SHOULDER PAIN AND ITS RISK FACTORS AMONG WHEELCHAIR BASKETBALL PLAYERS IN JOHANNESBURG

UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

Oyewole Oluwayemisi Christiana

Student number: 1925907

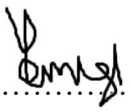
A dissertation submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in fulfilment of the requirement for Master of Science in Physiotherapy.

2019

Declaration

I, Oyewole Oluwayemisi, declare that the content of this work is my own. This dissertation is being submitted in fulfilment for the degree of Master of Science in Physiotherapy at the University of Witwatersrand, Johannesburg, South Africa.

This work has not been submitted for any other degree or examination in this or any other university.



08/10/2019

…….. ……..

Oyewole Oluwayemisi Date

Dedication

Thanks to God with whom all things are possible.

To my family

Dad, Mum and Babatunde. Thank you for your endless support and encouragement.

Abstract

Introduction: Shoulder pain is a common sport injury among athletes who perform highly repetitive motion as in wheelchair basketball. People with disabilities participate in wheelchair basketball as a form of recreational activity and as part of rehabilitation. However, participation in the sports may also put the players at risk of shoulder pain.

Aim: The aim of this study was to determine the prevalence and associated risk factors of shoulder pain among wheelchair basketball players in Johannesburg.

Methodology: This was a cross-sectional study. Three wheelchair basketball clubs in Johannesburg with players who were 18 years old were included in the study. The Wheelchair User's Shoulder Pain Index (WUSPI) questionnaire was used to assess the demographics, medical history and activities of daily living of the participants. Assessment of the intrinsic factors and extrinsic were conducted. These included measurements of shoulder internal and external range of motion, shoulder instability tests: apprehension and relocation test, sulcus sign test and load and shift test.

Results: A total of 25 out of 30 participants completed the questionnaire and participated in the physical assessment, yielding an 83.33% response rate. The average age of the participants was 33 years, with 21 males and four females. The average number of years of disability among the participants was 28 years. The prevalence of shoulder pain from the onset of wheelchair use was found to be 72% among the study participants while 52% reported shoulder pain at the time of the study. The average external range of motion was 91.87^{0} for the left, and 94.44^{0} for the right. Internal range of motion was 59.61^{0} for the left and 61^{0} for the right Shoulder pain was associated with: shoulder internal range of motion ($p=0.03$), years of wheelchair use ($p=0.01$), the point classification($p=0.03$), shoulder instability (0.02) and training loading ($p=0.01$).

Conclusion: The results of this study showed a high prevalence of shoulder pain. Shoulder pain was found to be associated with: shoulder internal range of motion, years of wheelchair use, point classification, shoulder instability and training loading. This study provides baseline information, which may help clinicians, to better develop treatment and rehabilitation programmes for shoulder pain among wheelchair basketball players.

Keywords: shoulder pain, wheelchair athletes, wheelchair basketball players.

Acknowledgement

This dissertation would not have been possible without the support and assistance of certain people. I would like to thank them for their time and professional expertise all through the journey.

To Mr. Siyabonga Kunene and Mrs. Sadiya Ravat thank you for putting so much time and effort into guiding my research, and for your friendship which made the whole process much easier and more enjoyable

To Professor Aimee Stewart, Ms Franso-Marie Olivier and Ms Monique Keller for your advices and assistance in the validation of the content of the questionnaire

To Dr Tunde Ajidahun for your assistance with the statistical report of the study. You were helpful in so many ways.

To the Eagles Basketball club players for their assistance ensuring the reliability of the extrinsic questionnaire.

To the management of Wheelchair Basketball South Africa, the coaches, team managers, and the players for helping and accommodating me during the data collection process.

To my family and friends for your love and encouragement throughout the entire process.

Definition of terms

Shoulder pain: Shoulder pain is a sensational snap, a sudden pain frequently followed by a pain free period and then recurrence (Sergio and Sabina, 1997) that affects athletes during practice, training or competition resulting in stopping, missing or modifying participation of athletes (Ferrara et al., 1992).

Extrinsic Risk Factors: An extrinsic risk factor is incidental, it has an origin in an earlier injury with direct application from an external force or environment (Williams, 1971), which are also independent of the athletes and more related to the activities during the incidence of injury (Taimela et al., 1990) and this includes factors such as; equipment, weather, training error and playing surface.

Intrinsic Risk Factors: An intrinsic risk factor is concerned with the self or is internal to the athletes. It includes biological, biomechanical and psychosocial factors. (Meeuwisse, 1994; Taimela et al., 1990).

Table of content

1 Contents

List of appendices

List of tables

List of figures

List of abbreviations

WUSPI- Wheelchair Users Shoulder Pain Index

ROM- Range of motion

FIM- functional Independence measure.

USA- United State America

MRI- Magnetic Resonance Imaging

IR- Internal rotation

ER- External rotation

WC- Wheelchair

1 CHAPTER ONE: INTRODUCTION

1.1 Background and need

Shoulder pain is a common injury among wheelchair basketball athletes (Akınoğlu and Kocahan, 2017) and it account for 67% of injuries among wheelchair basketball players in the Turkish national team. This could be related to the increase use of the shoulder during activities of daily living, wheelchair propulsion and pressure relief (Akbar et al., 2011). According to the injury surveillance system during the 2012 Paralympic games; there was a predominance of upper limb injuries; i.e. of all the injuries, 50.2% were upper limb injuries, with shoulder injuries being most prominent, 17.7%, of all injuries (Willick et al., 2013). In their study, Finley and Rodgers, (2004) reported that 44% of shoulder pain in wheelchair users generally showed clinical signs and symptoms of rotator cuff impingement, 50% manifested signs of biceps tendonitis and 28% were found to present with shoulder instability.

Wheelchair basketball is one of the most popular and well known adaptive sports in team games (Cristina et al., 2015; Wang et al., 2005). It was included in the Paralympic Games in 1960 (Mutsuzaki et al., 2014). The sport involves activities such as wheelchair manoeuvring and ball handling that require a high level of strength, speed and an intermediate intensity (Akınoğlu and Kocahan, 2017; Ozmen et al., 2014). Wheelchair basketball involves the strong coordinated use of the upper extremity muscles especially the shoulder muscle complex, which provides the major contribution during the propulsion of the wheelchair. This increases the rate at which the shoulder muscles contracts intermittently (Akınoğlu and Kocahan, 2017). It has been shown that the speed of propulsion determines the amount of force created in the shoulder joint. As a result of this, greater force is put on the shoulder in sports such as basketball in which speed is required (Fullerton et al., 2003). The repetitive load in conjunction with wheelchair propulsion has been associated as a potential risk factor for shoulder pain (Collinger et al., 2008).

Other risk factors for shoulder pain development in wheelchair basketball players, that have been established in the literature include age and the level of neurological injury (Ferrero et al., 2015). The level of trunk control in players determines the playing position and the activities that they are engaged in, on the court and thus increases the amount of stress imposed on the player causing shoulder pain. Trunk stabilisation in players play a role in the amount of load imposed on the upper extremities especially on the shoulder joint. Therefore, players with poor trunk stabilisation

experience more pain (Yildirim et al., 2010). In a study by Akbar et al. (2015), it was established that overhead motion during the repetitive activities of daily living results in the shoulder girdle being at risk of rotator cuff tendonitis (Akbar et al., 2015). Heyward *et al.*(2017) reported that the cause of shoulder pain among wheelchair athletes is likely to be multi-factorial causes, with no consensus being reached on the related risk factors. The review by Heyward et al. (2017) showed that the most commonly reported factors that were associated with increase shoulder pain were found to be, the years of disability, age and body mass index. On the other hand, activities of daily living, sport participation and wheelchair propulsion were vaguely related to shoulder pain across the studies reviewed. Other studies on risk factors for shoulder pain are available in several overhead sports such as volleyball, swimming and baseball. A systematic review by Hill et al. (2015) found that the competition level and a previous history of injury presented a moderate level of evidence as risk factors for shoulder pain among swimmers. On the other hand, age, years of experience and training load provided a low level of evidence as risk factor for shoulder pain among swimmers (Hill et al., 2015).

Since its inception in 1970, wheelchair basketball in South Africa has become more population and it is in fact a fast growing sport (Lepera, 2010). According to the study by Lepera (2010) the prevalence of shoulder pain was found to be 72.4%, this study was among wheelchair basketball players in Gauteng, South Africa. Another study by Mateus (2015) conducted in South Africa found the prevalence of shoulder pain to be 89.58% using different point classification for the participants (Mateus, 2015). The availability of literature on risk factors of shoulder pain among wheelchair athletes is generally limited, with little evidence on risk factors of shoulder pain among wheelchair basketball players in South Africa. Therefore, there is a need for such a study on shoulder pain and the risk factors among wheelchair basketball players in South Africa.

1.2 Problem statement

Shoulder pain is the most common problem experienced by wheelchair basketball players (Akbar et al., 2011; Akınoğlu and Kocahan, 2017 and Fullerton et al., 2003). It accounted for 67% to 83.3% of shoulder injuries among wheelchair basketball players (Akınoğlu and Kocahan, 2017; Kathleen A Curtis and Black, 1999; Lepera, 2010; Mateus, 2015 and Tsunoda et al., 2016). Its cause has been found to be multifactorial (Heyward et al., 2017). Current studies on wheelchair basketball players in South Africa are based solely on the prevalence of shoulder pain and the

musculoskeletal injuries profile. Although shoulder pain is caused by several factors, some factors provide conflicting evidence (e.g. age, sex, the number of years of disability, the number of years of wheelchair use, years of experience) whereas others are not reported among wheelchair basketball players. Identifying these factors associated with shoulder pain specific to wheelchair basketball players can help to devise strategies for an injury prevention program.

1.3 Research question

What is the prevalence of shoulder pain and its associated risk factors for wheelchair basketball players in Johannesburg?

1.4 Aim of the study

The aim of the study was to determine the prevalence of shoulder pain and its risk factors among wheelchair basketball players in Johannesburg.

1.5 Objectives of the study

The objectives of the study were to determine;

- The sociodemographic profile of wheelchair basketball players.
- The prevalence of shoulder pain among wheelchair basketball players.
- The associated intrinsic risk factors to shoulder injury among wheelchair basketball players.
- The associated extrinsic risk factors to shoulder injury among wheelchair basketball players.
- The association between the prevalence and risk factors of shoulder injury and sociodemographic profile of wheelchair basketball players.

1.6 Significance of the study

There is comprehensive evidence on the need to understand the risk factors for shoulder pain in wheelchair basketball players. In addition, determining the risk factors of shoulder pain is important to build a pain free athlete. This study will provide valuable knowledge to clinicians, athletes and club managers regarding the prevalence of shoulder pain and its risk factors among wheelchair basketball player. Furthermore, the study could be useful as a baseline for future intervention studies and the development of prevention, treatment and rehabilitation of shoulder

pain. Lastly, the key insights from this study will contribute to the general body of knowledge on the prevalence and risk factors of shoulder pain among wheelchair basketball players.

1.7 Organisation of dissertation

The dissertation is structured around six chapters and the figure below gives a brief description of each chapter.

Figure 1.1: Organisation of the dissertation

2 CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter provides current knowledge on the research of shoulder pain and its risk factors in wheelchair users, athletes who perform overhead sport, and precisely wheelchair basketball players. The review discusses shoulder epidemiology, anatomy and biomechanics, causes and symptoms, predisposing factors and management strategies related to the shoulder pain.

Relevant articles were sourced from the following databases; PubMed, Ebscohost, Science Direct, and Scopus through the University of the Witwatersrand Library. Only articles in English were considered.

The following keywords were used in the search process: shoulder pain, wheelchair basketball, wheelchair athletes, wheelchair users, overhead sports and risk factors.

2.2 Shoulder pain

2.2.1 Definition of shoulder pain

"Shoulder pain is a sensational snap; a sudden pain frequently followed by a pain free period and then recurrence" (Sergio and Sabina, 1997) "that affects athletes during practice, training or competition and results in stopping, missing or modifying the participation of athletes for one day or more" (Ferrara et al., 1992).

The above definition was adapted for the purpose of this current study and it is specific to shoulder pain. Other definitions used in literature are based on musculoskeletal injury and they include definition by Magno Silva et al., (2013) "which state any injury that caused an athlete to stop, limit, or modify participation for one or more day". And another by Willick et al.,(2013) "Any sport-related musculoskeletal or neurological complaint prompting an athlete to seek medical attention, regardless of whether or not the complaint resulted in lost time from training or competition".

2.2.2 Anatomy and biomechanics

The shoulder joint is the most mobile joint in the body (Strandring, 2016). The glenohumeral joint, a complex joint, relies on the static and dynamic stabilisers of the shoulder structures to bring it to a steady state. A compromise to this structure leads to injuries or malfunctioning such as

dislocation, recurrent instability, impingement syndrome, superior labral tear from anterior to posterior (SLAP) tear and biceps tendinitis. The labrum and ligament structures are important for the stability of the shoulder. One fourth of the humeral head is in contact with glenoid cavity at any point during the range of motion of the shoulder joint. The labrum functions to strengthen the humeral head with the glenoid cavity, provides an attachment site for ligaments of the glenohumeral structure and prevents the humeral head from rolling back (Dumont et al., 2011). The overhead throwing athletes involve in activities that results in repetitive movement of the shoulder, thereby putting the shoulder at risk of injury. The placement of the shoulder under extreme conditions makes it susceptible to injury through a mechanism of "plastic capsular deformation" (Doukas and Speer, 2000). The manoeuvring of the wheelchair, improper handling of ball during the throwing mechanics can result in an unsafe generation and dissipation of energy around the shoulder joint (Akınoğlu and Kocahan, 2017; Doukas and Speer, 2000 and Ozmen et al., 2014). The repetitive motion of the shoulder joint forces abduction and external rotation which in turn generates high humeral angular velocities and rotational torques, that overtime weakens the anterior static restraints and lead to microtrauma of rotator cuff against the posterosuperior glenoid (Doukas and Speer, 2000). Gradually, this also results in the loss of the posterior humeral translation that accompanies the external rotation, thereby causing the humeral head to remain in a more anterior position. This in turn leads to injury to the underlying surfaces of the supraspinatus and infraspinatus tendon, thus causing pain and weakness that further exacerbates the injury (Doukas and Speer, 2000).

Wheelchair athletes requires the use of their arms for sports, mobility and activities of daily living (Boninger et al., 2005). The frequency and the force required to perform these activities places the wheelchair user at risk for injuries to the upper extremity (De Luigi and Cooper, 2014). Maintaining muscle balance around the shoulder complex during propulsion is important for performance and prevention of injury (Ambrosio et al., 2005; De Luigi and Cooper, 2014) Desroches et al. (2010) studied upper joint dynamics during the action of propelling a wheelchair and found that shoulder joint account for 40% of the propulsion cycle with 92% of its stabilisation being contributed during the recovery phase. It has been proposed that propelling by a means of high contraction force of the rotator cuff muscle could also cause fatigue and increase the risk of developing an overuse injury to the shoulder joint (Desroches et al., 2010). Likewise as opposed to the load phase, the joint reaction force is of a much greater intensity during the weight relief

lifting phase during wheelchair propulsion (Van Drongelen et al., 2011). The glenohumeral loading occurs during the recovery phase and the forces emanating from that process are sometimes larger that the forces during the propulsion phase (Collinger et al., 2008). Collinger et al. (2008) reported that shoulder pain does not alter the propulsion pattern of wheelchair users. Rather, the pattern of propulsion contributes to the pathology of shoulder pain. It has been reported that wheelchair users who propel with superior force and internal rotation moments at the shoulder joints are inclined to experience shoulder pain during physical examination and to show signs of pathology on a Magnetic Resonance Imaging (MRI). This same study reported that all of the propulsion patterns of those who experienced this type of pathology were in the same direction (Mercer et al., 2006). Similar to these findings is the study by Boninger et al. (2003), which reported that women are able to propel with a higher radial force than men and showed worse MRI findings of the shoulder joint in women.

The biomechanics principles that are applicable across wheelchair sports involves the push-rim propulsion that is divided into two phases; the propulsion phase and the recovery phase (Boninger et al., 2005). The propulsion phase occurs when the hands are in contact with the push-rims and continues until they are removed at the end of each stroke while the recovery phase involves the motion whereby the hands are removed from the push- rim and swing backward (Ambrosio et al., 2005). A manual wheelchair user propels their wheelchair for an average of 1000 strokes per day at a net peak force of 70newton (De Luigi and Cooper, 2014 and Koontz et al., 2001). The stroke patterns which reduce the frequency of propulsion and the cadences during wheelchair propulsion have been associated with a low risk of injury (Boninger et al., 2002). Boninger et al. (2002) reported from their study that the semi-circular pattern of propulsion showed the lowest cadence and the highest ratio of push time to recovery time thereby recommending it for training in wheelchair propulsion.

2.2.3 Epidemiology

A study by Fullerton et al. (2003), conducted among wheelchair basketball players in United State of America (USA), determined that 67% of their study participants experience shoulder pain during wheelchair use while 40% of the participants reported shoulder pain at the time the study was conducted. Similarly, Curtis and Black (1999) reported an overall result of 72% female

wheelchair basketball players from the US national team had experienced shoulder pain since the onset of wheelchair use. Finley and Rodgers (2004) discovered that 61.5% of the participants in their study had experienced shoulder pain during the period of wheelchair use, with 28.8% suffering shoulder pain at the time of the study. Furthermore, studies among wheelchair basketball players in Gauteng, South Africa have found the prevalence of shoulder pain from the onset of the use of the wheelchair to be 72.4% (Lepera, 2010) while Mateus (2015) reported that 89.58% of the elite wheelchair basketball players in South Africa have had a history of shoulder pain.

