



Original

## Shoulder pain assessment in elite wheelchair basketball players



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### ABSTRACT

**Objective:** The aim of this study was to evaluate shoulder pain in a sample of elite wheelchair basketball players during their preparation for a major competition.

**Method:** Seventeen male wheelchair basketball players, between 16 and 43 years of age, were studied during their athletic preparation for a wheelchair basketball championship. The shoulder pain questionnaire, impingement tests and shoulder range of motion were evaluated during a training camp. Spearman's rank correlation coefficient was used to analyze the relationship between shoulder pain and range of motion indicating the value of the effect size.

**Results:** Shoulder pain was evident in 52.9% of the sample and was significant and negatively correlated with range of motion, while 35.3% related to impingement tests player's reported pain. The correlation was moderate to high.

**Conclusions:** In conclusion, the use of shoulder pain questionnaire, goniometric measurements and clinical test could be a useful approach for monitoring the shoulder injuries of wheelchair basketball players to explore the possible consequences of performing repetitive movements.

**Keywords:** physical disability, adapted sport, joint range, impingement test, questionnaire.

### Evaluación de dolor de hombro en jugadores de baloncesto en silla de ruedas de élite.

#### RESUMEN

**Objetivo:** El objetivo de este estudio fue evaluar el dolor de hombro en jugadores de baloncesto en silla de ruedas de élite durante su preparación para una competencia de alto nivel.

**Método:** Diecisiete jugadores masculinos de baloncesto en silla de ruedas, entre 16 y 43 años, fueron evaluados con el cuestionario para el dolor de hombro en jugadores de baloncesto en silla de ruedas, las pruebas clínicas y el rango de movimiento del hombro durante la preparación para un campeonato. El coeficiente de correlación de Spearman se utilizó para analizar la correlación entre el dolor de hombro y el rango de movimiento, indicando el valor del tamaño del efecto.

**Resultados:** El dolor de hombro fue evidente en el 52.9% de la muestra, siendo significativo. En tanto que, hubo una correlación negativa entre el dolor de hombro y el rango de movimiento, mientras que el 35.3% reportó dolor de acuerdo con las pruebas clínicas. La correlación fue de moderada a alta.

**Conclusiones:** La utilización del cuestionario, las mediciones goniométricas y las pruebas clínicas podrían ser herramientas adecuadas para monitorear la condición del hombro en los jugadores de baloncesto en silla de ruedas, y así explorar las posibles consecuencias de los movimientos repetitivos.

**Palabras claves:** discapacidad física, deporte adaptado, amplitud articular, pruebas clínicas, cuestionario.

### Avaliação da dor no ombro em jogadores de elite de basquete em cadeira de rodas.

#### RESUMO

**Objetivo:** O objetivo deste estudo foi avaliar a dor no ombro em uma amostra de jogadores de elite de basquete em cadeira de rodas durante sua preparação para uma competição de alto nível.

**Método:** Dezesete jogadores de basquete em cadeira de rodas do sexo masculino, entre 16 e 43 anos de idade, foram avaliados com o questionário de dor no ombro, testes clínicos de impacto e amplitude articular durante o treinamento para um campeonato. O coeficiente de correlação de Spearman foi utilizado para analisar a relação entre dor no ombro e amplitude de movimento que indica o valor do tamanho do efeito.

**Resultados:** A dor no ombro foi evidente em 52,9% da amostra e foi significativa e negativamente correlacionada com a amplitude de movimento, enquanto 35,3% teve uma correlação de moderada a alta em relação à dor durante os testes de impacto.

**Conclusões:** Em conclusão, o uso de questionário de dor no ombro, medições goniométricas e teste clínico poderia ser uma abordagem útil para monitorar as lesões no ombro de jogadores de basquete em cadeira de rodas para explorar as possíveis consequências da realização de movimentos repetitivos.

**Palavras-chave:** deficiência física, desporto adaptado, amplitude articular, teste do impacto, questionário.

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## Introduction

Wheelchair basketball (WB) is probably the most popular adapted sport. Its practice and competition are regulated by the International Wheelchair Basketball Federation (IWBF), establishing a functional classification system for every player, according to it being a requirement to establish equitable competition.<sup>1</sup> The Spanish National Team and the Paralympics Games received fourth place in Atlanta, fifth place in London 2012 and second place in Rio de Janeiro 2016. In 2011 and 2013, the men's team received bronze in both European Championships competitions.

