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Risk Factors for Shoulder Pain in the Practice of Wheelchair Basketball in Burkina Faso

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Abstract- **Introduction: Shoulder pain has become very common among wheelchair basketball players in Burkina Faso. Objective: This study aims to establish the prevalence of shoulder pain at the national level and identify risk factors. Methods: This cross-sectional study involved 68 wheelchair basketball players. Physical capacity in relation to performance, characteristics of wheelchairs and the condition of training grounds were assessed. The evaluation of the intensity of shoulder pain is made using the Shoulder pain scale for wheelchair basketball players and the EVA. Results: The prevalence of shoulder pain is 70.6%. Age, number of years of experience in practice, profession, physical ability, condition of the training ground are correlated with the intensity of shoulder pain and have a direct effect. Wheelchairs characteristics correlate with physical ability with an indirect effect on pain. Conclusion: Identification of risk factors is a train for strategies to prevent shoulder pain in wheelchair basketball**.

Index Terms- **Basketball, Shoulder pain, Wheelchair**

I. Introduction

The practice of sport provides benefits in human development, both personal and collective. In competition, practice has its physical, material and moral requirements in improving performance. Shoulder pain has become very common among practitioners. Poor practice conditions cause health problems and even physical injuries. The most popular para-sports in Burkina Faso are athletics, wheelchair basketball and cycling. For basketball, the adaptation of this sport to people with reduced mobility is done by the use of wheelchairs manufactured in Burkina Faso. The practice requires an environment suitable for movement and a good physical condition for maneuvering the chair and playing. The upper limbs being the only ones to play this dual role, are subject to overuse of the shoulder which is the joint more in demand. In a first study carried out with a wheelchair basketball team from Ouagadougou looking for pain in the practice of wheelchair basketball, it appears that 58% of practitioners suffer from shoulder pain. So, what can be the frequency of these pains at the national level and what are the risk factors for their appearance with a view to effective prevention.

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II. Materials et methods

A. *Study Population*

The study population is made up of all the wheelchair basketball players licensed by the Burkina Faso Federation of Sports for Persons with Disabilities in Burkina Faso. Burkina Faso has six sports associations for disabled basketball, including 2 in Ouagadougou and 4 in the other regions (Bobo-Dioulasso, Koudougou, Kaya and Ouahigouya).

B. *Study sample*

This study involved 68 participants from wheelchair basketball sports associations in the country.

C. *Experimental design*

This phase began by first contacting the teams concerned to explain the project in order to obtain their agreement to participate in the study by signing informed consent. It is followed by taking anthropometric measurements (mass, height) to predict the state of health and physical abilities of the participants. The characteristics of the chairs and the training ground will also be taken to evaluate the infrastructure and equipment of the practice of basketball.
Then followed the evaluation of the physical abilities of the players. For this, physical tests and classification are carried out. Thus, a motor agility test and a muscle assessment with 3 variables to be measured (strength, speed and endurance) according to the evaluation protocol of the international classification of functioning, disability and health (ICF) (1).

D. *Study variables*

Independent variables
- Age, Gender, Body Mass, Sitting Height
-Type of disability (Polio, Paraplegia, Amputee)
- Class (functional state)
- Physical Abilities (Skill, Muscular Strength, Muscular Endurance, Muscular Speed)
- Weight of wheelchair
- State of the ground (Soil, concrete, parquet, tartan)
- Wheelchairs characteristics (chair height, footrest height, large wheel diameter)

Dependent Variables
Pain intensity (Shoulder pain scale for wheelchair basketball players and EVA)

E. *Statistical analysis*

The data is entered in Excel (Microsoft Office Excel 2010). Descriptive statistics were performed with SPSS software (version 25). Thus, an analysis of variance was

carried out with a view to comparing means to find the effects of risk factors on the onset of pain. A principal component analysis (PCA) followed by a linear regression also called regression on the principal components of the independent variables was used in order to reduce the number of variables to facilitate their interpretation (3). The significance threshold is p=0.05.