In comparing the prevalence of shoulder pain among wheelchair users, it was found that the non-athletic population of wheelchair users also reported high levels of shoulder pain. Akbar et al. (2011) conducted another study on paraplegic patients. Their study reported 71% of the study participants experienced shoulder pain. A study by Akbar et al. (2010) discovered that 67% of the paraplegic patients who used a wheelchair experienced shoulder pain as opposed to the 16% in the able bodied control group that was used in the study. According to Alm et al. (2008), they found that 67% of their study population had a reported history of shoulder pain from the time they started using a wheelchair.

All the results from these studies are closely related. Some were conducted on the paraplegic athletes (Curtis and Black, 1999; Fullerton, Borckardt and Alfano, 2003; Finley and Rodgers, 2004; Lepera, 2010 and Mateus, 2015) whereas other studies focused on the paraplegic general population (Akbar et al., 2011, 2010; Alm et al., 2008). All these studies arrived at the same conclusion: namely that the prevalence of shoulder pain is high among both athletic and non-athletic populations.

2.3 Risk factors for shoulder pain

2.3.1 Age and gender

Research has shown that age is related to shoulder pain among wheelchair basketball players. Most of the studies have supported the premise that advanced age among wheelchair users is related to an increase in shoulder pain (Akbar et al., 2011, 2010; Brose et al., 2008; Fullerton et al., 2003; Pepke et al., 2018; Tsunoda et al., 2016).

Tsunoda et al. (2016) reported that increased age is related to the cause of shoulder pain. Pepke et al. (2018) found that the risk of developing a rotator cuff rupture increases by 11% with increasing age among wheelchair athletes. In studies by Pepke et al. (2018); and Tsunoda et al. (2016), both showed that there is an association between age and the development of shoulder pain. However, as opposed to the findings of the study by Tsunoda et al. (2016), Pepke et al. (2018) found that the likelihood of experiencing shoulder pain increases with age. The mean age of the study participants was 29 years in the study by Tsunoda et al. (2016) while it was 48 years in Pepke et al. (2018) study. This could account for the likelihood ratio, as well as the methodology employed in the research. Both studies used a cross sectional survey. However, the study by Pepke et al. (2018) employed diagnostics to identify rotator cuff tears in the paraplegic population. On the other hand, Tsunoda et al. (2016) did not use any form of diagnostic approach . This could account for the difference in incidence ratio. Despite this, the study was not specific to wheelchair basketball players, although athletic activities were considered (Pepke et al., 2018). The study by Tsunoda et al. (2016) was specific to wheelchair basketball players.

Considering studies on wheelchair users generally, it was shown that increasing age was related to shoulder pain among paraplegics (Akbar et al., 2010). Among paraplegics, the morphological features of the rotator cuff muscles also changes with the age which underlines the theory that "wear and tear" occurs in wheelchair users (Akbar et al., 2011).

The Ultrasound Shoulder Pathology Rating Scale was correlated to age and showed a positive trend for shoulder pain among manual wheelchair users with spinal cord injury (Brose et al., 2008). The effect of age is a likely contributing factor to the high percentage of participants with shoulder pain in the non-athletic group (Fullerton et al., 2003). In their study population Alm et al. (2008) found that while age correlates positively with shoulder pain, the risk of shoulder pain increases as age increases.

It has been reported that along with age, gender is also associated with the risk of developing shoulder pain. However, there have been only a few studies to correlate gender difference with the risk of shoulder pain. A study by Pepke et al. (2018) discovered that women are 2.6 times more likely to develop rotator cuff tear than men. In an earlier study by Boninger et al. (2003) it was reported that women showed worsened abnormalities in their shoulder on the MRI screening than men did. Women also exact more force during the propulsion of wheelchair which could account

for the exacerbation of their abnormalities. Boninger et al. (2003) also reported that alongside with age, oestrogen causes ligament laxity and the anatomical difference between women and men also contribute to the abnormal findings in female population as opposed to those concerning the male.

In contrast, Tsunoda et al. (2016) found that the male athletes earn higher scores for shoulder pain on the Wheelchair User Shoulder Pain Index. Men were found to be more likely to feel shoulder pain than women on the account of their lower flexibility as opposed to that of women (Dyson-Hudson and Kirshblum, 2004; Salisbury et al., 2003 and Tsunoda et al., 2016) and compared to women, men play wheelchair basketball more aggressively.

2.3.2 Range of motion and shoulder instability

The studies on shoulder instability and Range of Motion (ROM) among wheelchair basketball players are few, however, there are more studies on wheelchair users and overhead athletes. Owing to the paucity of studies on wheelchair basketball players, studies on wheelchair users and overhead able-bodied athletes are used in the discussion of range of motion in the shoulder and shoulder instability in relation to shoulder pain.

Curtis et al. (1995) reported that the limitation of the ROM of the shoulder among wheelchair basketball players was not associated with pain in the activities of daily living. However, studies have shown that the presence of shoulder pain is associated with a reduced ROM in the shoulder (Eriks-Hoogland et al., 2009 and Salisbury et al., 2003). Limitation in the range of motion in the shoulder at discharge are associated with limitation in the functional activities on the Functional Independence Measure (FIM) motor score (Eriks-Hoogland et al., 2016). Salisbury, Choy and Nitz (2003) found that a loss in the ROM was evidence in their population study of it, being markedly associated with shoulder pain.

In able bodied athletes, it has been said that the ability of an overhead athletes to throw with accuracy and velocity requires adaptations to be made within the shoulder complex (Manske et al., 2013). One such adaptations would be an increase in the glenohumeral external ROM and a decrease in the internal ROM. A systematic review on range of motion deficit among overhead athletes showed that an excessive gain in external ROM or a loss of internal ROM favours injury risk in overhead throwing athletes (Robert et al., 2018). The findings of Myers et al. (2006) demonstrated that athletes with an internal rotation deficit also showed a pathological impingement

of the shoulder joint, with a posterior tightness of the shoulder. However, Manske et al. (2013) and Wilk et al. (2011) reported that overhead throwing athletes with more than the 18^{0} to 20^{0} gain in external ROM are 2.5times more likely to sustain shoulder injury.

In relation to the ROM deficits in the shoulder as a cause of shoulder pain, the presence of shoulder instability has been reported to also impact upon the functional abilities of wheelchair users. The shoulder joint is a highly mobile joint. Owing to this orientation there is a form of laxity in the joint. However, as opposed to non-athletes (Savoie and Brien, 2014) this laxity is magnified in throwing athletes, wheelchair users and wheelchair athletes (Akbar et al., 2010). This could result in instability of the shoulder over time when motion increases and the shoulder becomes painful (Savoie and Brien, 2014). The shoulder instability is classified into two types, namely, the anterior instability and posterior instability of the shoulder joint. The former is more common among athletes than the posterior instability. Saremi et al. (2016) found that athletes with ligament laxity of the shoulder joint experienced increased shoulder pain, shoulder instability and a large number of shoulder injuries. A study by Chahal et al. (2010) found that athletes with ligaments laxity were 6.8times more likely to develop shoulder instability.

2.3.3 Years of experience and years of wheelchair use

According to Finley and Rodgers (2004) the duration of wheelchair use among both athletic and nonathletic wheelchair users impact upon the level of shoulder pain in both groups that reported to be experiencing shoulder pain at the time of survey. A study by Fullerton, Borckardt and Alfano (2003), reported no relationship between the duration of wheelchair use among both non-athletes and athletes and the presence of shoulder pain. Pepke et al. (2018) found that the risk of developing a rotator cuff tear increases by 6% with each additional year of wheelchair use. On the other hand, Curtis and Black (1999) found no correlation between the number of years of wheelchair use and the presence of shoulder pain. This study is in keeping with one study by Fullerton et al. (2003) which reported duration of wheelchair dependence is considered to be a risk factor for developing rotator cuff injury among paraplegias who participates in overhead sports (Akbar et al., 2015)

Along with the years of wheelchair use, the years of experience playing wheelchair basketball is also associated with the development of shoulder pain. Tsunoda et al. (2016) in their study of wheelchair basketball players of both male and female wheelchair basketball players, reported that

the greater the number of years involved in wheelchair basketball, the greater the risk of developing shoulder pain among men. Akbar et al. (2010 and 2011) reported that the occurrence of rotator cuff tears depended on the duration of wheelchair dependency with their findings supporting the theory of "wear and tear". A study on able bodied swimmers also supported the fact that participation in swimming over many years is associated with shoulder pain and dysfunction (Dischler et al., 2018).

2.3.4 Activities of daily living

Overuse injury often contributes to the development of shoulder pain, which interferes with the functioning of wheelchair users. Wheelchair users are fully dependent on the upper extremities for the performance of their independent daily activities (Kathleen A Curtis and Black, 1999). It has been reported that the presence of shoulder pain or pathology may interfere with the performance of these activities. Curtis and Black (1999) found that according to the Wheelchair User's Shoulder Pain Index (WUSPI) shoulder pain interferes with the performance of functional activities such as household chores, having to pushing up ramps and outdoor inclines and sleeping among wheelchair basketball players. Samuelsson, Tropp and Gerdle (2004), reported that shoulder pain does not have an impact on the functional performance of shoulder function, or on the ability to perform activities and to participate in societal activities among wheelchair basketball. Nevertheless, despite the lack of an association between pain and the performance of functional activities, the study still reported that their participants tends to experience pain on performing such wheelchair activities as "loading the wheelchair into a car", "pushing up the ramp or an incline" and activities that involve transferals (Samuelsson et al., 2004).

The pain experienced during these activities is similar to that experienced in activities that increase pain intensity as in the study participants of Curtis et al. (1999). The difference in results could be as a result of the outcome measures used in the study as well as the study participants. Curtis and Black (1999) used the WUSPI as the outcome measures while Samuelsson, Tropp and Gerdle (2004) used the WUSPI, the Klein and Bell ADL-index, the Canadian Occupational Performance Measure (COPM) and the Constant Murley Score. All these functional scales could have leveled out the impact of the WUSPI score, resulting in the determination of those functional activities that are not limited by shoulder pain. The study participants of Curtis and Black (1999) comprises of both tetraplegia and paraplegia (spinal cord injury) patients. The reports showed that tetraplegics

had a higher pain intensity than the paraplegics while the participants of Samuelsson, Tropp and Gerdle (2004) were all paraplegics.

Furthermore, it has been reported that the higher the level spinal cord lesion, the higher the level of shoulder pain (Dyson-Hudson and Kirshblum, 2004; Salisbury et al., 2003 and van Drongelen et al., 2006). However, in the group attached to the study by Salisbury, Choy and Nitz (2003), it was reported that there was no association between the presence of shoulder pain in participants who reported pain and the functional outcome of the participants. The results of this study by Salisbury et al. (2003) are in contrast to those of Curtis and Black (1999) which included tetraplegics in their sample population of participants.

This study reported conflicting evidence on the impact of shoulder pain on the activities of daily living among wheelchair basketball players and wheelchair athletes (Curtis et al., 1999; Dyson-Hudson and Kirshblum, 2004; Samuelsson et al., 2004 and van Drongelen et al., 2006).

2.3.5 Trunk control

Research has established that the level of neurological impairments affects the intensity of shoulder pain (Ferrero et al., 2015; Tsunoda et al., 2016; Yildirim et al., 2010). Paraplegics players with high thoracic level of spinal cord injury have higher risk of developing shoulder pain than those with lower level of spinal cord injury (Ferrero et al., 2015). It was found that players without trunk control experience pain twice as much as those athletes with trunk control (Yildirim et al., 2010). Yildirim, Comert and Ozengin (2010) further explained that the sitting position of the players without trunk control has the pelvis titled more posteriorly and as such prevent efficient motion of the scapulothoracic and glenohumeral positioning. The lower ability class of wheelchair basketball players were associated with greater shoulder pain when performing transfers from wheelchair to car, pushing the wheelchair for more than ten minutes and pushing up ramps or outdoor inclines in men (Tsunoda et al., 2016). For athletes to participates in disability sport they should be classified, based on the degree of ability, which is the central aspect of wheelchair sports (Gil et al., 2015 and Goosey-Tolfrey and Leicht, 2013). A study on wheelchair fencers found that athletes with poor trunk control were 4.7 times more vulnerable to injuries than their counterpart with good trunk control (Chung et al., 2012).

For a player to be allowed to compete in the wheelchair, the player must be classed under the International Wheelchair Basketball Federation (IWBF) classification system. To be eligible for the classification, players should have a permanent physical disability that limits the functioning of their lower limbs to the extent the player cannot function at the same level as required for an able-bodied player (IWBF Player Classification Commision, 2014). However athletes are affected by a wide range of injuries and diseases, which constitutes different levels of disability and resulting in different capacities and levels of performance (Gil et al., 2015). It is important to ensure that all players have equal rights and the opportunity to play. The team's functional potential is directly related to the athlete's abilities and skills and not to the level of impairment. The IWBF classifies players into eight classes numerically ranging from 1.0 to 4.5 (IWBF Player Classification Commision, 2014). The IWBF classification is based on their physical capacity to perform the fundamental basketball movements such as pushing the wheelchair, braking, pivoting, dribbling, shooting, passing, catching, rebounding, tilting and reacting to contact (IWBF Player Classification Commision, 2014). The players are assigned a classification between the range of 1.0 and 4.5, and a total of 14 points is assigned to a team of five players for any given game (IWBF Player Classification Commision, 2014). Therefore, this classification reflects the level of disability in the players which is the central aspect of wheelchair sports (Gil et al., 2015 and Goosey-Tolfrey and Leicht, 2013).

2.3.6 Management of shoulder pain

Studies on the management of shoulder pain among able-bodied athletes and non-athletic population are vast, with very few specific to wheelchair basketball players.

Overuse can increase the risk of shoulder injury in overhead throwing athletes, so prevention and rehabilitation of injury begins with the recognition of pain and dysfunction (Zaremski et al., 2017). A study by Wilroy and Hibberd (2017) conducted among wheelchair basketball players found that six weeks programmes that include strengthening exercises, therapeutic bands and stretching exercises improves shoulder ROM and mitigate pain. Studies on able bodied athletes show varying results on the most beneficial way to manage shoulder pain. A review on the use of eccentric exercises among swimmers show that eccentric exercises are beneficial. However there is no strong indication on which of the eccentric exercises is/are the most beneficial (Valier et al., 2014). Another study among able bodied basketball players found that myofascial release alongside

therapeutic taping is effective in treating shoulder pain as opposed to myofascial release alone (Gandhi et al., 2016). A review on the efficacy of stretching exercises in overhead athletes found that stretching with mobilisation yields better results in relieving pain, improving shoulder ROM and function that stretching alone (Harshbarger et al., 2013).

With this information, it is difficult to conclude as to the best management strategy to employ in the management of shoulder pain among wheelchair basketball players. Further studies are required on the management of shoulder pain.

2.3.7 Outcome Measures

For this study, each participant needs to complete both a subjective assessment and an objective assessment. The instruments used in this study included; the Wheelchair User's Shoulder pain index (WUSPI) questionnaire and the goniometer.

Wheelchair user's shoulder pain index (WUSPI)

The WUSPI is a self-reported questionnaire, it was developed by Curtis et al. (1995). The questionnaire was designed to assess the level shoulder pain impact upon activities of daily living. The questionnaire is divided into three sections, namely; the demographic section which consist of age, gender, sex and other question. The second section is based on the medical history of shoulder pain and the third section requires participants to rate the intensity of shoulder pain in respect of activities of daily living. The WUSPI has a test retest reliability of 0.97 and a validity of 0.97. It has been successfully used among wheelchair basketball player (K A Curtis and Black, 1999; Tsunoda et al., 2016 and Yildirim et al., 2010).

Range of motion

This is an instrument used to measure plane angles, it was developed by Samuel L. Penfield (1990). It was first designed to measure plane angles of crystals and was subsequently integrated into measurement of different angles. The goniometer has two hands the stationary hand and the moveable arm which is calibrated. Several studies have validated the use of the goniometer in measurement of ROM. A systematic review by van de Pol et al. (2010) founded that passive ROM of the shoulder is best assessed using the goniometer.

For this study, the following indices were measure using the goniometer; internal range of motion of the shoulder and external range of motion of the shoulder. The reliability of the goniometer in the measurement of range of motion of the shoulder was found to be ≥ 0.94 while the validity was ≥0.85 (Kolber and Hanney, 2012).

Intrinsic and extrinsic risk factors

Musculoskeletal injury is developed as a result of complex interaction between internal and external risk factors or also referred to as intrinsic and extrinsic risk factors (Bahr, 2003; Taimela et al., 1990). Extrinsic risks factors are independent of the injured person (Taimela et al., 1990), such as; sport factors (coaching), protective equipment's (helmets), sport equipment's (shoes) (Bahr and Krosshaug, 2005), while intrinsic risk factors: are individualistic, linked to the biological and psychological characteristics predisposing a person to the outcome of a musculoskeletal injury (Taimela et al., 1990) such as; age, sex, body composition, health (Bahr and Krosshaug, 2005). It is the presence of these risk factors and the interaction between them that results in injury occurring in a given situation (Bahr and Krosshaug, 2005). As an example, Boninger et al., 2003 showed that there is an increased risk for shoulder pain among women who propel the wheelchair with higher radial force. This indicates that there is an interaction between sex (intrinsic risk factors) and the wheelchair (extrinsic risk factor) in injury risk, which suggests that there may be a difference in the characteristics of the inciting events between sexes.

2.4 Conclusion

This chapter focused on the prevalence of shoulder pain, the predisposing factors and the biomechanics among wheelchair users and wheelchair basketball athletes. Thus, from this review it is noted that there has been extensive research pertaining to shoulder pain among wheelchair user especially spinal cord injury patients, and to some extent on wheelchair athlete but with little research having been done on wheelchair basketball athletes.

The literature shows that there is a high prevalence of shoulder pain ranging from 37.9% to 89.58%. These pools of surveys consulted indicated that age and gender are a predisposing factor for shoulder pain. They show that other contributing factors in terms of the impact of training, playing position, shoulder ROM and glenohumeral instability, the prevalence of shoulder pain is yet to be established. Literature is available on these predisposing factors among able-bodied

athletes, especially swimmers and volleyball athletes, and for some wheelchair sports such as tennis. However, these factors are yet to be established among wheelchair basketball players in Johannesburg.