WB players must have a physical disability to compete, such as spinal cord injury (SCI), congenital deformities, post-polio syndrome, lower limb amputation and orthopedic deformities that can be demonstrated by Magnetic Imaging Resonance or X-ray. For WB, it is essential to clarify that not all players who participate in WB use a wheelchair for activities of daily living (ADLs).<sup>2</sup> The use of a wheelchair for ADLs and competition is a risk factor developing skeletal muscle disorders.<sup>2</sup>

The architecture of the shoulder, because of its limited stability and small supporting musculature, is not well designed for the tasks required of manual wheelchair users.<sup>3</sup> For that reason, wheelchair users may report shoulder pain (SP).<sup>4,5</sup> Previous studies have reported shoulder injuries as a common problem in WB,<sup>6-8</sup> and these are mainly from the increased load and repetitive stress of ADLs and sport activities.<sup>9</sup> Different aspects of the propulsion technique and muscle imbalance have been shown to affect the pathogenesis of the SP in wheelchair athletes.<sup>6,10,11</sup> According to some authors,<sup>12,13</sup> range of motion (ROM) provides relevant information related to the presence or absence of injury. In this regard, clinical tests could evaluate SP related to a specific shoulder injury through performing orthopedic tests that determine the integrity of the muscle and tendon.<sup>14-16</sup>

A few studies suggest the association of age and SP.<sup>9,17,18</sup> SP has been reported to be increased with age, suggesting that subjects over 50 years were over four times as high as the average score of subjects between the ages 21-30 years.<sup>18</sup> However, studies with WB players with less than 20 years showed high index scores for SP.<sup>9</sup> There is a clear relationship between daily wheelchair use and the onset of SP,<sup>5</sup> affecting sedentary populations and athletes with SCI.<sup>19</sup> However, some studies have stated that sports activities could be affected by SP.<sup>20,21</sup>

In this regard, SP initially does not limit a player's ability to independently perform activities; however, it may involve functional costs in wheelchair users by influencing the efficiency of movement, fatigue and neuromuscular disorders.<sup>2</sup> Therefore, it is important to describe the SP and ROM and how they affect the daily activities. This study is original as the study participants were WB players under preparation for major competition, being necessary to investigate how shoulder conditions could affect WB player's development. The aim of this study was to characterize SP in WB players in the context of preselection and preparation of the Wheelchair Basketball World Championships in South Korea, 2014.

## Methods

The present study was an observational cross-sectional study. The protocol for this study was approved by the Ethical Committee Technical University of Madrid, Spain. Table 1 reflects the general characteristics of the sample. The data collection procedure was performed according to the Declaration of Helsinki.<sup>22</sup>

### Subjects

Seventeen WB players voluntarily participated in the study with an age range between 16 to 43 years. To participate in the study,

the following three inclusion criteria were determined: (1) selected as member of preselection male national team, (2) use a manual wheelchair for at least 3 hours a day and at least one year before the study for players who use a wheelchair for ADLs and (3) use wheelchair at least one year before the study for players who use a wheelchair for sports only. All participants provided written informed consent.

### Procedures

A Shoulder Pain Index in Wheelchair Basketball player (SPI-WB) was used to measure SP. Scientific evidence support,<sup>8</sup> based on the Wheelchair User Shoulder Pain Index (WUSPI),<sup>17,19</sup> a mechanism to analyze the incidence of SP in this sport. According to previous study, SPI-WB had adequate  $\alpha$  Cronbach scores ( $\alpha = 0.899$ ), and significant Intraclass Correlation Coefficient (ICC) ( $r = 0.976$ ,  $p < 0.05$ ). It consisted of the following three main components: a) demographic data, including shoulder dysfunction (15 items), and six items, including the years of experience in WB practice, actual pain at the right/left shoulder, time since SP onset, SP location, numbness or cramps at the shoulder and pain in other body parts; b) pain related ADLs, distinguishing between wheelchair users (5 specific items) and all participants (10 items) and c) 4 items related to SP perception when performing sport skills (SS), including shooting, pushing, rebounding or one-handed long pass, and other game situations.<sup>8</sup>

Clinical tests were used in the evaluation of orthopedic shoulder injury, including the Neer's and Hawkins-Kennedy tests to determine subacromial impingement.<sup>14,15</sup> The Jobe test was used to evaluate the integrity of the supraspinatus muscle and tendon.<sup>16</sup> A goniometer was selected to explore the shoulder ROM<sup>13,20</sup> and the notation system was on a scale of 0° of 180°. For standardized goniometric measurements intra- and inter-rater reliability were used prior to the study. To determine the presence of injury, the Parameters Standard Grade Mobility according to the American Academy of Orthopedic Surgery (AAOS) were used.