F. Ethical Considerations

Prior to the start of this study, authorization from the National Ethics Committee for Health Research of Burkina Faso was obtained. Also, authorizations are obtained from the managers of the sports structures (federations and sports associations concerned). Before participating in this study, all participants gave their written consent after a detailed written and oral explanation of the advantages and constraints of participating in this study as stated in the Declaration of Helsinki 2013 (4). Participants have the option to withdraw from the study at any time. The study is placed under the control of the Department of Physical Medicine of the Center Hospital University of Bogodogo (CHU-B) of Burkina Faso and the ethical rules of this institution will be respected.

III. RESULTS

A. General characteristics of participants

The study involved 68 participants made up of players from six (6) wheelchairs basketball Associations in Burkina Faso. The average age of the participants is 36 years old, with 85% male, working mainly in the field of crafts, weaving and trade. The main cause of disability is poliomyelitis (95%).

B. Characteristics of wheelchairs and training ground

The wheelchairs have an average mass of 13.69 kg with an average height of 52.38 cm. The diameter of the big wheels varies is 60 cm. The characteristics of the wheelchairs used are identical in categories A and B.
For the training grounds, 2 out of the 6 have obstacles on the surface.

C. Physical abilities of participants and intensity of shoulder pain

The physical capacity of the participants is recorded in Table I. No significant difference is recorded between categories A and B.

Table I: Physical abilities and pain intensity of participants in relation to classification

	Cat A (class 1 - 2,5)		Cat B (class 3 - 4,5)	
	N	Mean ± SD	N	Mean ± SD
Agility test(s)	19	20,24 ± 2,8	49	20,37 ± 2,44
Speed without ball (s)	19	5,98 ± 0,8	49	6,13 ± 0,8
Speed with ball (s)	19	7,71 ± 1,4	49	7,98 ± 1,6
Yoyo test 1 (m)	19	531,58 ± 287	49	523,67 ± 252
Maximum pass (m)	19	10,62 ± 2,0	49	11,52 ± 2,37
Pain intensity	19	4,95* ± 1,9	49	3,84* ± 1,7

* significance level p=0.05 ; SD : standard deviation ; Max:maximum ; Cat : category

D. Frequency of shoulder pain

Participants with shoulder pain intensity greater than or equal to) 3 cm of VAS are 70.6% (Table II)

Table II: Frequency of shoulder pain

Pain intensity	n	%	n1	% Cat A	n2	% Cat B
< 3	20	29,4	4	21,1	16	32,7
≥ 3	48	**70,6**	15	78,9	33	67,3
Total	68	100,0	19	100	49	100

E. Influences of participants' general characteristics, physical capacity, characteristics of wheelchairs and training grounds on shoulder pain intensity

General characteristics show that age, number of years of experience in the practice of wheelchair basketball and occupation have positive and significant correlations with the intensity of pain. In terms of physical capacity, speed is negatively and significantly correlated with pain intensity.
The characteristics of gaming wheelchairs show no significant correlation with pain intensity. Rather, these characteristics are correlated with physical capacity variables. The presence of obstacles and class category are also correlated with pain. The principal component analysis of the risk factors gave the results in Table III.

Table III: Principal component analysis: the component matrix

	Component	
	1	2
Sex	,696	,346
Age	-,094	,162
Number of years of experience	-,422	,158
Body mass	-,229	,225
Seat size	-,571	-,107
Occupation	,272	-,447
type of disability	,300	,116
Agility t-test	**,878**	-,059
speed without the ball	**,862**	,328
speed with ball	**,889**	,232
Level 1 Yoyo test	**-,735**	,161
Maximum pass	**-,709**	-,185
Mass wheelchair	,289	**-,697**
Ferris wheel diameter	-,029	**-,807**
Height floor-footrest	-,134	**,793**
Maximum wheelchair height	-,064	**,712**
Presence obstacles on ground	-,319	**,668**
class category	,150	,081
Total	4,788	3,396
% Variance	26,602	18,869
% Cumulative	26,602	45,471

IV. DISCUSSION

A. Frequency of shoulder pain

The study population is composed of 68 basketball players from six (6) Wheelchair Basketball Sports Associations in Burkina Faso.
In this population, 20 participants did not have shoulder pain or low-intensity pain, i.e. less than 3 VAS, i.e. 29.4%. The other 48 presented with shoulder pain intensities greater than or equal to 3 of the VAS, i.e. 70.6% who needed treatment. So the prevalence in this population is 70.6%.