Thus, this study will fill this gap in the research to gain insight into the likely area of concerns and needs among the wheelchair basketball athletes in Johannesburg, thereby ensuring safe participation in sports and minimising injury.

3 CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter focuses on the materials and procedures that were employed in this study. It describes the study design, participants, data collection tools, the data collection procedure, ethical consideration and data analysis.

3.2 Type of study

This was a cross-sectional study. The study design is evaluated as the best method of data survey for prevalence and risk factors (Fitzgerald and Moss, 2012). The study involves a survey pertaining to a specific population data which were collected at a specific point in time.

3.3 Participants

Wheelchair basketball players were recruited from the three clubs in Johannesburg with a total population of 30 players (Table 3.1). The clubs were sourced through the Organisation of basketball South Africa. There are only three wheelchair basketball clubs in Johannesburg, two male clubs and one female club and the study is based on players in Johannesburg. The following list includes the inclusion and exclusion criteria:

Inclusion Criteria

- Wheelchair basketball players, currently playing in a club.
- Participants who were 18 and above.
- Participants who had at least one-year of experience playing in a club

Exclusion Criteria

- Recreational players
- Amateur players with less than one-year of experience.
- The population size for each club is represented in the table below.

Table 3.1: Population size of each club

S/N	Clubs	Population
1	Eagles Club	14
2	Lions Club	9

3	Stinging Bees	7
	Total	30

3.4 Sample and sample size

The convenience sampling method was used. The sample size was calculated using the Raosoft statistical tool, taking into consideration 95% level of confidence and 5% margin error. According to the statistical tool, 28 participants were supposed to constitute the sample size, but the researcher decided to include the entire population. Unfortunately, five players eventually ended up not participating. A sample size of 25 participants out of a population of 30 was thus recruited for the study. Furthermore, three of the five that was not included in the study were not at training on the day the data were collected. The remaining two refused participation and could not be included in the study.

Table 3.2 represent wheelchair basketball players per club who finally participated in the study.

Table 3.2: Sample size of each club

S/N	**Clubs**	**Population**
1	Eagles Club	12
2	Lions Club	9
3	Stinging Bees	4
	Total	25

3.5 Data collection tools and measurement used

Wheelchair User's Shoulder Pain Index (WUSPI) Questionnaire (Appendix B)

The Wheelchair User's Shoulder Pain Index is a self-reported standardised tool that is used to determine the prevalence of shoulder pain among wheelchair users (KA Curtis *et al.*, 1995). The questionnaire, consisting of 15-item was found to be both valid and reliable questionnaire. It assesses the intensity of pain experienced by the participants during activities of daily living in the two weeks preceding the survey. The participants rated their pain during these activities on a 10cm visual analogue scale. The scale anchored at 0 (no pain) and 10 (worst pain ever experienced) with option of activity not performed for individuals who did not perform certain functions (e.g in the

case of tetraplegia and in part-time wheelchair users in sport participation only). The total obtainable score on the scale ranged from 0 to 150. The Performance Corrected -Wheelchair Users Shoulder Pain Index was used for athletes that did not perform certain functions as listed in the questionnaire. Participants also filled in a demographic questionnaire, detailing their age, sex, number of years of wheelchair use, the type of disability and their medical history of shoulder pain as well as the intensity of the pain that they endured. The reliability of this questionnaire could be confirmed since it has been used on wheelchair athletes, and had resulted in an intra class correlation for a test retest reliability of 0.99 and a validity of 0.97 (K A Curtis et al., 1995).

Questionnaire for extrinsic risk factor (Appendix C)

A questionnaire to assess the extrinsic risk factors for shoulder pain was compiled by the researcher. The questions were developed based on current literature available (Kathleen A Curtis and Black, 1999; Finley and Rodgers, 2004; Fullerton et al., 2003; Hill et al., 2015 and Mateus, 2015). The questionnaire, a 14-item questions, was divided into three categories namely; participant's information, sport history and training history. A total of five experts with experience in sports physiotherapy, research and statistics were asked to help with the process of the validating the content. The questionnaire was sent to a few experts to be reviewed by them and for their comments. Changes were made according to the experts' recommendations prior to it being given to a group of athletes assess its face validity and test retest reliability.

3.5.1 Measuring instruments

The goniometer: A 12inch plastic baseline goniometer (model 12-1000) fabrication enterprises (White Plains, New York) was used to measure the internal and external range of motion of the shoulder joint. The measurements obtained were all in degrees. The instrument had been tested for validity and reliability for the measurement of the internal and external range of motion. The reliability of the goniometer was ≥ 0.94 with a concurrent validity of ≥ 0.85 (Kolber and Hanney, 2012).

3.5.2 Physical assessment (Appendix E)

The Apprehension test and relocation test: These tests are used to determine the anterior instability of the shoulder joint (Hattam and Smeatham, 2010). The apprehension test which is the key to the findings. It is used to diagnose shoulder instability while the relocation test is used to relieve the

feeling of apprehension or pain and is used to confirm the diagnosis of the apprehension test. The test has reliability of 0.71 and the specificity of 92% (McFarland et al., 2017). They proved positive when the participant showed apprehension or guarding, and relief from the pain was subsequently felt when a relocation test was done. Such a result could then indicate glenohumeral instability or joint pain.

Sulcus sign test: This test is used to detect the inferior instability of the shoulder and the multidirectional instability of the glenohumeral joint (Hattam and Smeatham, 2010). The manoeuvre test assesses the superior glenohumeral ligament. A positive sulcus test shows the appearance of a sulcus or dimple in the subacromial region as the humeral head translated in the glenoid cavity inferiorly (Tzannes and Murrell, 2002). The test has a reliability of 0.61 and a specificity of 85% (McFarland et al., 2017)

Load and shift test: The principle of the load and shift test is to test the anterior and posterior instability of the shoulder (Hattam and Smeatham, 2010). It also evaluates the amount of translation of the humeral head on the glenoid. Several methods have been used to grade this test. However, the most common grading used is the amount of movement in the glenoid fossa and the replication of pain during the movement. The test has moderate a reliability of 0.68 and a validity of 0.61 (Hattam and Smeatham, 2010; Tzannes et al., 2004). The test is positive if there is an increased movement of the humeral head on the glenoid and as long as the pain symptoms are replicated. The procedure for performing all the physical tests can be found in appendix E

3.6 Procedure

3.6.1 Pilot Study

A pilot study was carried out by administering the developed questionnaire for extrinsic risk factors, the Wheelchair User Shoulder Pain Index questionnaire and the physical assessment.

3.6.1.1 Objectives of the pilot study were to determine:

- The face validity of the questionnaire in that whether the participants would agree that the questionnaire was easy to comprehend.
- The test retest reliability of the extrinsic risk factor questionnaire.
- The time taken to complete the extrinsic risk factor questionnaire, the Wheelchair User's Shoulder Pain Index questionnaire and the assessment procedures.

3.6.1.2 Methodology of the pilot study

Ten members of the Eagles Wheelchair Basketball Club in Johannesburg were asked to participate in the pilot study. They completed the developed questionnaire that had been passed by the panel of experts and altered according to their recommendations. This questionnaire was completed on two separate occasions with an interval of five days apart during their scheduled training sessions in Mandeville Sport Centre. The researcher was present on both occasions to explain the procedure, the objectives of the study and to answer any questions with regards to the questionnaire. The participants were also asked to make notes in the questionnaire regarding any question that they found difficult to comprehend. The participants were asked specifically whether in their opinion the questionnaire answers the objective of the study and if the questions were not ambiguous to them. The time taken to complete the questionnaire was recorded on both occasions.

On the second occasion on which the researcher attended the training session, both the Wheelchair user shoulder pain index (WUSPI) questionnaire and the developed questionnaire was completed by the participants, and the total time taken to complete both questionnaires was noted. Prior to the distribution of the questionnaires the procedure for assessment was explained to the participants and the reason for the assessments were given. The time taken to complete the assessment for each participant was noted to determine the total time taken to complete both the questionnaire and the assessment for the main study. Prior to this pilot study, the researcher held a practice session of all the physical assessment using the university's female football team where certain of the members volunteered to participates.

The data were then analysed to determine the test-retest reliability. The results were expressed as the scale of reliability coefficient.

3.7 Results of the pilot study

Test retest reliability and face validity

Of the 14 wheelchair basketball members of the Eagle Club, 12 players were available at the training session to complete the questionnaire. Twelve completed the questionnaire at the first occasion and five completed it on the second occasion. Twelve were available for the face validity of the extrinsic risk factor questionnaire and five for the test-retest reliability.

Test retest reliability

A total of five questionnaire were correlated using the spearman's correlation. This is done to determine how often participants gave the same answer to a question asked on two separate occasion. The result of the reliable coefficient was measured at 0.70, which shows a high level of reliability. This means that most of the questions were answered in the same way on the two-separate occasions.

Face validity

The participants reported no problem in understanding and filling in the questionnaire. They had no suggestions or corrections to make regarding the questions asked. No corrections were made after the face validity assessment had been done.

Time taken to complete both questionnaire and assessments

The time taken to complete the developed questionnaire were about three to five minutes and the time taken to complete both questionnaires was 10 to 12 minutes. Thus, the physical assessment on each participant was completed within 15 minutes. The total time taken for each participant to complete both the questionnaire and the physical assessment was 30 minutes.

3.7.1 Main Study

Permission to conduct the study was obtained from the chairman of Wheelchair Basketball South Africa (Appendix H)

After obtaining permission, the contact details of the coaches and the team manager of the clubs were obtained from the South African Wheelchair Basketball Association. The coaches were then asked telephonically and via the email for their consent for their players to participates in the study. A convenient time for the players to complete the questionnaire was agreed upon (during the training sessions of the team).

The players who were willing to participates in the study were required to sign an informed consent form (Appendix G) and then to fill out the questionnaire and take part in the assessment. The participants were tagged with code numbers that related to the number on their questionnaire and their assessment sheets to facilitate the collation of the results.

All procedures were carried out by the researcher and research assistant. The researcher administered the questionnaire and the research assistant collected the completed questionnaire without the researcher having access them. This was done to minimise bias.

The researcher performed all the physical assessments and the research assistant recorded the findings (Appendix D). After collection of the questionnaire, each participant was physically assessed in the following order; starting with the shoulder internal and external range of motion passively on both upper limbs using the goniometer (Appendix E). The measurement by the goniometer were repeated three times and an average for the three was determined and used in the analysis (Nussbaumer et al., 2010).

Thereafter, the glenohumeral laxity and instability were assessed, starting with the apprehension test and the relocation test on both shoulders of the participants in a supine position. This was followed by the sulcus sign test and finally the load and shift test were conducted with the participants in supine position for all the tests. All readings were recorded on the spreadsheet by the research assistant immediately after each assessment (Appendix D).

3.8 Ethical Consideration

Ethical clearance was obtained from the University of the Witwatersrand's Human Research Ethics committee (Appendix A). Permission was obtained from Wheelchair Basketball South Africa and the from club managers and coaches (Appendix H). All potential participants were provided with an information sheet with details about the study (Appendix F) and informed consent was obtained from each participant for their participation in the study (Appendix G). The participants then had the opportunity to ask the researcher any questions based on the questionnaire. The questionnaire and assessment sheet required no names to filled in. Codes were given to the participants to facilitates collation of the data. The codes were removed immediately after the data were managed to remove any form of identification. The results and recommendation of the study will be shared with the participants and their coaches. The researcher also undertook to ensure veracity in all scientific communications when reporting on the data, the results, methods, procedures and publications. Furthermore, the researcher strived to avoid all forms of bias in the study and set out to ensure that no harm and risk to were posed to the health of the participants throughout all of the procedures, instead participant's dignity, privacy and autonomy was ensured all through the process.

3.9 Data Analysis

Data were captured on a Microsoft Excel spreadsheet. The identifiers were removed to ensure the confidentiality of the participants and the data set was cleaned and encoded before it was transported into a Statistical Package for Social Sciences (SPSS) version 25 for analysis. The tool was set at a significant p-value of <0.05. Table 3.3 provides the details of the ways data were analysed according to each variable measured.

Table 3.3: Statistical tests used to analyse data

S/N	Objectives	Variables	Type of data	Statistical test
1	To determine the sociodemographic characteristics of the participants	Independent: Age	Scale	Mode, Frequency and percentages
		Independent: Gender, years of using a wheelchair, duration of disability	Nominal	Mode, Frequency and percentages
2	To establish the prevalence of shoulder pain	Dependent: Presence and duration of pain	Scale	Mode, frequency and percentage.
3	To identify associated intrinsic risk factors for shoulder injury among the wheelchair basketball players	Independent: range of motion, age, gender, glenohumeral joint laxity, duration of disability, type of disability,	Nominal	Fisher's-exact test and mann-whitney U test

		point classification.		
4	To identify associated extrinsic risk factor for shoulder injury among wheelchair basketball players	Independent: years of wheelchair use, playing position, number of years of experience, number of hours spent practicing and training,	Norminal	Fischer's exact Test, Mann U Whitney and Independent T-test
5	To determine the association between prevalence and risk factors of shoulder injury with sociodemographic profile	Dependent: Prevalence Independent: Age and gender	Gender: Nominal Age: Scale	Fischer's exact Test Mann U Whitney and Independent T-test

3.10 Summary of methodology

This is a cross-sectional study to determine the prevalence and risk factors of shoulder pain among wheelchair basketball players. It was achieved using both questionnaires and objective assessments.

The prevalence and the extrinsic risk factors were determined using the WUSPI and the developed questionnaire while the extrinsic risk factors were determined using the objective assessment and both questionnaires.

The following chapter discusses the results and highlights the findings of interest from the survey.

4 CHAPTER FOUR: RESULTS

4.1 Introduction

This chapter provides the results of the statistical analysis of the data collected. It describes the outcome of the pilot study and the results of the main study. The results of the main study include the following: the response rate, the test of normality of the data, data analysis matrix, the sociodemographic characteristics, the prevalence of shoulder pain, the associated intrinsic risk factor, the associated extrinsic risk factors, the activities of daily living and the management of shoulder pain.

4.2 Response rate

The population consisted of a total of 30 wheelchair basketball players playing at the club level in Johannesburg. For the study to be valid, a minimum response rate of 70% was required (n=21) (Fincham, 2008)

A total of 25 participants completed the questionnaire and assessments, thus yielding a response rate of an acceptable 83.33%. Three of the five participants who were not included in the study were not at training on the day the data were collected. The remaining two refused to participate and could not, therefore be included in the study. Data from the pilot study were also included in the analysis of the main study since the participants understood the questions and no changes were made to the questionnaire.

4.3 Test for normality of data

The Shapiro-Wilk test was used to test for the normality of the data. The test for normality was done using some of the selected variables from the questionnaire. The result illustrated below is that of the age variable, which shows that the data were not normally distributed. Hence, the graph is shown to be skewed to the left.

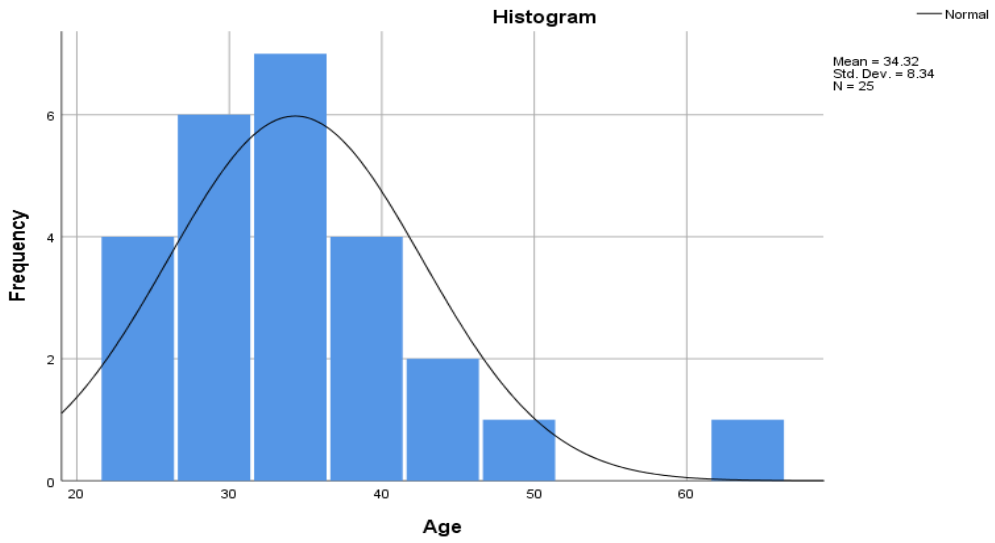


Figure 4.1: Left skewed data of normality test using age variable

The test for normality was done using some of the selected variables from the questionnaire. The variables displayed below were continuous variables since only continuous variables could be used to test for normality. The results of the normality test are represented below.

Table 4.1: Test for normality

	Shapiro-Wilk		
Tests of Normality	Statistic	Df	Sig.
Age	0.885	24	0.01
Years of WC use	0.837	24	0.00
Number of transfers per day	0.612	24	0.00
Number of work/hours per week	0.783	24	0.00
Number of hours spent on sport/leisure	0.768	24	0.00
Number of hours spent driving	0.677	24	0.00

Number of years of playing Wheelchair Basketball	0.933	24	0.12
Number of days of training	0.884	24	0.01
Number of hours training per session	0.761	24	0.00
Total number of minutes spent on warm up exercises	0.935	24	0.13
Total number of minutes spent cooling down exercise	0.885	24	0.01
Total WUSPI	0.711	24	0.00
Internal rotation Left hand	0.892	24	0.02
Internal rotation Right hand	0.947	24	0.23
External rotation left hand	0.955	24	0.35
External rotation right hand	0.987	24	0.98

Some of the variables such as age, years of wheelchair use and number of transfers per day were not normally distributed, while external range of motion for both left and right hand, and internal rotation right hand were the only normally distributed variable. Non-Parametric statistics (median and interquartile range) was used to summarise the skewed variables and parametric was used to for the normally distributed variables.