Clinical evaluation was conducted during a 5-day training camp while the player was in a seated position. For every player, SPI-WB was applied first; second, a general assessment of Active ROM was performed measuring the flexion, extension, internal rotation, external rotation and abduction of shoulders; then, we evaluated possible injuries with the Neer, Hawkins-Kennedy and Jobe clinical tests.

### Statistical Analysis

For statistical analysis, all demographic data were analyzed using descriptive statistics. The Spearman correlation coefficient was used to establish correlations between SP and ROM. A post hoc power analysis was performed based on an effect-size approach and revealed with 17 participants, there was 80% power to detect the correlation,  $\alpha=0.05$ , effect size 0.547 based in coefficient of determination  $p^2=0.30$ . The interpretation of the effect size was made considering values  $<0.20$  as very low; between 0.20 to 0.39 as low; 0.40 to 0.59 as moderate; 0.60 to 0.79 as high; and 0.80 to 1 as very high.<sup>23</sup> Excel (Microsoft Office 2007) and SPSS V18.0 program was used for data processing and analysis. The significance level was set at  $\alpha \leq 0.05$ .

## Results

Table 1 reflects the general characteristics of the sample. In this study, 82.4% of the WB players used a wheelchair for ADLs and sport practice, while 17.6% used it for sport practice alone. Most of the subjects reported SCI (70.6%); 9 had dorsal injury and 3 had low back injuries. SP was evident in 52.9% of the WB players according to the SPI-WB. However, 35.3% had SP according to the clinical test; 41.1% of those had pain in their right shoulders, and 11.8% of the participants had bilateral SP.

**Table 1.** General characteristics of the participants

Player	Functional class	Years since injury	Wheelchair users ADLs	Years using wheelchair in ADLs	Years Sports	Type of Disability
1	1	11	Yes	11	11	SCI
2	1.5	32	Yes	32	21	SCI
3	2	18	Yes	18	17	SCI
4	3	29	Yes	14	12	SCI/SB
5	3	18	Yes	18	22	SCI
6	3	27	Yes	6	15	SCI/SB
7	3	27	Yes	7	15	SCI/SB
8	4	19	No	-	12	Lower limb injury
9	4	16	No	-	11	AMP
10	3	18	Yes	21	5	SCI
11	1	16	Yes	16	16	SCI
12	1.5	16	Yes	16	3	SCI
13	3	13	Yes	10	3	SCI
14	4.5	2	No	-	6	Knee injury
15	1	14	Yes	10	7	SCI
16	2	21	Yes	20	1	SCI
17	1	7	Yes	7	-	SCI

ADLs activity of daily living; SCI Spinal Cord Injury; SB Spina Bifida; AMP Amputation.

According to age, four groups were established, which were those under 20, between 20 and 30, between 30 and 40 and older than 40 years of age for identify which group have more SP as a descriptive information. Shoulder pain related to ADLs and SS was more frequent in players with an age between 20-30 years. Regarding the functional class, it is important to note that only higher classes (4-4.5) have less pain. On other hand, those with spinal cord injury (SCI) have a disability that is associated with more pain; however, they represented a large proportion of the study sample size. Regarding the active ROM, the mean was below the data AAOS, indicating a decrease in ROM, although the participants had functional mobility (Table 2).