More than 70% of practitioners require secondary management of shoulder pain following the practice of wheelchair basketball. In the literature, studies have proven that 16-76% of wheelchair sports athletes have shoulder pain (5). Curtis et al. 1999 showed a 72% prevalence of international wheelchair athletes among women [6]. In elite wheelchair tennis players a prevalence of 63.6% has been established [7]. Malinge et al. 2010 recorded a frequency of 85% of wheelchair basketball and tennis players [8]. In Africa, studies have also assessed prevalence in wheelchair basketball. In South Africa, a prevalence of 76% has been established [9]. Ohouko et al. established a frequency of 85.7% in Benin among wheelchair basketball players [10].

This study also showed that the prevalence is 78.9% in category A and 67.3% in category B. This already shows that the class category influences the intensity of shoulder pain in practitioners. Class A players are the most vulnerable due to weak core muscles. Our results corroborate those of Kurtis et al. who had found a prevalence of 59% in quadriplegics and 42% in paraplegics [11].

In the literature, several risk factors have been identified for these shoulder pain in wheelchair basketball players. What about Burkina Faso?

B. Identification of risk factors for shoulder pain associated with wheelchair basketball practice

General characteristics of participants

The participants have an average age of 36 years old, with an average of 9 years of experience in the practice of wheelchair basketball. More than 95% are victims of poliomyelitis. Which shows the teams are aging for a practice of competitive sport. The recommended age range varies between 12 to 35 years [12]. The majority (64.7% of practitioners) are aged 35 or over and are therefore at greater risk of health problems in competitive sports.

Also, the average age and the number of years of experience in the practice of wheelchair basketball are significantly correlated with the intensity of the pain. These results corroborate those of Kenji et al. (2016) who showed that age and long time in practice are related to high shoulder pain intensity [13].

With respect to gender, the present study did not find a significant correlation to pain intensity. Unlike the study by Kenji et al. (2016) who showed that men had higher pain than women [13].

Regarding the profession, the participants work mainly in the field of crafts, weaving and trade. Thus, in the exercise of their function of weaving, crafts and trade, the participants are exposed to a long time in a seated position, often with awkward postures and repetitive gestures. The literature indicates that occupations requiring repetitive movements with arm lifts are potential risks for tendonitis [14]. Fager et al. (2014) demonstrate that swimming, basketball, and athletics had the highest prevalence of overuse shoulder injury [15].

Also, the class category is significantly correlated with the intensity of shoulder pain with a significant difference ($p=0.026$) between category A and B. Participants in category A are participants belonging to lower classes to 3 (class1; 1.5; 2 and 2.5). This category of participants has a low physical capacity, because they do not have a mastery of their trunk. They are more exposed to shoulder pain compared to those in category B (class 3 to 4.5). These results are also proven by Yildirim et al. (2010) who show that trunk stability is a key factor in shoulder function [16]. Also Kenji et al. showed that low class was correlated with the intensity of shoulder pain in wheelchair basketball players [13]. The lower the class, the higher the risk of having shoulder pain.

General characteristics show that age, number of years of experience in the practice of wheelchair basketball, occupation and class category have positive and significant correlations with pain intensity.

Physical capacities of the participants

According to the international classification of wheelchair basketball, participants are grouped into 2 categories: category A for players of class 1 to 2.5 and category B grouping players of class 3 to 4.5 according to their functional capacity. In the present study, the physical capacity between class categories does not show a significant difference. These results are similar to those of previous studies [17–19]. This is how Yanci et al. (2015) believed that the classification system should consider other parameters of functional ability for classification criteria [17]. The classification system is based on each player's physical ability to perform fundamental wheelchair basketball movements; pushing the chair, dribbling, shooting, passing the ball, catching, rebounding and reacting to contact [20].

Also, the number of years of experience in the practice of basketball is strongly correlated with the variables of physical capacity. This means that the number of years of experience has an effect on the physical capacity of players. It is a performance indicator in the sense that experience shows the mastery of technical gestures and the improvement of physical capacity.

In terms of physical capacity, speed is significantly correlated with pain intensity. Those who have good speed are the most experienced and older, therefore also the most exposed to shoulder pain.