Data analysis matrix

Owing to the skewness of the continuous variables as shown in figure 4.1, except for the right internal and external rotation and the right internal rotation, the descriptive statistics of median and interquartile range were used to summarize the data as appropriate. For the normally distributed data (left internal and external rotation and left internal rotation), the mean and standard deviation

were used to summarise the data. Non-parametric inferential statistics were used to determine the significant difference between those participants with a history of pain and those without pain.

4.4 Sociodemographic profile of participants

Table 4.2 shows the sociodemographic characteristics of the participants.

Table 4.2: Demographic characteristics (n=25)

Demographics	**N (%)**
Gender	
Male	21 (84)
Female	4 (16)
Marital status	
Single	17 (68)
Married	8 (32)
Primary Occupation	
Employed	16 (64)
Student	1 (4)
Retired	2 (8)
Other	6 (24)
Dominant	
Left handed	10 (40)
Right handed	15 (60)

A total of 25 wheelchair basketball players participants in the study. Most of the participants were males (21, 84%), with an average age of 33 years and with an interquartile range of 28.5-39. Most of the participants were employed (16, 64%) and (17, 68%) of them were single.

4.4.1 Disability Characteristics

In Table 4.3, the sociodemographic profile is presented according to the disability characteristics of the participants. Frequencies are used as the descriptive data. The average number of years of disability among participants amounted to 28 years with an interquartile range of 22 to 33 years. The median number of years wheelchair use amounted to 11 years with an interquartile range of 0 to 23.5.

Table 4.3: Disability characteristics (n=25)

Variables	**N (%)**
Types of disability	
Spinal cord injury	8 (32)
Thoracic level	4 (50)
Lumbar level	3 (37.5)
Not reported	1 (12.5)
Polio	7 (28)
Amputation	6 (24)
Spina Bifida	1 (4)
Others	3 (12)
Mobility characteristics	
Form of mobility	
Everyday wheelchair users	11 (40)
Other form of mobility	15 (60)
Type of wheelchair	
Manual	13 (52)
Power	0 (0)

Spinal cord injury accounted for the major cause of disability among the participants. Eight participants reported to have presented with this type of injury. Majority of the spinal cord injuries reported were at the level of the thoracic spine. Eleven (40%) of the participants used a wheelchair as their daily form of mobility. All the participants who reported the wheelchair as a form of mobility were using the manual wheelchair.

4.4.2 Playing characteristics

Table 4.4 shows the sociodemographic characteristics of the participants according to their playing profile in wheelchair basketball.

Table 4.4: Playing characteristics (n=25)

Level at which wheelchair basketball is played	**N (%)**
Club	25 (100)
National	17 (68)
International	13 (52)
Playing position in the club	
Shooting guards	6 (24)
Point guards	9 (36)
Centre	3 (12)
Forward guards	6 (24)
Point classification in wheelchair basketball	
1.0	3 (12)
1.5	6 (24)
2.5	1 (4)
3.0	1 (4)

3.5	5 (20)
4.0	6 (24)
4.5	3 (12)

All the participants played at club level which was also one of the criteria gain eligibility to be included in this study. Nine (36%) of the participants playing position was a point guard. Six (24%) of them was classified as 1.5 players and another six (24%) as 4.0 players under the International Wheelchair Basketball Federation's classification system.

4.5 Prevalence of shoulder pain

The prevalence of shoulder pain according to the onset of the pain and the region affected is represented in the table below.

Table 4.5: Prevalence of shoulder injury (n=25)

Wheel chair and shoulder injury history	**N (%)**
Current shoulder pain	**13 (52)**
Left	5 (38.46)
Right	5 (38.46)
Both	3 (23.08)
Shoulder pain during wheelchair use	**18 (72)**
Left	7 (38.89)
Right	10 (55.56)
Both	1 (5.56)
Shoulder pain prior to wheelchair use	**12 (48)**
Left	5 (41.67)

Right	7 (58.33)
Shoulder pain limiting performance of usual activity	**12 (48)**
Hand or elbow pain during the wheelchair use	**15 (60)**
Shoulder surgery	**3 (12)**
Which shoulder?	
Left	1 (33.3)
Right	2 (66.7)

Eighteen (72%) of the participants presented with shoulder pain during wheelchair use with majority of the pain emanating from the right upper limb. The current shoulder pain at the time of the study was reported among 13 (52%) of the participants. Hand and shoulder pain during wheelchair use were also reported in 15 (60%) of the participants.

The Figure 4.2 below illustrates the prevalence of shoulder pain according to the reported history of pain prior to wheelchair use, during wheelchair use and the current shoulder pain at the time of the study.

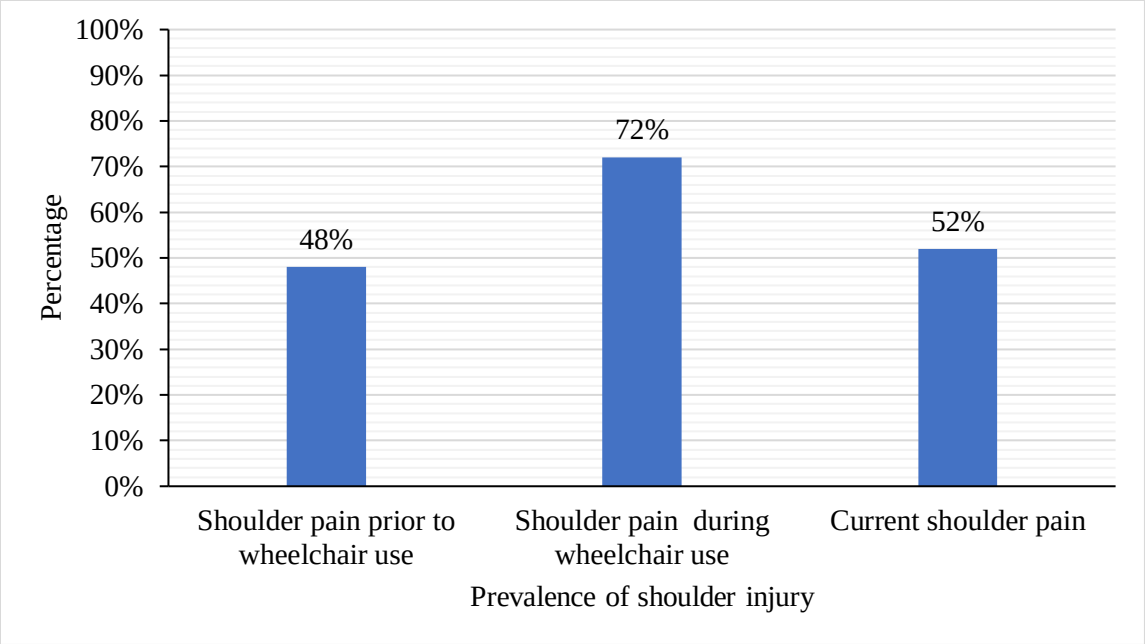


Figure 4.2: Prevalence of shoulder pain (n=25)

The Figure 4.3 below is a representation of the distribution of shoulder pain according to the history of shoulder pain and according to the side that is affected. This illustration shows that the right shoulder joint is more affected to a greater degree than the left shoulder joint in respect of shoulder pain during wheelchair use and shows pain prior to wheelchair use.

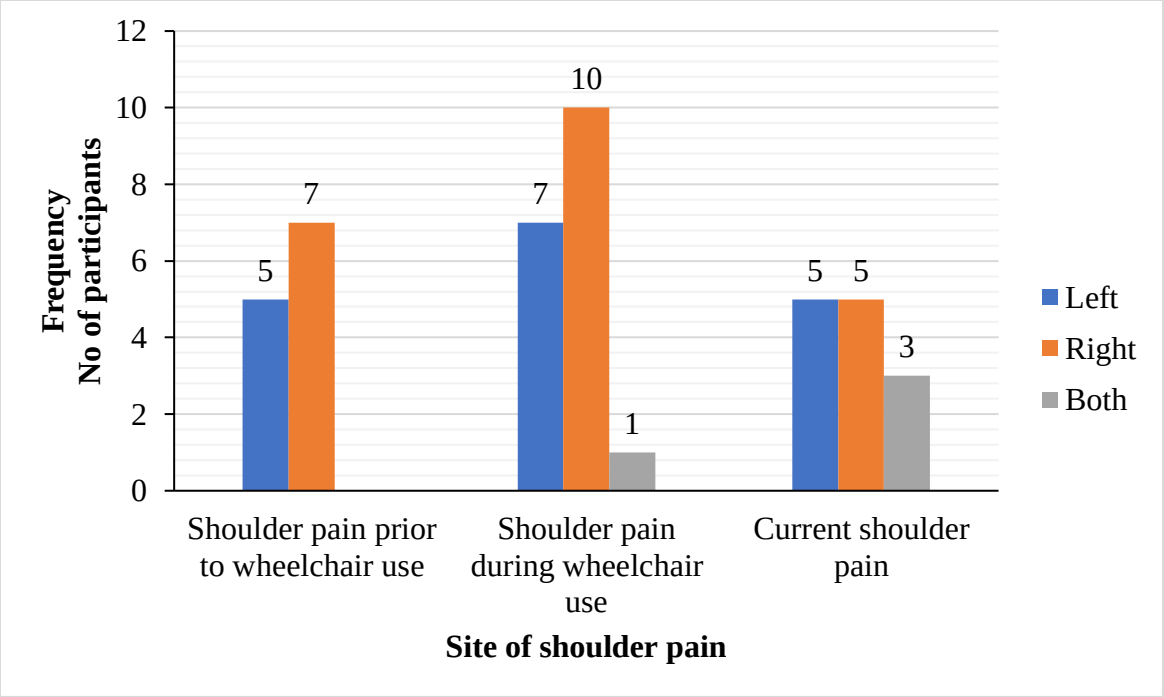


Figure 4.3 Prevalence of shoulder pain according to the site of injury (n=25)

4.6 Intrinsic risk factors

4.6.1 Relationship between socio-demographic characteristics and occurrence of shoulder pain

Age, gender and shoulder pain

As shown in Table 4.6 below, there was no significant association between shoulder pain and age (p=0.79), and gender (p=0.59) respectively among the participants.

Table 4.6: Association Between age, gender and history of shoulder pain (n=25)

	Age Without pain	Age With pain	Fishers - exact test (p-value)	Male	female	Fishers- exact test (p-value)
Shoulder pain prior to WC use	33 (4)	36 (16)	0.96	10	1	0.60
Shoulder pain during WC use	35 (10)	29 (10)	0.10	15	2	0.57

Current shoulder pain	33 (10)	33 (12)	0.79	10	3	0.59

*WC- Wheelchair

4.6.2 Disability type and shoulder pain

The table 4.7 below represents the total number of participants in each of the disability groups who reported shoulder pain prior to wheelchair use, shoulder pain during wheelchair use, and current shoulder pain. This table also represents the association between disability type and the shoulder pain history

Table 4.7: Association between disability type and shoulder pain history (n = 25)

	Spinal cord injury	**Polio**	**Amputation**	**Spina bifida**	**Others**	**Fisher-exact (p-value)**
Shoulder pain prior to wheelchair use	1	5	3	1	1	0.14
Shoulder pain during wheelchair use	5	5	5	1	1	0.57
Current shoulder pain	6	2	3	1	1	0.33

The Table 4.7 shows that there is no significant association between the type of disability the participants had and their history of shoulder pain (p=0.33). However, six (50%) of the participants with spinal cord injuries reported shoulder pain at the time of the survey (current shoulder pain).

The Table below shows the association between the history of shoulder pain and years of disability. The average number of years of disabilities among participants amounted to 28 years with an interquartile range of 22-33years.

Table 4.8: Association between number of years of disability and the history of shoulder pain (n = 25)

	Years of disability	Mann-Whitney U	p-value
Shoulder pain prior to WC use	15.14	53.5	0.2
Shoulder pain during WC use	13.18	65	0.86
Current shoulder use	11.31	56	0.23

*WC- Wheelchair

Table 4.8 shows that there was no significant association between number of years of disability and the reported history of shoulder pain among the individuals (p=0.23).

4.6.3 Range of motion

The average range of motion for internal rotation and external rotation is represented below

Table 4.9: Average range of motion (n=25)

Range of motion in degrees	Normal	Right	SD	Left	SD
External rotation	90^0	91.87^0	9.26	94.44^0	8.91
Internal rotation	90^0	59^0	17.44	61^0	17.45

The average range of motion across all the participants was 94.44^0 for the left external rotation and 91.87 for the right. The average internal rotation was 61^0 for the left and 59^0 for the right. This shows that both the internal rotation and external rotation were higher on the left-hand side than on the right-hand side.

The Table 4.10 represents the average internal and external range of motion (left and right) for both males and females. It also shows the association between age, gender and internal and external rotation on both the right and left arms.

Table 4.10: Association between age, gender and range of motion

Range of motion	Gender				Age	
	Male	Female	Mann-Whitney U	p-value	Correlation coefficient	p-value
ER Left	90.93^{o}(11.6)	96.83^{o}(11.3)	22	0.136	-0.150	0.473
ER right	93.86^{o}(10.7)	97.45^{o} (6.3)	26.5	0.16	-0.047	0.824
IR left	58.11^{o}(32.8)	60.7^{o} (18.9)	42	1.00	0.113	0.590
IR right	58.23^{o}(28.7)	61.83^{o}(11.5)	36	0.66	0.093	0.659

*ER- external rotation, IR- Internal rotation

Table 4.10 shows that there was no significant difference (p=0.136) between the average left internal rotation of the male and female participants. It also shows that the average internal rotation on the left for females was higher (96.83^{0}) than that for the males (90.93^{0}). This result also shows that there was no significant association between age and the range of motion on both left and right internal and external rotation of the shoulders, (p=0.59)). There was however, a negative correlation coefficient on the left and right side for external rotation of the shoulder joint. This negative correlation coefficient (-0.12) shows there is an inverse relationship between age and the shoulder right external range of motion.

Association of shoulder pain and range of motion

The Table 4.11 below represent the association between shoulder pain prior to wheelchair use, during wheelchair use and current shoulder pain respectively in terms of the measured shoulder internal and external range of motion based on the Mann-Whitney U test.

Table 4.11: Association between shoulder pain history and range of motion (n=25)

	Right		**Left**	
Pain prior to WC use	**Mann-Whitney U**	**p-value**	**Mann-Whitney U**	**p-value**
External rotation	27	0.06	23	0.03*
Internal rotation	66	0.55	42.5	0.06
	Right		**Left**	
Pain during WC use	**Mann-Whitney U**	**p-value**	**Mann-Whitney U**	**p-value**
External rotation	51	0.32	53	0.382
Internal rotation	49	0.27	54	0.42
	Right		**Left**	
Current pain	**Mann-Whitney U**	**p-value**	**Mann-Whitney U**	**p-value**
External rotation	72	0.17	78	0.18
Internal rotation	64.5	0.46	73	0.79

* WC- Wheelchair

Table 4.11 shows the significant association between the internal range of motion for the left shoulder and shoulder pain prior to wheelchair use, (p=0.03). No association was found between internal and external rotation and shoulder pain during wheelchair use (p=0.42) and current shoulder pain (p=0.79).

4.6.4 Shoulder instability

Shoulder joint physical assessment tests

The Table 4.12 below represent the results for the group of participants who tested positive for the physical assessment of the shoulder joint.

Table 4.12: Shoulder joint assessment test (n=25)

	Apprehension test n (%)	Relocation test n (%)	Sulcus sign test n (%)	Load and shift tests n (%)
Left shoulder	9 (36)	9 (36)	6 (24)	6 (24)
Right shoulder	6 (24)	6 (24)	6 (24)	4 (16)

A total of 15 participants tested positive for the apprehension and relocation test on both right and left shoulders. Twelve participants tested positive for the sulcus sign test while ten tested positive to the load and shift test.

Shoulder assessment according to the frequency of affectation side

The diagram below shows the distribution of the results for the assessment test in terms of the affected shoulder joint, the number of participants who reported shoulder pain during wheelchair use, shoulder pain prior to wheelchair use and current shoulder pain. Eight of the participants who reported shoulder pain during wheelchair use tested positive to the apprehension and relocation test on the left-hand side of the shoulder joint

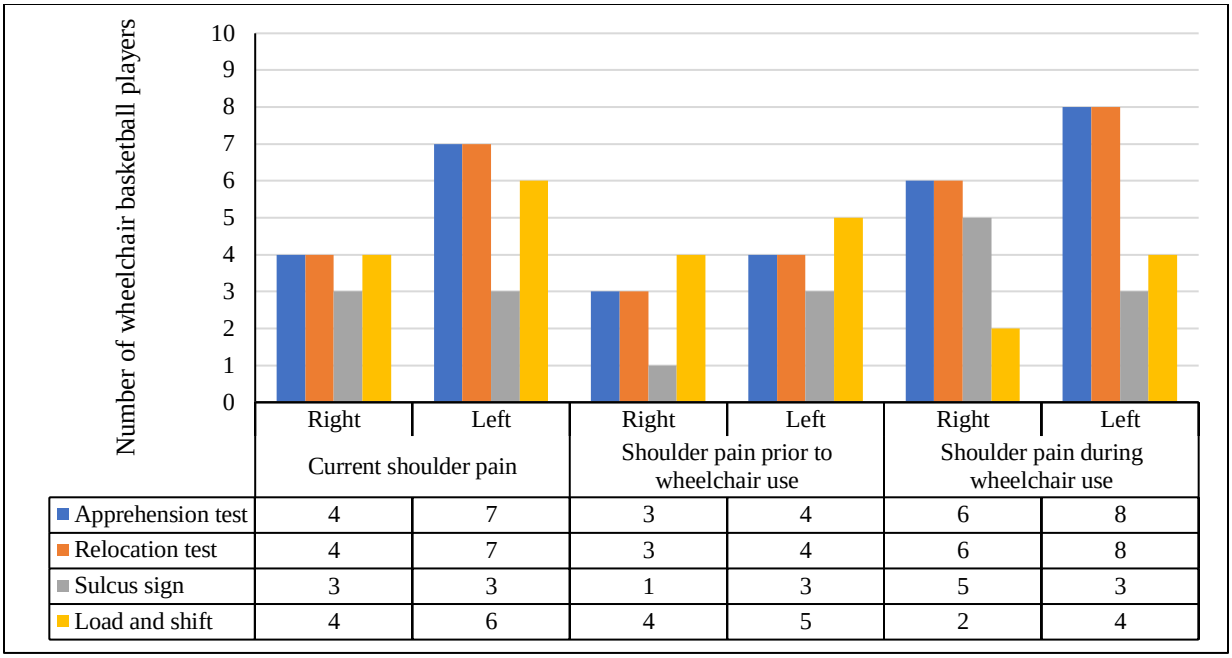


Figure 4.4: Shoulder pain according to the reported history of injury (n=25)

Relationship between history shoulder pain and shoulder instability

As shown below, the Table 4.13 represent the association between the reported history of shoulder pain and the results of the shoulder instability assessment tests.

