain, 33 women reported a history of shoulder pain since using a wheelchair. The authors of the study say that people associated with the sport of disabled people should pay attention to the prevention of pain and chronic disability in athletes using wheelchairs (Curtis et al., 1999).

Although many studies confirm that pain and injuries in wheelchair basketballers are a common occurrence, only two literature items were found in the study that address the subject of injury in the group of wheelchair basketballers. However, the study does not have clear answers about the injured structures. Studies from qualified articles are mostly cross-sectional studies using a questionnaire. Hollander et al. qualified their study as prospective, but it was not a multi-year study, but was limited in time to the professions during which the data was collected. In total 364 basketball players were included in the review. Considering statistics that say 30,000 registered players it should be noticed that the number of patients in this review represents a small percentage of this population. Therefore, the above analysis can be treated as an introduction to consider the problem. The study observed a wide range of pain and shoulder injury, from 11% to 89%. A large discrepancy can be the result of many aspects, including different study design, and using various questionnaires. Subjects also reported continuous shoulder pain as well as a pain history since they started using the wheelchair. Only one study was designed to compare a group of athletes with people who do not train or use a wheelchair every day. In other cases, it is hard to justify whether the pain felt by the participants of the study was associated with the sport or the wheelchair itself. These factors may be additional reasons for the discrepancy in the reported data on the prevalence of the problem in the literature. The

results and conclusions obtained in our study are the same as the results of the review of Omar et al., who in 2017 assessed shoulder pain in a group of wheelchair athletes (without separation into individual disciplines). Only 13 studies were included in the qualitative assessment of full articles (all works were cross-sectional studies) and they highlight the poor quality of the included studies. Agreeing with review authors research, they emphasize that pain is a common problem in wheelchair athletes, but based on current literature,

the cause of shoulder problems is difficult to identify and is likely to be multifactorial.

The authors of this review are aware of the impossibility to find all articles about the pain and injuries of wheelchair basketball players. The limitations of the study were the small amount of research available, the lack of detailed data on the types of clinical injuries and various research questionnaires used by the authors of the study, which made it difficult to unify the results of the review.

Table 1. Injury of wheelchair basketball players

	Hollander et al., 2019	Hoo et al., 2019
Population	132 participants (age 29.7 ± 6.1 years old).	A group of amateur athletes, including a subgroup of 25 wheelchair basketballers
Intervention and questionnaires	Data collected during the Wheelchair Basketball World Championship on August 16-26, 2018. Information about new injuries was provided daily by the medical staff of the teams.	Research conducted from June to December 2016, using a survey. One part concerned sport-related injuries in the last year preceding the survey.
Results	In the studied group, 11% suffered shoulder injury, which was 14% of all reported injuries.	44% of people have been injured in the last 12 months after completing the survey. 17% of them were shoulder joint injuries.

Table 2. Pain in wheelchair basketballers

	Aytar et al., 2014	Curtis et al., 1999	Ortega-Santiago et al., 2019	Tsunoda et al., 2016	Yildirim et al., 2019
Population	22 basketball players in wheelchairs (age 25.27 ± 9.19 years old)	46 basketball players in wheelchairs (age 33 ± 9 years old).	Group of basketball players in wheelchairs from the 1st Spanish league: 18 with shoulder pain (age 30 ± 8 years old), 22 without pain (age 32 ± 10 years old) and 20 not disabled from a professional sports club.	40 Japanese wheelchair basketballers, 19 men (age 29.7 ± 5.2 years old) and 21 women (age 29.0 ± 8.2 years old). Study conducted during the training season.	59 wheelchair basketballers: a group of 30 players without trunk control (age 25.33 ± 4.89 years old) and 29 players with trunk control (age 25.00 ± 5.52 years old).
Intervention and questionnaires	Assessment of shoulder position using LSST. Pain assessment using the VAS scale. Assessment of the ability to perform everyday activities using the Q-DASH scale.	Shoulder pain assessment using the WUSPI scale. The study was conducted in 1997.	Shoulder pain assessment using the WUSPI scale. Assessment of trigger points bilaterally on selected muscles and the presence of pain at the pressure site and transferred pain. Pain assessment using a scale (NPRS)	Assessment of shoulder joint pain using the WUSPI scale. The study was conducted in March 2012 in a group of men and in January 2014 in women.	Shoulder pain assessment using the WUSPI PC scale.

Results	Average on the VAS scale in basketball: 3.86 ± 3.21 points, Q-DASH 12.49 points.	The average result on the WUSPI scale was: 15.6 ± 20.5 points.	The average WUSPI score was: in the group with shoulder pain 15.1 ± 13.4 points, in the group without shoulder pain 1.0 ± 2.0 points.	The mean pain on the WUSPI scale in the group of men was (16.18 ± 17.39 points) was statistically higher than in the group of women (8.62 ± 15.70 points).	The mean score on the corrected WUSPI PC scale was 20.83 ± 25.23 points in group 1 and 11.79 ± 27.30 points in group 2.
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Conclusion

Pain of shoulder is a common occurrence in wheelchair basketball players. During the preparation of the work, authors tried to identify problems regarding the shoulder joint of wheelchair basketball players. Based on the literature, it can be determined that this topic is relatively rarely discussed and requires more detailed research (retrospective and prospective studies). These studies would allow for more detailed considerations on the biomechanics of injury in wheelchair basketballers, which would also be a source of information on possible prevention of these occurrences.

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