As for the other variables of capacity, namely muscular strength and cardiorespiratory endurance, they are not correlated with the intensity of the pain but with the number of years of experience. Davis et al., said that muscular strength and endurance are important aspects of the functional capacity of people with disabilities [21]. The physical capacity on the ground depends on the adaptation of the user and his chair which form an entity.

Characteristics of wheelchairs and training grounds

The characteristics of the wheelchairs used in the two class categories have no significant difference. The height of the chair is 53 cm for category A and 54 cm for category B. This does not comply with the official international classification regulations. In wheelchair basketball, the rules give the characteristics of the wheelchairs by class category. For example, the maximum height of the chair is 63 cm for category A players and 58 cm for category B players.

The uniformity of the characteristics of the wheelchairs in this study shows that their design does not take into account the type of handicap but on standard measurements for any gamer. Compared to category A players, these chairs have a relatively lower height and this requires extra effort in the game, especially for shooting baskets. Basketball chairs for

category A players have a higher recline angle than category B. Peters et al. have shown the importance of the angle of inclination of wheelchairs in the stability of the trunk in wheelchair basketball players [22].

Also, in this study, the average mass of the gaming chairs in this study is 30 lbs. The characteristics of the chairs are correlated with the physical capacity of the participants. However, the regulations do not take into account the mass of gaming chairs. Apart from the mass of gaming chairs, it influences the physical capacity of practitioners, which in turn influences the intensity of pain. So the mass has an indirect effect on the intensity of the pain. Our results are not in agreement with Sagawa et al., 2010 who showed that a mass difference of up to 5 kg did not influence physiological parameters such as perceived exertion and heart rate in wheelchair users wheels [23]. The same study shows significant effects (decrease in performance) in able-bodied people. Which means that the fit of gaming chairs is an important factor in performance. The wheelchair is an integral part of the player, hence its custom design is recommended [24]. These authors argue that wheelchair performance is based on certain factors such as bearing quality and other parameters rather than mass. But the conclusion of their study remains limited because it concerns only a sample of eight (8) people with spinal cord injuries.

In terms of the quality of training grounds, the presence of obstacles on the ground has a significant effect on pain. In the present study, the presence of obstacles means that the surface of the ground is in a state of degradation thus presenting holes or cracks. This further increases the difficulties of propulsion and imbalance in movement.

However, the surfaces of the training grounds are made of concrete, some of which are in the process of degradation (3 grounds out of 6). Our results corroborate those of Rachel et al., 2009 which showed that the surface resistance and the mass of the armchairs increase the force of movement [25]. According to the recommendations of the Paralyzed Veterans Clinical Guideline, the frequency of thrusts and the forces during propulsion are factors influencing the onset of musculoskeletal disorders [26].

The use of non-custom-designed wheelchairs with a high mass on training grounds with obstacles presents a high risk of the onset of pain among basketball players in the present study.

Indeed, according to the WHO, an unsuitable chair by its choice or by its adjustments constitutes a major handicap, both in sports practice and in daily life with increased risks of musculoskeletal disorders [27].

The main components of risk factors

The principal component analysis made it possible to group the various risk factors into two main components. The first component groups together the physical capacity variables related to the participants' performance. And the second component retains the characteristics of the wheelchairs and the playground. The other factors such as age, class category, gender and number of years of experience are non-modifiable risk factors. These two main components provide activity guidance for the management of shoulder pain in wheelchair basketball athletes.

V. Conclusion

In this study, the risk factors identified are the age of the participants, the number of years of experience, the profession, the physical capacity and the quality of the gaming chairs and the training grounds. Thus, clinical evaluations could make it possible to locate the level of severity of damage to the anatomical structures of the shoulder. The identification of risk factors is a full train to guide decision-making in the overall management of shoulder pain. These main risk factors identified will make it possible to establish a standard protocol for the prevention of shoulder pain. The results of this project will not only make it possible to develop recommendations for improving performance in wheelchair basketball in Burkina Faso, but also for preserving the health of practitioners. This will also serve as scientific evidence to plead with the political authorities for better support for people with disabilities through sport.

Declaration of conflict of interest: authors declare no conflict of interest

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