Table 4.13: Association between shoulder instability tests and history of shoulder pain (n=25)

	Prior to WC use (p-values)		**During WC use (p-values**		**Current pain (p-value)**	
Instability tests	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**
Apprehension test	1.00	1.00	0.13	0.18	0.65	0.10
Relocation test	1.00	1.00	0.13	0.18	0.65	0.10
Sulcus sign	0.18	1.00	0.62	0.34	1.00	1.00
Load and shift	0.03*	0.06	0.57	1.00	0.10	0.02*

This result shows that there is a significant association between participants who reported shoulder pain prior to wheelchair use (p= 0.03), current shoulder pain (p= 0.02) and those that showed positive results for the load and shift test.

Association between the point classification and shoulder pain history

Table 4.14 shows the association between respective point classes of players and history of shoulder pain. It shows the total number of participants that reported shoulder pain according to their point class.

Table 4.14: Point classification and shoulder history (n=25)

	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	p-value
Shoulder pain prior to wheelchair use	0	0	0	1	1	3	3	3	0.03*
Shoulder pain during wheelchair Use	1	4	0	1	1	2	5	3	0.37
Current shoulder pain	1	4	0	0	0	3	2	3	0.34

As shown in the Table 4.14 above, there was a significate association between the point classification of the wheelchair basketball players and shoulder pain prior to wheelchair use (p= 0.03). The 3.5 players to 4.5 players reported shoulder pain across all the history of shoulder pain than 1.0-3.0 players.

4.7 Extrinsic Risk factors

4.7.1 Associated extrinsic risk factors

The Table 4.15 below represents the median and mean distribution of the associated extrinsic risk factors.

Table 4.15: Associated extrinsic risk factors (n=25)

Variables	Mean	SD	Median	IQR
Number of years of wheelchair use	11.32	12.18	11	24
Number of years of playing wheelchair basketball	13.64	7.24	13	8
Number of days of training per week	3.04	1.17	3	2
Numbers of hours of training per session	3.04	1.99	2	2
Number of years of ambulatory device use	20.64	11.3	24	16

Since the variables listed in Table 4.15 was not normally distributed, the median range has been reported. The median number of years of wheelchair use in the sample population was 11 years with an interquartile range of 24, while majority of the participants had been playing wheelchair for a median number of 13 years with an interquartile range of 8. The median number of days that the participants trained per week amounted to three days with an interquartile range of 2, while the median number of hours spent per training session was two hours with an interquartile range of 2.

4.7.2 Relationship between the associated extrinsic risk factors and history of shoulder pain

The Tables shown below (Table 4.16, 4.17, 4,18) represents the relationship between history of the associated extrinsic risk factors shoulder pain prior to wheelchair use, during wheelchair use and current.

Table 4.16: Relationship between associated extrinsic risk factors and shoulder pain prior to wheelchair use (n = 25)

	With history of shoulder pain		Without history of shoulder pain			
Shoulder pain prior to WC use	**Median**	**IQR**	**Median**	**IQR**	**Mann-Whitney U**	**p-value**
Number of years of wheelchair use	0	13	23	22	31	0.01*
Number of years of playing wheelchair basketball	15	6	12	7	49	0.12
Numbers of days of training	3	2	3	1	67.5	0.58
Number of hours training per session	2	3	2	1	56	0.18

*WC- Wheelchair

This shows that there was a significant difference between the number of years of wheelchair use and the reported history of shoulder pain prior to wheelchair use among participants who reported shoulder pain and those without shoulder pain (p= 0.01), with a median of 23 years of wheelchair use among those that reported no pain prior to wheelchair.

Table 4.17 represents the relationship between the associated extrinsic risk factors history of shoulder pain during wheelchair use.

Table 4.17: Associated extrinsic risk factors and shoulder pain during wheelchair use (n=25)

	With history of shoulder pain		**Without a history of shoulder pain**			
Pain during WC use	**Median**	**IQR**	**Median**	**IQR**	**Mann-Whitney U**	**p-value**
Years of Wheelchair use	12	20	0	26	67.5	0.98
Years of playing wheelchair basketball	14	8	13	7	54	0.41
Numbers of days of training	3	2	3	2	60.5	0.64
Number of hours training per session	2	4	2	0	31.5	0.01*

*WC- Wheelchair

As shown above, there is a significant difference between the number of training hours per session and the reported history of shoulder pain during wheelchair use among those with and without pain (p=0.01). The median number of hours per training session was two hours for those who reported shoulder pain during wheelchair use as well as for those without shoulder pain.

Table 4.18 represents the relationship between the associated extrinsic risk factors and current shoulder pain.

Table 4.18: Associated extrinsic risk factors and current shoulder pain (n=25)

	With history of shoulder pain		**Without history of shoulder pain**			
Current shoulder pain	**Median**	**IQR**	**Median**	**IQR**	**Mann-Whitney U**	**p-value**
Years of wheelchair use	13	20	0	24	72.5	0.75
Years of playing wheelchair basketball	13	6	13	9	72	0.73
Numbers of days of training	3	2	3	2	61	0.28
Number of training per session	2	3	2	4	66	0.53

The Table 4.18 above represent the relationship between the associated extrinsic risk factors and current shoulder pain. This table shows that there is no significant difference between the associated extrinsic risk factors and current shoulder pain as opposed to those without shoulder pain as reported by participants (p=0.53).

4.7.3 Association between playing position and history of shoulder pain

Table 4.19 represent the relationship between the playing position of players and the history of shoulder pain

Table 4.19: Playing position and shoulder pain (n=25)

		Shooting guard	Point guard	Centre	Forward guard	p-value
Shoulder pain prior to WC use	Yes	3	4	2	2	0.78
	No	3	5	1	4	
Shoulder pain during WC use	Yes	5	8	1	3	0.13
	No	1	1	2	3	
Current shoulder pain	Yes	4	4	1	3	0.72
	No	2	5	3	6	

*WC- Wheelchair use

The results in Table 4.19 shows that there is no signification difference between playing position of wheelchair basketball players and the reported history of shoulder pain (p= 0.72). The frequency of shoulder pain is the greatest in players playing in the point guard position.

4.7.4 Wheelchair users shoulder pain index (WUSPI)

Table 4.20 represents the mean and the frequency of pain intensity during the performance of activities of daily living. The Performance corrected score was used in the analysis of this study (PC-WUSPI).

Table 4.20: Wheelchair User's Shoulder Pain Index (n=25)

Activities performed	**n**	**Mean pain intensity**	**SD for pain intensity**
Transferring from a bed to a wheelchair	5	0.62	1.42
Transferring from a wheelchair to a bed	4	0.58	1.42

Transferring from a wheelchair to the tub or shower	4	0.62	1.49
Loading your wheelchair into a car	2	0.39	1.64
Pushing your wheelchair for 10minutes or more	8	0.96	1.65
Pushing up ramps or incline outdoor	5	0.60	1.45
Lifting objects down from an overhead shelf	5	1.08	2.28
Putting on pants	5	0.52	1.22
Putting on t-shirts or pullover	6	0.86	1.88
Putting on a button-down shirt	5	0.54	1.34
Washing your back	7	1.11	2.07
Usual daily activities at work or school	6	0.87	1.69
Driving	3	0.23	0.67
Performing household chores	5	0.78	1.84
Sleeping	6	0.87	1.71
Total PC-WUSPI		**19.23**	**27.44**

According to Table 4.20, the most painful activities of daily living was washing the back (1.11), followed closely by lifting objects down from an overhead shelf (mean- 1.08), and then pain during sleep (0.87). Majority of the participants reported pain in pushing a wheelchair for 10minutes or more.

Figure 4.5 illustrates the intensity of shoulder pain during the activities of daily living. Starting from the least painful activity which was driving with an intensity of 0.23 to the highest painful activity which was washing the back (1.11).

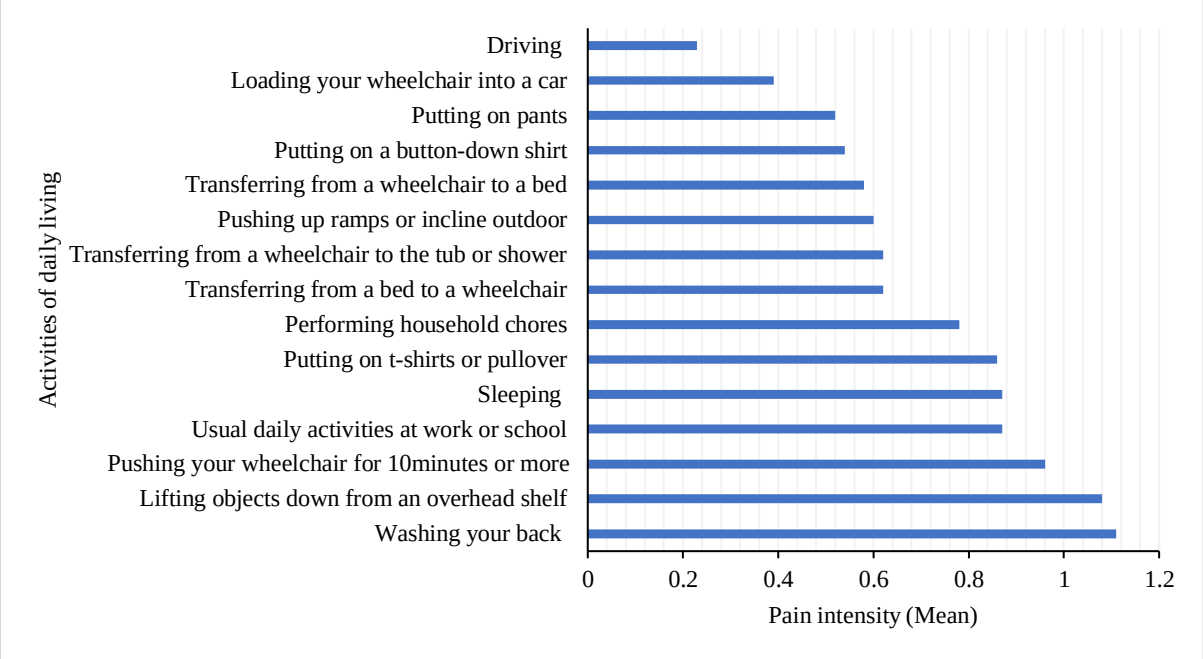


Figure 4.5 Activities of Daily Living according to pain intensity

Association between history of shoulder pain and WUSPI

The analysis shows that there was no association between shoulder pain and the WUSPI (p=0.15). This is represented in the Table 4.21.

Table 4.21: History of shoulder pain and WUSPI (n=25)

	With pain		**Without pain**			
History of shoulder pain	**Median**	**IQR**	**Median**	**IQR**	**Mann Whitney U**	**p-value**
Shoulder pain prior to WC use	0	38	0	54.94	63.5	0.61

Shoulder pain during WC use	0	51.5	0	13.5	49.5	0.48
Current shoulder pain	22.2	58.44	0	12.8	49	0.15

4.8 Management

Table 4.22 below represent the descriptive frequencies of management strategies used by the participants in the treatment of shoulder pain.

Table 4.22: Management of shoulder pain (n = 25)

Management of shoulder injury	**N (%)**
Medical attention for pain management	8 (32)
Medical practitioner sought	
Physician	4 (5)
Physical therapist	6 (75)
Traditional medicine	1 (12.5)
Treatment of shoulder pain	
Ice	17 (68)
Heat	12 (48)
Exercise	11 (44)
Medication	3 (12)
Rest	8 (32)
None	4 (16)
Warm up activities	**25 (100)**

Stretches	24 (96)
Circular passes	18 (72)
Sprints	20 (80)
Ball pickups	16 (64)
Others	5 (20)
Cool down activities	**21 (84)**
Stretches	21 (84)
Deep breathing	14 (56)
Aerobics	19 (76)

Only eight (32%) of the participants reported to have sought medical attention for the treatment of shoulder pain. Majority of the participants sought the services of a physical therapist for the management of their pain 6 (75%) while four (5%) sought a physician. The most common modality used in the management of pain was ice therapy, 17 (68%) of the participants reported this as their choice treatment. Warmup exercises were reported by all the participants while 21 (84%) reported cool down exercises.

4.9 Conclusion

The results for this group of participants in this study showed high prevalence of shoulder pain from the onset of the using of a wheelchair among participants (72%). On the other hand, the current shoulder pain at the time of the study was found to be 52%. Shoulder pain was associated with: shoulder internal range of motion, number of years of wheelchair use, point classification, shoulder instability and training loading. Shoulder pain was found to have no association with the number of years of disability, the different types of disability, age, gender, and number of years of playing wheelchair basketball. These results are discussed in more details in the chapter that follows

5 CHAPTER FIVE: DISCUSSION

5.1 Introduction

This chapter discusses the results of the study that were presented in Chapter 4. The objectives of the study were to determine; the sociodemographic characteristics of the participants, the prevalence of shoulder pain among wheelchair basketball players and the intrinsic and extrinsic associated risk factors for shoulder pain was discussed. The final objective was to determine the association between the prevalence and risk factors of shoulder pain and sociodemographic variables were explored.

5.2 Sociodemographic characteristics

This section is based on objective one of the study namely; to determine the sociodemographic profile of wheelchair basketball players.

The median age of the participants in this study was 33 years which is closely related to those of a previous study by Kathleen A Curtis and Black (1999), conducted among female wheelchair basketball players in playing for USA national team, the average age was found to be 33.3 years. On the other hand, studies by Lepera (2010) and Tsunoda et al. (2016) involved younger participants with an age ranges of 29 years, which is not similar to the result of this current study. This age difference across the studies could be account of differences in the population of participants that were employed in the studies. The ratio of males to females in the study was 84% to 16%, showing that the study had more male than female participants. As such, the wheelchair basketball sport in Johannesburg is dominated by male athletes. This current study included more females than the two previous studies undertaken in South Africa. A study by Lepera (2010) included only male athletes, while the study by Mateus (2015) included one female. Globally, there has been only one study that include only female athletes (Kathleen A Curtis and Black, 1999) whereas, another study included both females and males (Tsunoda et al., 2016). These two studies were conducted among the wheelchair basketball players representing the US and Japanese national team respectively. One could say that the sport is played more by males in South Africa which could be attributed to the fact that the male clubs are well organized and holds different competitions all year round.

The result of this current study shows that the average number of years of disability was 28 years of which; and that the major cause of disability among the participants was spinal cord injury with

16% of the spinal injury at the thoracic level of the spine and 12% in the lumbar spine. These results are similar to that of Finley and Rodgers (2004) and Tsunoda et al. (2016). Both studies were conducted among wheelchair basketball players who reported that majority of their participants sustained spinal cord injuries (70% and 63% respectively). Apart from spinal cord injury, another major causes of disability among the participants in this study was polio at 28% of the participants, and amputation accounting for 24% of the causes of disability. Furthermore, 10% of the participants presented with spina bifida and 12% with other types of disability. Because spinal cord injury has featured as the major cause of disability, 40% of the participants are dependent on the wheelchair to facilitates their mobility.

The average number of years of wheelchair use was found to be 11years which compares well with the result of a study by Kathleen A Curtis and Black (1999). This study also reported an average of 11.5 years for the number of wheelchair use. This current study showed that there are different types of disabled individuals involved in wheelchair basketball. However, majority of the participants in this study were found to be disabled due to spinal cord injury.

5.3 Prevalence of shoulder pain

The prevalence of shoulder pain during wheelchair use among wheelchair basketball players was found to be high (72%). These statistics shows the large number of participants who have experienced shoulder pain since the onset of using of a wheelchair. However, 48% of the participants had experienced shoulder pain prior to the use of a wheelchair which indicated that the introduction of a wheelchair into one's daily life or its use for sporting activities plays a role in intensifying of shoulder pain. The point prevalence of shoulder pain was reported to be slightly high also (52%). This study was conducted after the basketball season which could account for the disparity in the prevalence of shoulder pain between during wheelchair use as opposed to the prevalence of current shoulder pain. Most of the pain experienced by athletes occurs during wheelchair use and since this study was conducted during the off-season periods, so it is possible that the rest period could influence the presence of shoulder pain at this point in time in the study. Overall, 60% of the participants reported hand and elbow pain from the onset of using a wheelchair and only 12% reported that they had undergone previous shoulder surgery.