**Table 2.** Relationship of Range of Motion with Shoulder Pain

Shoulder Movement	AAOS	Media	SE	Minimum	Maximum.
Right flexion	180	172.35	12.39	150	190
Left flexion	180	167.06	24.69	110	190
Right extension	60	65.00	11.46	35	80
Left extension	60	65.29	12.81	40	80
Right abduction	180	167.94	16.30	130	185
Left abduction	180	167.06	24.24	100	185
Right internal rotacion	70	65.88	19.70	20	100
Left internal rotation	70	69.12	16.89	30	100
Right external rotation	90	87.06	11.05	60	110
Left external rotation	90	80.00	12.75	40	90

AAOS American Academy of Orthopedic Surgeos; SE Standard Error

According SP, there was a significant negative correlation between the SPI-WB scores and ROM, showing that subjects with less shoulder ROM reported more pain during both ADLs (>10-min duration, ramp/uneven, washing back and sleeping) and SS. The practical significance was moderate to high. These correlations indicate that reducing ROM may be related to the degree of pain because lower amplitude corresponds to greater articular of the shoulder.

Statistical analysis indicates that there is a negative correlation between SP according to the impingement test and ROM. There was a greater relationship between the Neer test and right abduction ( $r = -0.56$ ;  $p \leq 0.05$ ), right internal rotation ( $r = -0.496$ ;  $p \leq 0.05$ ) and left extension ( $r = -0.56$ ;  $p \leq 0.05$ ). For the Hawkins-Kennedy test, there was a significant negative correlation with right bending ( $r = -0.60$ ;  $p \leq 0.05$ ) and internal rotation ( $r = -0.52$ ;  $p \leq 0.05$ ), and there was no correlation with the test Jobe regarding ROM. According to ROM and SP-WUSPI, the correlation was moderate to high. However, the relationship to the impingement test was moderate.

**Discussion**

In this study, 52.9% of the sample studied reported SP, which is consistent with previous studies.<sup>4-6,9,21</sup> The percentage of players who reported SP is troubling, especially in the preparation process for a WB championship. Eight of the nine subjects with SP (41.2 %) reported pain at the right shoulder and 11.8% reported bilateral pain. Considering that 94.1% of the participants have right shoulder as dominant side, these results could explain the appearance of chronic SP in this population with greater effects on the dominant side.

According to the statistical analysis, the functional class did not influence SP. However, subjects with a lower functional class had SP during ADLs. In contrast, one study reported that SP in athletes who use a wheelchair (1-3.5, functional class) is lower compared to those who participate in sports.<sup>9</sup> One study reported that players without trunk control had more SP than those with trunk control.<sup>24</sup> Subjects with ages between 20 and 30 years had more SP than others. However, subjects who were more than 31 years of age had more SP.<sup>6</sup> Also, there is a relationship between the type of disability during ADLs, such as sleep, and specific sport skills. SP could be related to repetitive activities; meanwhile some authors have reported that SP may result from lifting, especially with abduction and internal rotation.<sup>10,17,25</sup> In this regard, internal rotation could influence rebounds, considering that internal rotation a very important factor to performance WB.<sup>25</sup> The most affected ADLs in WB players were sleeping and pushing a wheelchair up ramps/inclines. According to SS, the most affected activities were shooting and other game actions.

In wheelchair users, factors like overuse and impingement positioning could cause pain,<sup>7,9,10</sup> and these conditions could influence the shoulder ROM. ROM could be affected by the SP (SP-WB), showing a significant negative correlation with ROM in contrast to previous study.<sup>9</sup> However, players can perform ADLs and SS related to WB without a problem. The obtained averages were according to data from the AAOS (Table 2). On other hand, according to clinical data, there is a relationship between SP and ROM. There is a greater association with the subacromial impingement tests, and subacromial impingement is a common lesion in athletes,<sup>14</sup> including WB players. In this regard, it is relevant to characterize SP in WB players because it can provide useful information for the physiotherapist and coach. It would be appropriate to implement strategies that could prevent shoulder injuries in WB as well as to develop a multidisciplinary, clinical approach during their preparation. As well take in consideration funtional class in the strategies development because could influence players performance. As a study limitation, these results cannot be generalizable to other adapted sports nor other categories of physical disability.

The practical implication is focus in provide evidence to implement strategies for shoulder injuries prevention and treatment in this population. Being necessary to use a clinical evaluation that provides information about SP in ADLs and SS in wheelchair basketball. In conclusion, the use of shoulder pain questionnaire, goniometric measurements and clinical test could be a useful approach for monitoring the shoulder injuries of wheelchair basketball players to explore the possible consequences of performing repetitive movements.

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