Previous studies relating to shoulder pain among wheelchair basketball players reported a 67%-89.9% prevalence of shoulder pain with the onset wheelchair use (Curtis and Black, 1999; Lepera, 2010 and Mateus, 2015) which compares well to the findings of this current study. These studies were conducted in USA and in South Africa, respectively. Studies on athletes and non-athletes populations, have reported varying prevalence ranging from 44% to 67% (Finley and Rodgers, 2004 and Fullerton et al., 2003). Both of these studies were conducted in USA and a general population of wheelchair users were recruited. Curtis and Black (1999) reported 52% of the participants to currently have shoulder pain at the time of the study which is like the result of this present study. However, the result of this present study is not similar to a previous study done in South Africa where it was recorded that only 37.9% of the sample population reported current shoulder pain (Lepera, 2010). Comparing the results of this present study to the study on athletes and non-athlete only 28.8% reported current shoulder pain (Finley and Rodgers, 2004). The similarity in the Curtis and Black study (1999) and this current study could be as a result of the timing of the assessment. The assessments for this study was conducted immediately after the league season and associated with ongoing championship training while the assessment of Curtis and Black (1999) was during a tournament. The Finley and Rodgers (2004) study was conducted by sending out questionnaires to the participants while the study by Lepera (2010) was conducted before the start of the league season.

These results show that the period when the study was conducted influences the prevalence of shoulder pain. However, all studies reported a high prevalence of shoulder pain irrespective of the time or the place when/where the study was conducted. These findings indicate that shoulder pain is a common injury among wheelchair basketball players which needs to be attended to. Therefore, shoulder pain prevention, treatment and rehabilitation programmes, are highly recommended in order to improve quality of life among basketball players.

5.4 Intrinsic risk factors

Age and Gender

This study found no association between age and shoulder pain which means that age did not contribute to shoulder pain wheelchair basketball players.

A previous study by Tsunoda et al. (2016) among wheelchair basketball players in the Japanese national team showed that age was associated with shoulder pain. The mean age of the participants in this group was 29.7 years which is less than the mean age in this current study (33 years). Tsunoda et al. (2016) reported that the associated between age and shoulder pain was found among the older players. This is in contrast with the present study that found no respective association between age and shoulder pain prior to wheelchair use, during wheelchair use and current shoulder pain. The results of this current study is similar to the study by Curtis and Black (1999); and Lepera (2010). They also found no association between age and shoulder pain. The mean age range in both studies were found to be similar to that of the current study, which ranges from 30years-33.3years. However, studies among athletic and non-athletic wheelchair users reported an association between age and shoulder pain (Fullerton et al., 2003). A mean age of 41years was found in the population sample which is higher than that of the current study

Compared to previous studies among general wheelchair users, studies also involving paraplegics and quadriplegics found that increasing age is associated with shoulder pain (Akbar et al., 2011, 2010; Alm et al., 2008 and Pepke et al., 2018). The mean age across these studies ranged from 41years to 52years. This disparity could be due to the age range of the participants who were wheelchair users and do not participates in any form of sporting activities. Furthermore, this current study did not find any association between age and shoulder pain.

Similarly, there was also no significant difference between gender and shoulder pain ($p<0.59$). It should be noted, however, that there were more males than females in this current study. These results were similar to that of the study by Curtis and Black (1999) which included only female wheelchair basketball players and that of Lepera (2010) among male players only. The investigation into the prevalence of shoulder pain in these two studies both show that gender plays no role in shoulder pain. However, these findings contrasts to those of Tsunoda et al. (2016) conducted among equal population of male and female wheelchair basketball players. The afore-mentioned study reported that males scored higher for shoulder pain on the Wheelchair User's Shoulder Pain Index. The disparity in these results may be due to the unequal distribution of gender. Furthermore, studies on paraplegic participants reported that women were more likely to experience shoulder pain than men (Boninger et al., 2003 and Pepke et al., 2018). This also conflicts with the findings of (Salisbury et al., 2003) that reported that men are more likely to

develop shoulder pain than women. Therefore, there is no consensus in the relevant literature on the relationship between gender and shoulder pain. The results depend on the population and few studies have reviewed the correlation of shoulder pain among wheelchair basketball players. This study found no association between gender and shoulder pain within its participants.

Years of disability and type of disability

The result of this study showed that there was no significant association between the type of disability, the number of years of disability and the history of shoulder pain.

A study by Bernardi et al. (2003), wheelchair athletes from different sporting codes found that the disability type (spinal cord and amputation) was the determinant of sport related muscle pain. This result is not in keeping with the current study that found no significant association between the type of disability and shoulder pain. The disparity in the results could be due to fact that the current study pertains specifically to wheelchair basketball players as opposed to that of Bernardi et al. (2003), that includes different wheelchair sports. There is limited literature on the relationship between types of disability and shoulder pain among wheelchair basketball players. However, studies among paraplegics and tetraplegics patients showed that tetraplegics reported shoulder pain twice more than the paraplegics (Curtis et al., 1999) a findings which cannot be compared to this current study. The discrepancy between Curtis et al. (1999) and this current study is due to the fact that Curtis et al. (1999) was conducted among paraplegia and tetraplegia as a result of spinal cord injury while this current study include a different types of disability. The lack of association between these two variables could be because all the players were exposed to the same level of risk irrespective of their type of disability.

Range of motion

The internal and external range of motion was measured with the following results; the average external rotational range of motion was 93.2^{0} while internal rotational range of motion was 60^{0}. The external range of motion is known to be high in athletes participating in overhead sports (Manske et al., 2013 and Wilk et al., 2011). It has been reported that an increase in external range of motion and a decrease of the internal range of motion is necessary to perform the required mechanics for throwing (Manske et al., 2013). Manske et al. (2013) reported in their review of able-bodied overhead athletes that an increase in external rotation greater than 18^{0} to 20^{0} from the

normal can result in shoulder pathology. This current study compares to study by Curtis et al. (1995), where it was reported that the internal rotation of the shoulder was lower than that of the external rotation of their study population.

There was no significant difference between the male and female left internal range of motion. The average range of motion for the left-hand side of the male was found to be lower than that for the female. The female participants had greater range of motion than their male counterparts. Eriks-Hoogland et al. (2009) reported that the female participants in their study showed no risk in terms of limited ROM of the shoulder. Females have been reported to have higher range of motion than males due to the greater flexibility of their ligaments (Boninger et al., 2003).

There was no significant association between age and the internal and external ROM. However, there was a negative correlation coefficient between age and right and left external ROM. This is not in keeping with the study by Ballinger et al. (2000), where they found that age was associated with ROM problems in the shoulder among men with spinal cord injury. This means that as an individual grows older there is loss of shoulder flexibility leading to reduced ROM. The findings of this study are also similar to that of Eriks-Hoogland et al. (2009), in that older people are at risk in terms of shoulder problems. Both studies arrived at the same conclusion since spinal cord patients are generally associated with long term use of the wheelchair were the only participants. For these two studies (Ballinger et al., 2000 and Eriks-Hoogland et al., 2009) the mean age was 37.8 and 40.8 respectively which is higher than the mean age of 33 years reported in this current study. Furthermore, the findings of these studies do not compare with those of this current study that found no association between age and shoulder range of motion.

Association between shoulder pain prior to wheelchair use and range of motion in the shoulder was also found. These results does not compare with that of the study by Curtis et al. (1995) that found that there was no association between shoulder pain and shoulder ROM. Eriks-Hoogland et al. (2014) found that the limitations of shoulder ROM was predictive of shoulder pain in non-athletic population of persons with spinal cord injury. The findings of the present study compares with that of Eriks-Hoogland et al. (2014), in that an association was found between left shoulder internal rotation and shoulder pain. Although, as reported in this study, there is the benefit of increased range of motion for athletes. However, this increase in range overtime could result in

shoulder pain as reported in this study. Further studies are required on how to maximise the increase in shoulder range of motion without impacting the shoulder joint.

Shoulder instability tests

Fifty percent (50%) of the participants were positive to the apprehension and relocation test for both the left and right shoulder joint, while 40% were positive to the load and shift test and finally 48% was positive to the sulcus sign test.

The load and shift test for the right and left shoulder showed a significant association with shoulder pain prior to wheelchair use. The load and shift test is a test used to diagnosis the posterior glenohumeral instability. Most of the studies have been on the prevalence of rotator cuff tear and biceps tendinitis. According to Akbar et al. (2015) rotator cuff tear was found to be symptomatic in 92% of the participants group involved in overhead sports. This same study reported that those wheelchair users involved in sports were twice more likely to have rotator cuff tear than their counterpart. In contrast, Finley and Rodgers (2004) found that nine of 18 of the participants with painful shoulders had biceps tendinopathy while eight of 18 had shoulder instability. The results of this current study compares with that of Finley and Rodgers (2004). It has also been said that the presence of shoulder instability can result in impingement syndrome (Finley and Rodgers, 2004). Impingement syndrome is known to be a secondary condition of shoulder instability and participants may be at risk of developing further pathology in shoulder pain. However, this study did not perform an assessment on shoulder pathology so that a conclusion cannot be reached on the presence or absence of shoulder pathology in relation to shoulder instability. The results also showed that there was no association between history of shoulder pain and apprehension test, relocation test and sulcus sign test.

Point classification

The 1.0-3.0 players were classified as low point players that have no trunk control in some places and requires the arm to return to the upright position when balance is lost (IWBF Player Classification Commision, 2014). Furthermore, they sit with the pelvis titled at 15^0 more to the posterior to compensate for the loss of trunk control (Yildirim et al., 2010) on the other hand, while the 3.5 - 4.5 class players have trunk control and stability. The point classification of the players was found to be significantly associated with shoulder pain prior to wheelchair use. The result of

the study shows that 1.0 to 3.0 class player reported less shoulder pain as opposed to the 3.5-4.5 class play. In contrast, it has been reported that lower point players reported more pain in respect of the activities of daily living than higher point players (Tsunoda et al., 2016), which is expected because lower class players generally constitute the majority in everyday wheelchair user. Studies that looked at the correlation between the point classification and strength of players have also found that lower class players have lesser strength than high point class players (Yildirim et al., 2010).

The result of this study did not compare with the previously study by Tsunoda et al. (2016),where they found that majority of the higher point class player reported shoulder pain more than the lower class player. This could be because the lower-class player is a daily wheelchair user and have learnt to tolerate the pain that result from the use of the wheelchair than the higher-class player who uses the wheelchair mainly for sport.

5.5 Extrinsic risk factors

Years of wheelchair use and years of experience

The average number of years of using a wheelchair as a daily mobility device amounted to 11years. The duration of use is significantly associated with shoulder pain prior to wheelchair use ($p=0.01$). These results compares with the results of Pepke et al. (2018) which reported that the risk of developing shoulder injuries increased by six percent (6%) per year among wheelchair dependent people. Similarly a study by Akbar et al. (2015) reported the risk of rotator cuff tear increase by 10fold with each year of wheelchair use.

The shoulder joint is the primary weight bearing joint in wheelchair users thereby creating a dynamic relationship between mobility and stability which eventually leads to overuse and the eventual degeneration of the shoulder joint as shown on radiological investigation into a wheelchair bound person after prolonged used of wheelchair (Boninger et al., 2003; Brose et al., 2008 and Pepke et al., 2018). The findings from this study support the fact that wheelchair users are completely dependent on their upper limbs for both mobility and the performance of activities such as weight relief and manoeuvring (Patel et al., 2018). This could result in sustained repetitive and continuous loading of the shoulder joint during wheelchair propulsion. Due to the high

intensity of movement in the propulsion of the wheelchair, the superior translation of the humerus and the compression of the subacromial structures against the acromion can occur; thus leading to the wear and tear of the joint (Akbar et al., 2011 and Patel et al., 2018). Studies have shown that involvement in athletic activities by wheelchair users slows down the development of shoulder dysfunction (Fullerton et al., 2003). However, research also shows that wheelchair users who are involved in overhead sports such as wheelchair basketball are more likely to sustain shoulder injuries (Akbar et al., 2015).

However, according to this current study, the length of time (years) of playing wheelchair basketball is not associated with shoulder pain. The average number of years of experience was 13years. This compares to the findings of (Fullerton et al., 2003) that the years of playing wheelchair sport is unrelated to shoulder pain. It can then be said that the number of years of wheelchair use impacts upon shoulder pain and not years of playing wheelchair basketball.

Training load

The average number of hours spent per training session was two hours for both groups and this is significantly associated with shoulder pain during wheelchair use. An average of six hours was spent training per week.

According to literature, the relationship between training load and shoulder pain is controversial. A study by Bernardi et al. (2003) looking at sport-related muscle pain in wheelchair athletes found that a training period above seven hours per week was related to muscle pain. In contrast, Curtis and Black (1999) and Lepera (2010) did not find any association between shoulder pain and the number of hours spent training or conditioning at the gym and leisure among wheelchair basketball players.

The literature in able bodied athletes also found a relationship between hours spent training and shoulder pain. Sein et al. (2010), found that swimmers who swim for more than 15 hours per week were at risk of developing supraspinatus tendinitis. The number of swimming miles covered per week could also be considered as an influencing factor in this respect. Furthermore, the average number of days used to train per week was three times per week in this current study, however, no relationship was found between the number of days spent training and shoulder pain. The benefits of physical activities as a protective mechanism for improving the quality of life and for delaying

the onset of cardiovascular disease are emphasized in literature (Nyland et al., 1997). A moderate level of activity is recommended to delay the onset of muscle related injury (Hootman, 2001). Research has shown that involvement in overhead sport increases the risk of shoulder pain and the number of years of wheelchair use also impacts upon shoulder pain. Likewise, the number of hours spent in training is also associated with shoulder pain. Therefore, to delay the development of shoulder pain, the hours spent on training should be tempered. However, this study does not include the required number of hours that would be appropriate for the athletes to spend on programmes in preventing or delaying the onset of shoulder pain. Further research is required to establish the specific hours of training that would be beneficial to athletes.

Activities of daily living

Everyday wheelchair users require their shoulders for both mobility and for the performance of the activities of daily living, such as transfers, wheelchair propulsion and self-care all of which results in the overuse of the shoulder joint (Akbar et al., 2011). It was reported by Curtis and Black, (1999) that the presence of shoulder pain influences the performance of Activities of Daily Living (ADL). The 15-item wheelchair user's shoulder pain index (WUSPI) was used to measure pain intensity during activities of daily living. The mean PC-WUSPI was found to be 19.23, which compares to previous study by Curtis and Black (1999); and Tsunoda et al. (2016). Both reported the mean pain intensity among wheelchair basketball players of 15.6 and 16.18 respectively. This study examines the effects of activities of daily life on shoulder pain among participants, however no relationship was found between the activities of daily living and history of shoulder pain. This does not confirm the fact that there are no activities that increases shoulder pain when performed. The highest pain intensity was reported for "washing the back", "lifting objects from an overhead shelf", "pushing the wheelchair or 10minutes or more" and "sleeping". The highest pain intensity reported involved activities such as propulsion, self-care and transfers.

This study shows that wheelchair users, employs high intensity forces to propel their wheelchair which results in shoulder pain. Athletes needs to be trained in respect of the proper biomechanics of wheelchair dexterity to reduce the force exerted during propulsion. Further research is also required on wheelchair designs.

Management of shoulder pain

Thirty-two percent (32%) of the participants with shoulder pain were found to have sought medical attention for the treatment of the shoulder pain. These results is not similar to those of previous studies such as that of Fullerton et al. (2003) that reported that 70% of participants had sought treatment for pain. In this current study 75% of them those who reported shoulder pain have sought a physical therapist for the management of pain while five percent (5%) of them had sought a physician for treatment. The participants reported ice (68%) as the most common means of treating shoulder pain, it is followed by heat used (48%) and exercise (44%). Medication was found to account for the least means of treating shoulder pain among the participants (12%). Wilroy and Hibberd (2017) reported that a six-weeks exercise-based programme, helps to improve the internal and external range of motion among wheelchair athletes. There are few studies on the management of shoulder pain among wheelchair basketball players. A general study on the management of shoulder pain shows that the use of analgesia with an holistic approach is an important way in which to encourage rehabilitation among patients (Mitchell et al., 2005). In facts, athletes need more education on management of shoulder pain.

All the participants reported engaging in warm up activities for training and games, comprising mainly of stretches (96%), circular passes (72%) and sprints (80%). Only 84% reported that they engaged in cooling down activities after games or training.

5.6 Summary of the discussion

This chapter was based on the results of the research data and was, as such in line with the objectives of the study. Comparisons were made between the findings of this study and the results from other researches on wheelchair basketball players, wheelchair athletes, wheelchair users and able-bodied athletes in overhead sports. The results of the prevalence are consistent generally, however, the association analysis gives variation in the results emanating from this study and others.

6 CHAPTER SIX: CONLUSION, LIMITATIONS AND RECOMMENDATIONS

The aim of this study was to determine the prevalence of shoulder pain and its associated risk factors among wheelchair basketball players in Johannesburg.

6.1 Conclusion and implication of the study

It can be concluded from the sample population studied that the prevalence of shoulder pain among wheelchair basketball players in Johannesburg is considerable. The study determined the prevalence of shoulder pain from the point of the onset the use of wheelchair to be 72% and the point prevalence at the time of the study was 52%. The associated intrinsic risk factors for shoulder pain were as follows:

- There was no significant difference between males and females in terms of range of motion of the shoulder. However, as opposed to males, females had a higher internal range of motion.
- The association between participants who reported shoulder pain prior to wheelchair use and left external range of motion of the shoulder was significant.
- There was an association between participants who tested positively in the case of load and shift test and shoulder pain.
- Participants with a higher point classification reported shoulder pain more frequently than participants with a lower point classification.
- There was no association between the number of years of suffering from a disability and shoulder pain.
- Age and gender were not significantly associated with shoulder pain among the wheelchair basketball players studied.
- Results for the load and shift test were found to be significantly associated with shoulder pain in participants who reported pain prior to wheelchair use.

On the associated extrinsic risk factors included the following;

- There was a significant association between the number of years of wheelchair use and shoulder pain
- The number of hours spent training was found to be significantly associated with shoulder pain during wheelchair use.

- There was no association between shoulder pain and pain during activities of daily living.
- The participants reported that some activities that involves transfers, propulsion and self-care were significantly painful to perform.
- The number of years of wheelchair use was significantly associated with shoulder pain prior to wheelchair use
- The number of years of playing wheelchair basketball was not significantly associated with shoulder pain.

These findings have implication for athletes, coaches, athletic trainers and clinicians. Given that shoulder pain is associated with several risk factors, so caution should be exercised when prescribing certain training activities for athletes. The number of hours spent on training should be moderate and technical adaptation would be helpful in preventing physiologic laxity and preventing a wheelchair basketball player from becoming a pathological case.

6.2 Limitations of the study

The study was restricted to wheelchair basketball players in Johannesburg which makes it difficult to generalise on the findings of this study. The restriction resulted in the small sample size, in spite of the fact that, Johannesburg has the largest number of wheelchair basketball clubs in South Africa, and only three were in the rest of the province. Therefore, the use of a logistic regression analysis to identify the specific predictors of shoulder pain among the study population was not possible. There were more male included than female, is because the South African female wheelchair basketball clubs are not as organised as the male counterparts. Furthermore, there are fewer tournaments in the country for the female wheelchair basketball players to compete in within the country.

6.3 Recommendations for future research

This study was conducted at the end of the league season; Therefore, a prospective longitudinal study design is needed to monitor the progress, patterns and changes in shoulder pain before, during and after the league season. Therefore, research on the development and implementation of exercise programmes that are specific to the wheelchair basketball players and will address the complaint of shoulder pain. Thereby, helping to improve the longevity of the shoulder in the use of the game and daily life. A large sample size that includes all the players in South Africa and the female wheelchair basketball players is proposed and would be welcomed.

6.4 Recommendations for clinicians and coaches

This study highlighted the prevalence of shoulder pain among wheelchair basketball players. As such, clinicians and physical trainers should collaborate on the education of the athletes in terms of injury prevention, periodic checkups and concentrate on the management of their wellbeing. The volume of training per week was found to impact upon shoulder pain and coaches should set up specific training programmes to mitigate the occurrence of shoulder pain.

REFERENCES

Akbar, M., Balean, G., Brunner, M., Seyler, T.M., Bruckner, T., Munzinger, J., Grieser, T., Gerner, H.J., Loew, M., 2010. Prevalence of Rotator Cuff Tear in Paraplegic Patients Compared with Controls. *Journal of Bone and joint Surgery-American* Vol. 92, 23–30.

Akbar, M., Brunner, M., Balean, G., Grieser, T., Bruckner, T., Loew, M., Raiss, P., 2011. A cross-sectional study of demographic and morphologic features of rotator cuff disease in paraplegic patients. *Journal of Shoulder and Elbow Surgery*. 20, 1108–1113.

Akbar, M., Brunner, M., Ewerbeck, V., Wiedenhöfer, B., Grieser, T., Bruckner, T., Loew, M., Raiss, P., 2015. Do overhead sports increase risk for rotator cuff tears in wheelchair users? *Archives of Physical Medicine and Rehabilitation*. 96, 484–488.

Akınoğlu, B., Kocahan, T., 2017. Characteristics of upper extremity's muscle strength in Turkish national wheelchair basketball players team. *Journal of Exercise Rehabilitation*. 13, 62–67.

Alm, M., Saraste, H., Norrbrink, C., 2008. Shoulder pain in persons with thoracic spinal cord injury: Prevalence and characteristics. *Journal of Rehabilitation Medicine*. 40, 277–283.

Ambrosio, F., Boninger, M.L., Souza, A.L., Fitzgerald, S.G., Koontz, A.M., Cooper, R.A., 2005. Biomechanics and strength of manual wheelchair users. *Journal of Spinal Cord Medicine*. 28, 407–414.

Bahr, R., 2003. Risk factors for sports injuries -- a methodological approach. *British Journal of Sports Medicine*. 37, 384–392.

Bahr, R., Krosshaug, T., 2005. Understanding injury mechanisms: A key component of preventing injuries in sport. *British Journal of Sports Medicine*. 39, 324–329.

Ballinger, D.A., Rintala, D.H., Hart, K.A., 2000. The relation of shoulder pain and range-of-motion problems to functional limitations, disability, and perceived health of men with spinal cord injury: A multifaceted longitudinal study. *Archives of Physical Medicine and Rehabilitation*. 81, 1575–1581.

Bernardi, M., Castellano, V., Ferrara, M.S., Sbriccoli, P., Sera, F., Marchetti, M., 2003. Muscle pain in athletes with locomotor disability. *Medicine and Science in Sports and Exercise*. 35, 199–206.

Boninger, M.L., Dicianno, B.E., Cooper, R.A., Towers, J.D., Koontz, A.M., Souza, A.L., 2003. Shoulder Magnetic Resonance Imaging Abnormalities, Wheelchair Propulsion, and Gender. *Archives of Physical Medicine and Rehabilitation*. 84, 1615–1620.

Boninger, M.L., Koontz, A.M., Sisto, S.A., Dyson-Hudson, T.A., Chang, M., Price, R., Cooper, R.A., 2005. Pushrim biomechanics and injury prevention in spinal cord injury: Recommendations based on CULP-SCI investigations. *Journal of Rehabilatation Research and Development.* 42, 9.

Boninger, M.L., Souza, A.L., Cooper, R.A., Fitzgerald, S.G., Koontz, A.M., Fay, B.T., 2002. Propulsion patterns and pushrim biomechanics in manual wheelchair propulsion. *Archives of Physical Medicine and Rehabilitation*. 83, 718–723.

Brose, S.W., Boninger, M.L., Fullerton, B., McCann, T., Collinger, J.L., Impink, B.G., Dyson-Hudson, T.A., 2008. Shoulder Ultrasound Abnormalities, Physical Examination Findings, and Pain in Manual Wheelchair Users With Spinal Cord Injury. *Archives of Physical Medicine and Rehabilitation.* 89, 2086–2093.

Chahal, J., Leiter, J., McKee, M.D., Whelan, D.B., 2010. Generalized ligamentous laxity as a predisposing factor for primary traumatic anterior shoulder dislocation. *Journal of Shoulder and Elbow Surgery.* 19, 1238–1242.

Chung, W.M., Yeung, S., Wong, A.Y.L., Lam, I.F., Tse, P.T.F., Daswani, D., Lee, R., 2012. Musculoskeletal injuries in elite able-bodied and wheelchair foil fencers-a pilot study. *Clinical Journal of Sport Medicine.* 22, 278–280.

Collinger, J.L., Boninger, M.L., Koontz, A.M., Price, R., Sisto, S.A., Tolerico, M.L., Cooper, R.A., 2008. Shoulder Biomechanics During the Push Phase of Wheelchair Propulsion: A Multisite Study of Persons With Paraplegia. *Archives of Physical Medicine and Rehabilitation*. 89, 667–676.

Cristina, G., Javier, Y., Badiola, A., Iturricastillo, A., Montse Otero, Jurgi, Ol., Bidaurrazaga-Letona, I., M.Gill, Su., 2015. Anthropometry and Performance in Wheelchair Basketball. *Journal of Strength & Condititioning Research*. 29, 1812–1820.

Curtis, Kathleen A, Black, K., 1999. Shoulder pain in female wheelchair basketball players.

Journal of Orthopedics and Sports Physical Therapy. 29, 225–231.

Curtis, K.A., George, P.T., Bs, A.D., Lunza, R.D., Kolber, M., Vitolo, R.S., 1999. Shoulder Pain in Wheelchair Users With Tetraplegia and Paraplegia. *Academy of Physical Therapy and Rehabiliatation Medicine*. 80, 453–457.

Curtis, K A, Roach, K.E., Applegate, E.B., Amar, T., Benbow, C.S., Genecc, T.D., Gualan, J., 1995. Reliability and validity of the Wheelchair User ' s Shoulder Pain Index (WUSPI). *Spinal Cord* 595–601.

Curtis, Kathleen A, Roach, K.E., Applegate, E.B., Amar, T., Benbow, C.S., Genecco, T.D., J, G., 1995. Development of the Wheelchair User ' s Shoulder Pain Index (WUSPI). *Paraplegia* 33, 290–293.

De Luigi, A.J., Cooper, R.A., 2014. Adaptive sports technology and biomechanics: Prosthetics. *PM & R* 6, S31–S39.

Desroches, G., Dumas, R., Pradon, D., Vaslin, P., Lepoutre, F.X., Chèze, L., 2010. Upper limb joint dynamics during manual wheelchair propulsion. *Clinical Biomechanics*. 25, 299–306.

Dischler, J.D., Baumer, T.G., Finkelstein, E., Siegal, D.S., Bey, M.J., 2018. Association Between Years of Competition and Shoulder Function in Collegiate Swimmers. *Sports Health* 10, 113–118.

Doukas, W.C., Speer, K.P., 2000. Anatomy, pathophysiology, and biomechanics of shoulder instability. *Operatives Techniques in Sports Medicine*. 8, 179–187.

Dumont, G.D., Russell, R.D., Robertson, W.J., 2011. Anterior shoulder instability: A review of pathoanatomy, diagnosis and treatment. *Current Review in Musculoskeletal Medicine*. 4, 200–207.

Dyson-Hudson, T.A., Kirshblum, S.C., 2004. Shoulder pain in chronic spinal cord injury, Part I: Epidemiology, etiology, and pathomechanics. *Journal of Spinal Cord Medicine*. 27, 4–17.

Eriks-Hoogland, I., De Groot, S., Snoek, G., Stucki, G., Post, M., Van Der Woude, L., 2016. Association of shoulder problems in persons with spinal cord injury at discharge from inpatient rehabilitation with activities and participation 5 years later. *Archives of Physical*

Medicine and Rehabilitation. 97, 84–91.

Eriks-Hoogland, I.E., De Groot, S., Post, M.W.M., Van Der Woude, L.H. V, 2009. Passive shoulder range of motion impairment in spinal cord injury during and one year after rehabilitation. *Journal of Rehabilitation Medicine*. 41, 438–444.

Eriks-Hoogland, I.E., Hoekstra, T., de Groot, S., Stucki, G., Post, M.W., van der Woude, L.H., 2014. Trajectories of musculoskeletal shoulder pain after spinal cord injury: Identification and predictors. *Journal of Spinal Cord Medicine*. 37, 288–298.

Ferrara, M.S., Buckley, W.E., McCann, B.C., Limbird, T.J., Powell, J.W., Robl, R., 1992. The injury experience of the competitive athlete with a disability: prevention implications. *Medicine and Science in Sports Exercise*.

Ferrero, G., Mijno, E., Actis, M. V., Zampa, A., Ratto, N., Arpaia, A., Massè, A., 2015. Risk factors for shoulder pain in patients with spinal cord injury: a multicenter study. *Musculoskeletal Surgery*. 99, 53–56.

Fincham, J.E., 2008. Response Rates and Responsiveness for Surveys , Standards , and the Journal. *American Journal of Pharmaceutical Education*. 72, 2–4.

Finley, M.A., Rodgers, M.M., 2004. Prevalence and identification of shoulder pathology in athletic and nonathletic wheelchair users with shoulder pain: A pilot study. *Journal of Rehabilitation Research & Development*. 41, 395–402.

Fitzgerald, T.N., Moss, R.L., 2012. Clinical Outcomes Evaluation and Quality Improvement, 7th ed, *Pediatric Surgery*. Elsevier Inc.

Fullerton, H.D., Borckardt, J.J., Alfano, A.P., 2003. Shoulder Pain: A Comparison of Wheelchair Athletes and Nonathletic Wheelchair Users. *Medicine and Science in Sports Exercise*. 35, 1958–1961.

Gandhi, V.., Arun, B., Kumar, R.K.., 2016. Effectiveness of myofascial release therapy with shoulder taping on subacromial impingement syndrome in collegiate basket ball players - A quasi experimental pilot study. *Bangladesh Journal Medical Science*. 15, 347–351.

Gil, S.M., Yanci, J., Otero, M., Olasagasti, J., Badiola, A., Bidaurrazaga-Letona, I., Iturricastillo,

A., Granados, C., 2015. The Functional Classification and Field Test Performance in Wheelchair Basketball Players. *Journal of Human Kinetics*. 46, 219–230.

Goosey-Tolfrey, V.L., Leicht, C.A., 2013. Field-based physiological testing of wheelchair athletes. *Sport Medicine*. 43, 77–91.

Harshbarger, N.D., Eppelheimer, B.L., Mcleod, T.C.V., Mccarty, C.W., 2013. The effectiveness of Shoulder Stretching and Joint Mobilization on posterior shoulder Tightness. *Journal of Sport Rehabilitation.* 22, 313–319.

Hattam, P., Smeatham, A., 2010. Shoulder. In: Special Tests in Musculoskeletal Examination: An Evidence-Based Guide for Clinicians. Elsevier, pp. 18–88.

Heyward, O.W., Vegter, R.J.K., De Groot, S., Van Der Woude, L.H.V., 2017. Shoulder complaints in wheelchair athletes: *A systematic review. PLoS One.*

Hill, L., Collins, M., Posthumus, M., 2015. Risk factors for shoulder pain and injury in swimmers: A critical systematic review. *Physician Sportsmedicine*. 43, 412–420.

Hootman, J.M., 2001. Association among Physical Activity Level, Cardiorespiratory Fitness, and Risk of Musculoskeletal Injury. *American Journal of Epidemiology*. 154, 251–258.

IWBF Player Classification Commision, 2014. Official Player Classification Manual of International Wheelchair Basketball Federation. 1–29.

Kolber, M.J., Hanney, W.J., 2012. The reliability and concurrent validity of shoulder mobility measurements using a digital inclinometer and goniometer: a technical report. *International Journal of Sports Physical Therapy*. 7, 306–13.

Koontz, A.M., Cooper, R.A., Boninger, M.L., 2001. An autoregressive modeling approach to analyzing wheelchair propulsion forces. *Medical Engineering & Physics*. 23, 285–291.

Lepera, C., 2010. THE PREVALENCE OF SHOULDER PAIN IN PROFESSIONAL MALE WHEELCHAIR. Univ. witswatersrand.

Magno E Silva, M.P., Winckler, C., Costa E Silva, A.A., Bilzon, J., Duarte, E., 2013. Sports injuries in Paralympic track and field athletes with visual impairment. *Medicine and Science in Sports Exercise*. 45, 908–913.

Manske, R., Wilk, K.E., Davies, G., Ellenbecker, T., Reinold, M., 2013. Glenohumeral motion deficits: friend or foe? *International Journal of Sports Physical Therapy.* 8, 537–553.

Mateus, I.S., 2015. The prevalence and profile of musculoskeletal pain in elite wheelchair basketball players of different point classifications in South Africa . By. Durban University of Technology.

McFarland, E.G., DO, J.E.B., Borade, A., Malanga, G.A., Pappoe, T., 2017. Physical Examination of the Shoulder. In: Malanga, G.A., Mautner, K. (Eds.), Musculoskeletal Physical Examination: An Evidence-Based Approach. Elsevier Inc., philadelphia, pp. 31–71.

Meeuwisse, W.H., 1994. Assessing_Causation_in_Sport_Injury__A.4.pdf. *Clinical Journal of Sport Medicine.*

Mercer, J.L., Boninger, M., Koontz, A., Ren, D., Dyson-Hudson, T., Cooper, R., 2006. Shoulder joint kinetics and pathology in manual wheelchair users. *Clinical Biomechanics*. 21, 781–789.

Mitchell, C., Adebajo, A., Hay, E., Carr, A., 2005. Shoulder pain: diagnosis and management in primary care Sources and selection criteria. *BMJ Clinical Review.* 351, 1124–1128.

Mutsuzaki, H., Tachibana, K., Shimizu, Y., Hotta, K., Fukaya, T., 2014. Factors associated with deep tissue injury in male wheelchair basketball players of a Japanese national team. *Asia-Pacific Journal of Sport Medicine, Arthroscopy, Rehabilitation and Technology* 1, 72–76.

Myers, J.B., Laudner, K.G., Pasquale, M.R., Bradley, J.P., Lephart, S.M., 2006. Glenohumeral Range of Motion Deficits and Posterior Shoulder Tightness in Throwers With Pathologic Internal Impingement. *American Journal of Sports Medicine*. 34, 385–391.

Nussbaumer, S., Leunig, M., Glatthorn, J.F., Stauffacher, S., Gerber, H., Maffiuletti, N.A., 2010. Validity and test-retest reliability of manual goniometers for measuring passive hip range of motion in femoroacetabular impingement patients. *BMC Musculoskeletal Disorder.* 11.

Nyland, J., Robinson, K., Caborn, D., Knapp, E., Brosky, T., 1997. Shoulder rotator torque and wheelchair dependence differences of National Wheelchair Basketball Association players. *Archives of Physical Medicine Rehabilitation.* 78, 358–363.

Ozmen, T., Yuktasir, B., Yildirim, N.U., Yalcin, B., Willems, M.E.T., 2014. Explosive Strength Training Improves Speed and Agility in Wheelchair Basketball Athletes. *Revista Brasilerisa Medicine Do Esporte* 20, 97–100.

Patel, R.M., Gelber, J.D., Schickendantz, M.S., 2018. The Weight-Bearing Shoulder. *Journal of the American Academy of Orthopedic Surgeons.*

Pepke, W., Brunner, M., Abel, R., Almansour, H., Gerner, H.., A.Hug, Zeifang, F., Kentar, Y., Bruckner, T., M. Akbar, 2018. Risikofaktoren für Rotatorenmanschettenrupturen bei Paraplegikern Eine Querschnittstudie. *Orthopade* 47, 561–566.

Robert, K.A., Anthony, D.G.F., Julie, N.A., Orr, L., James, T.E., 2018. Glenohumeral Internal Rotation Deficit and Risk of Upper Extremity Injury in Overhead Athletes : A Meta-Analysis and Systematic Review. *Sport Health*. 10, 125–132.

Salisbury, S.K., Choy, N.L., Nitz, J., 2003. Shoulder pain, range of motion, and functional motor skills after acute tetraplegia. *Archives of Physical Medicine & Rehabilitation*. 84, 1480–1485.

Samuelsson, K.A.M., Tropp, H., Gerdle, B., 2004. Shoulder pain and its consequences in paraplegic spinal cord-injured, wheelchair users. *Spinal Cord* 42, 41–46.

Saremi, H., Yavarikia, A., Jafari, N., 2016. Generalized Ligamentous Laxity: An Important Predisposing Factor for Shoulder Injuries in Athletes. *Iranian Red Crescent Medical Journal* In press, 6–10.

Savoie, F.H., Brien, M.J.O., 2014. Anterior Instability in the Throwing Shoulder. *Sport Medicine Arthroscopy Revision.* 22, 117–119.

Sein, M.L., Walton, J., Linklater, J., Appleyard, R., Kirkbride, B., Kuah, D., Murrell, G.A.C., 2010. Shoulder pain in elite swimmers: Primarily due to swim-volume-induced supraspinatus tendinopathy. *British Journal of Sports Medicine* 44, 105–113.

Sergio, M.I., Sabina, M.C., 1997. Dictionary of Medical Syndromes, Fouth Edition edition Linppincott-Raven.

Strandring, S., 2016. Shoulder girdle and arm. In: Standring, S. (Ed.), Grays Anatomy. Elsevier

Ltd., pp. 797–836.

Taimela, S., Kujala, U.M., Osterman, K., 1990. Intrinsic risk factor and athletic injuries. *Sport Medicine*. 9, 205–215.

Tsunoda, K., Mutsuzaki, H., Hotta, K., Tachibana, K., Shimizu, Y., Fukaya, T., Ikeda, E., Wadano, Y., 2016. Correlates of shoulder pain in wheelchair basketball players from the Japanese national team: A cross-sectional study. *Journal of Back & Musculoskeletal Rehabilitation*. 29, 795–800.

Tzannes, A., Murrell, G. a C., 2002. Clinical examination of the unstable shoulder. *Sports Medicine.* 32, 447–457.

Tzannes, A., Paxinos, A., Callanan, M., Murrell, G.A.C., 2004. An assessment of the interexaminer reliability of tests for shoulder instability. *Journal of Shoulder & Elbow Surgery.* 13, 18–23.

Valier, A.R., Averett, R.S., Anderson, B.E., Bacon, C.E.W., 2014. The Impact of Adding an Eccentric-Exercise Component to the Rehabilitation Program of Patients with Shoulder Impingement: A Critically Appraised Topic. *Journal of Sport Rehabilitation.* 25, 195–201.

van de Pol, R.J., van Trijffel, E., Lucas, C., 2010. Inter-rater reliability for measurement of passive physiological range of motion of upper extremity joints is better if instruments are used: A systematic review. *Journal of Physiotherapy*. 56, 7–17.

van Drongelen, S., de Groot, S., Veeger, H.E.J., Angenot, E.L.D., Dallmeijer, A.J., Post, M.W.M., van der Woude, L.H. V, 2006. Upper extremity musculoskeletal pain during and after rehabilitation in wheelchair-using persons with a spinal cord injury. *Spinal Cord* 44, 152–159.

Van Drongelen, S., Van Der Woude, L.H.V., Veeger, H.E.J., 2011. Load on the shoulder complex during wheelchair propulsion and weight relief lifting. *Clinical Biomechanics.* 26, 452–457.

W, P., M, B., Abel, R., H, Al., H.J, G., A, H., F, Z., Y, K., T, B., M, A., 2018. Risk factors for rotator cuff ruptures in paraplegics _ SpringerLink.

Wang, Y.T., Chen, S., Limroongreungrat, W., Change, L.S., 2005. Contributions of selected fundamental factors to wheelchair basketball performance. *Medicine and Science in Sports Exercise.* 37, 130–137.

Wilk, K.E., MacRina, L.C., Fleisig, G.S., Porterfield, R., Simpson, C.D., Harker, P., Paparesta, N., Andrews, J.R., 2011. Correlation of glenohumeral internal rotation deficit and total rotational motion to shoulder injuries in professional baseball pitchers. *American Journal of Sports Medicine*. 39, 329–335.

Williams, J., 1971. Aetiological calssification of injuries in sportsmen. *British Journal of Sport Medicine.* 5, 228–230.

Willick, S.E., Webborn, N., Emery, C., Blauwet, C.A., Pit-Grosheide, P., Stomphorst, J., Van De Vliet, P., Marques, N.A.P., Martinez-Ferrer, J.O., Jordaan, E., Derman, W., Schwellnus, M., 2013. The epidemiology of injuries at the London 2012 Paralympic Games. *British Journal of Sports Medicine*. 47, 426–432.

Wilroy, J., Hibberd, E., 2017. Evaluation of a Shoulder Injury Prevention Program in Wheelchair Basketball. *Journal of Sport Rehabilitation*. 1–21.

Yildirim, N.U., Comert, E., Ozengin, N., 2010. Shoulder pain: A comparison of wheelchair basketball players with trunk control and without trunk control. *Journal of Back Musculoskeletal Rehabilitation.* 23, 55–61.

Zaremski, J.., Wasser, J.., Vincent, H.., 2017. Mechanisms and treatments for shoulder injuries in overhead throwing athletes. *Current Sports Medicine Report*. 16, 179–188.

Appendix A **Ethical clearance**

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Miss Oluwayemisi Christiana Oyewole

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M180703

NAME: (Principal Investigator)	Miss Oluwayemisi Christiana Oyewole
DEPARTMENT:	Physiotherapy Mandeville Sport Club
PROJECT TITLE:	Shoulder Pain and its risk factors among wheelchair basketball players in Johannesburg
DATE CONSIDERED:	27/07/2018
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Siyabonga Kunene
APPROVED BY:	Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	25/09/2018

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in **July** and will therefore be due in the month of **July** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix B **Wheelchair shoulder pain index questionnaire**

WHEELCHAIR USER'S SHOULDER PAIN INDEX (WUSPI)

The questionnaire used for this study has been removed in order not to breach the authors agreement. If you need to view the questionnaire kindly contact the author on the email address below;

Kathleen Curtis <kacurtis@utep.edu>

Appendix C **Extrinsic risk factor questionnaire**

EXTRINSIC RISK FACTORS FOR SHOULDER PAIN AMONG WHEELCHAIR BASKETBALL PLAYERS

Read carefully the following questions and fill in the gap where required and tick (✓) for the appropriate answer

Participants Information

1. How many years have you had your medical condition (Spinal cord injury, amputation, cerebral palsy, polio and others)? _____ years
2. What other supportive devices are you dependent on? Tick (✓) all that applies

A	Wheel chair	
B	Crutches	
C	Prosthetic	
D	Cane/walking stick	
E	Others	

Sport History

3. At what level do you play wheelchair basketball? Tick (✓) all that applies

a	Club	
b	National	
c	International	
d	Others	

4. What is your playing position in the team?

a	Shooting guard	
b	Point guard	
c	Center	
d	Power guard	
e	Forward guard	

5. What is your point classification in the wheelchair basketball?

A	**b**	**C**	**d**	**e**	**f**	**G**	**H**
1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5

6. How long have you been playing wheelchair basketball? _____ years

Training History

7. How many days do you train for basketball per week? _____ days
8. How many hours do you spend training for basketball per training session? _____hours
9. Do you engage in the following injury prevention activities?

A	Warm-ups	
B	Cool down	
C	Others	
D	None of the above	

10. What kind of warm-up activities do you engaged in and for how many minutes?

Tick all that applies.

	✓	**Minutes:**
a. Stretches		**Minutes:**
b. Circular pass		**Minutes:**
c. Sprints with or without cones		**Minutes:**
d. Ball pickup		**Minutes:**
e. Others		**Minutes:**

11. What kind of cool-down do you engage in and for how many minutes?

Tick all that applies:

a	Stretches		**Minutes:**
b	Deep breathing		**Minutes:**
c	Aerobic such as shoulder circle, arm swings		**Minutes:**

Appendix D **Assessment sheet**

Code Number: Dominant upper limb:

SHOULDER JOINT RANGE OF MOTION

		Passive left			**Passive right**		
V	**Internal Rotation**						
VI	**External rotation**						

Glenohumeral joint instability

	Right	**Left**
Apprehension test		
Relocation test		
Sulcus sign		
Load and shift test		

Appendix E Procedure for Assessment

PROCEDURES FOR ASSESSMENT

All examinations are standard procedure for assessment in clinical practice and will be carried out by a qualified physiotherapist.

Shoulder internal rotation: The participant will be in supine position. The shoulder will be at 90^0 abduction and 90^0 elbow flexion. The goniometer will be placed on the on the olecranon process, the stationary arm is perpendicular to the floor and the moving arm is perpendicular to the forearm. The forearm is actively moved downwards and measured before passively moved.

Shoulder external rotation: The participant will be in supine position. The shoulder will be at 90^0 abduction and 90^0 elbow flexion. The goniometer will be placed on the on the olecranon process, the stationary arm is perpendicular to the floor and the moving arm is perpendicular to the forearm. The forearm is actively moved upwards and measurements are recorded.

Apprehension test: The arm will be abducted at 90^0 and the shoulder will be gently externally rotated as far as the participant will allow. Test is positive when the participant shows apprehension or guarding. This indicates glenohumeral instability or joint pain.

Jobe relocation test: The arm will be abducted to 90^0 and then gently externally rotate until the participants becomes apprehensive that the shoulder might subluxate. The examiner then places a hand on the humeral head, stabilizing the proximal humerus. A positive test result is when the apprehension is relieved by a stabilizing force.

Sulcus sign: The test is performed with the patient sitting. The examiner pulls inferiorly on the arms and observes how much the humeral head moves inferiorly. The test is positive for instability if the head slides out of the socket, and the patient reports that this reproduces their symptoms.

Load and shift test: Load and shift test: The test will be performed by the examiner stabilizing the scapula with one hand while the other hand translates proximal humerus from front back. The test is to determine shoulder laxity. It can be graded into three, grade 1 is when the shoulder does subluxate over the rim, grade 2- shoulder subluxation over the rim, grade 3- subluxate and stay out of the glenoid.

Appendix F **Information sheet**

STUDY TITLE: SHOULDER PAIN AND ITS RISK FACTORS AMONG WHEELCHAIR BASKETBALL PLAYERS IN JOHANNESBURG

Dear Basketballer,

I, Oluwayemisi Oyewole, am a Master student at the department of Physiotherapy, University of Witwatersrand. I am doing research on shoulder pain among wheelchair basketball players. Studies have shown there is a high prevalence of shoulder pain among wheelchair basketball players. The overall aim of the study is to identify the prevalence and risk factors of shoulder pain.

Invitation to Participate

I am inviting you to take part in the research study.

What is involved in the study?

Participants will be required to complete a self-administered questionnaire with questions with regards to their sociodemographic, medical history, and professional history. It will take about 5minutes to complete the questionnaire.

Participants will undergo a musculoskeletal assessment of both upper limbs. He/she will be asked to perform certain movements and measurements will be taken. It will take approximately 15minutes to complete the assessments.

Are there any risk involved in this study?

There is no risk involved with taking part in the study. If the procedure becomes traumatic arrangement will be made for free professional counselling or alternate treatment.

Benefits of the study

There are no direct benefits to taking part in this study, the longer time objective is the possibility of development of exercise program. Participants will be given pertinent information on the study while involved and after the results are available.

Your participation is completely voluntary, refusal to participate will involve no penalty or loss of benefits. Participants can also discontinue participation at any time without any penalty or loss of benefits.

Reimbursement for out of pocket expenses: there will be no payment or cost associated with participation.

Confidentiality: Normally personal information will be treated in the strictest confidence and will only be available to the principal investigator and my Supervisors. The only exception and all of them are rare- would normally be:

1. Personal information may be disclosed if required by law
2. The human research ethics committees of the university may exceptionally require personal data to respond to a formal complaint, or for a compliance audit.

If results are published, this may, exceptionally, lead to cohort, or more rarely, individual identification. All data collected in the course of the study will be securely retained for two (2) years, if a scientific publication arises from the study and six (6) years, if there is no publication. Thereafter it will be destroyed accordingly. During this period data will be stored safely in a storage which will be accessible to only the researcher.

Anonymity can usually only be guaranteed in questionnaire, whether in hard copy or online

Outputs participants will be provided with the findings of the study after the study is completed

For further information on the study, report adverse event, you can contact researcher.

Ms. Oluwayemisi Oyewole

0785270765

Email: yemisioyewole.y@gmail.com

Supervisor

Mr. Siyabonga Kunene

0117173707

Siyabonga.kunene@wits.ac.za

Contact details of HREC administrator and chair – for reporting of complaints/ problems

HREC (Medical) Secretary:

011 717 2700/1234

Zanele.Ndlovu@wits.ac.za and Rhulani.Mukansi@wits.ac.za

HREC (Medical) Chairperson

Professor CB Penny

0117172301

Clement.penny@wits.ac.za

Appendix G **Inform consent**

Study title: Shoulder pain and its risk factor among wheelchair basketball players in Johannesburg.

I _____ hereby agree to participate in the study as described in the information sheet. I also confirm that I understand the nature of the research project and I consent to participating in this study.

I am aware that I won't be exposed to any risk and I can withdrawal from the research at any time I so desire. I understand that participation is voluntary.

Signature of basketballer: _____

Date: _____

Appendix H **Permission letter from wheelchair basketball south Africa**

WBSA
WHEELCHAIR BASKETBALL SOUTH AFRICA
Reg: 2004/012463/08

Mandeville Indoor Sports Centre
Cnr. 10th Street & 7th Avenue
Bezuidenhout Valley, 2094
PO Box 59193, Kengray, 2100
Tel: 27 11 601 5300
Fax: 27 11 616 9236
Email: wbsa@basketball.co.za

15 June 2018

University of Witswaterand
Ethics Review Committee

To whom it may concern

RE: Oluwayemisi Christiana Oyewole – Student No 1925907

This letter is confirmation that Ms OC Oyewole, Passport No A07689217, has been granted permission to carry out research in Shoulder Pain and its Risk Factors among Wheelchair Basketball players within Wheelchair Basketball SA.

We have been informed by Ms Oyewole that to determine finding and prevalence of risk factors would take approximately 2 months of research.

This would also truly assist Wheelchair Basketball SA in its High-Performance Programs in determining preventative training techniques in assisting athletes with regards shoulder injury.

Should there be any further requirements, please address the undersigned. Thank you

Regards,

Charles Saunders
CEO

Appendix I Permission to use wheelchair user's shoulder pain index

Permission for WUSPI

Curtis, Kathleen A <kacurtis@utep.edu> 1 March 2018 at 21:08

To: Oluwayemisi Oyewole <1925907@students.wits.ac.za>

Dear Yemesi:

RE: WHEELCHAIR USER'S SHOULDER PAIN INDEX

(WUSPI)

Thank you for your interest in the WUSPI, the Wheelchair User's Shoulder Pain Index.

Enclosed is a copy of the instrument, recommended demographics and scoring instructions. Please read below and understand that your use of the instrument requires that you follow these guidelines, intended to insure consistency in administration and that the instrument retains all of its original properties of reliability and validity:

1. Please note that the material contained herein is subject to U.S. Copyright Law. The authors (Curtis KA, Roach KE, Applegate EB, Amar T, Benbow C, Genecco TD, Gualano J) retain all rights associated with their respective copyrighted material.

2. Please do not alter the instrument in any way. Each item should include a 10 cm line.
This 10 cm visual analog scale cannot be replaced by an ordinal scale or by a verbal questionnaire, administered in person or over the phone. Any publication of this

scale (in print or electronic formats) is prohibited without the consent of the authors.

,Äã3. Please do not attempt to translate the WUSPI into other languages or provide verbal explanations in other languages. There are specific protocols for translation and retesting the translated instrument. I will be happy to provide these references for you and/or provide approved versions of the instrument as currently available in other languages.,Äã

4. Please do not post the scale on a website, publish or distribute without the author's permission. Please refer all inquiries to me at this address: Kathleen Curtis <kacurtis@utep.edu>

5. You may find the following references helpful:

Curtis KA, Roach KE, Applegate EB, Amar T, Benbow C, Genecco TD, Gualano J: Development of the wheelchair user's shoulder pain index (WUSPI). Paraplegia. 33:290-293, 1995.

Curtis KA, Roach KE, Applegate EB, Amar T, Benbow C, Genecco TD, Gualano J: Reliability and validity of the wheelchair user's shoulder pain index (WUSPI). Paraplegia. 33:595-601, 1995

Curtis KA, Drysdale G. West R., Vitolo R, Kolber M, Lanza D: Comparison of the prevalence and intensity of shoulder pain in individuals with tetraplegia and paraplegia. Arch Phys Med Rehabil. 1999 Apr;80(4):453-7

Curtis KA, Black K. Shoulder pain in female wheelchair basketball players. Journal of Orthopedic and Sports Physical Therapy- JOSPT. 1999 Apr;29(4):225-31.

Curtis KA, Tyner TM, Zachary L, Lentell G, Brink D, Didyk T, Hall J, Hooper M, Klos J, Lesina S, Pacillas B. Effect of a standard exercise protocol on shoulder pain in long-term wheelchair users Spinal Cord. 1999 37:421-429.

6. I would appreciate a copy of the results of any study you do with the WUSPI so that I can keep an ongoing log of instrument use. Please send this information to me at the contact address below.

If you have any questions, please don't hesitate to contact me.

Best wishes with your work. Let me know if you have any problems with the attachments.

Sincerely,

Kathleen A. Curtis, PT, Ph.D.
Dean Emerita and Professor Emerita of Health Sciences
The University of Texas at El Paso
College of Health Sciences
Email: kacurtis@utep.edu

From: Oluwayemisi Oyewole <1925907@students.wits.ac.za>
Sent: Tuesday, February 27, 2018 2:27 AM
To: Curtis, Kathleen A
Subject: Permission for WUSPI

[Quoted text hidden]

3 attachments

WUSPI_Pain_Index.pdf
68K

SCORING INSTRUCTIONS.docx
16K

Demographics.doc
30K