EFFECT OF 8-WEEK KETTLE-BELL WINDMILL CALISTHENICS ON MUSCULOSKELETAL DISORDER AMONG SECONDARY SCHOOL TEACHERS IN KANO METROPOLIS

BY

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DECLARATION

The researcher is hereby declare that this work is the product of his own effort, undertaken under the supervision of Dr. M. J. Yakasai. The researcher also declares that to the best of his knowledge, this research work has not been presented and will not be presented elsewhere for the award of degree or certificate. All the sources of information herein have been duly acknowledged.

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CERTIFICATION

This is to certify that the research work for this dissertation and the subsequent preparation of this dissertation by Hajarat Sadiq Abdullahi (SPS/10/MHE/00002) was carried out under my supervision.

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Dr. A. I. Darki (Head of Department)	Date

APPROVAL PAGE

This research work has been examined and approved as meeting the requirements for the award of Master of Science degree (M.Sc., PHE) in Physical and Health Education (Exercise and Sports Science).

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DEDICATION

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ABSTRACT

This study investigated the effect of 8-week Kettle-bell windmill calisthenics exercise on musculoskeletal disorder (MSD) among secondary school teachers in Kano Metropolis. A total of fifty four teachers within the age range of 30-60 years old recruited from the population of teachers with shoulders pain using judgmental sampling technique participated in the study. The subjects were randomly assigned to two groups; the experimental group received windmill calisthenics exercise for eight weeks, three times alternatively in each week, while the second group is the control group. Subjects were given a visual analogue scale on shoulder pain to fill before the commencement of the exercise and at the end of the eight weeks. The data obtained was analyzed using ANCOVA. The findings of this study indicated that there was significant increases in shoulder range of motion of teachers with shoulder musculoskeletal disorder. The research also concluded that training increase the muscular strength of the trunk extensors but did not significantly improve aerobic fitness or strength of the shoulders and trunk flexors. ($p<0.05$). It was therefore concluded that Kettle-bell windmill calisthenics exercise is more effective in the management of MSD. It is recommended that Kettle-bell windmill calisthenics exercise should be used more in the management of MSD.

CHAPTER ONE

INTRODUCTION

1.0 Background of the Study

Musculoskeletal disorders (MSD) represent one of the most common and most expensive occupational health problems in both developed and developing countries. School teachers represent an occupational group among which there appears to be a high prevalence of MSD. Musculoskeletal disorders (MSD) decreases productivity at work due to sick leave, causes absenteeism and early retirement and are also high cost in terms of treatment on individual (Cardoso, Araujo & Carvalho, 2009). In many occupations, musculoskeletal disorders (MSD) include a wide range of inflammatory and degenerative conditions such as nerve, bones and joints, and can occur from a single or cumulative trauma (Allsop & Auckland, 2010).

The work tasks of school teachers often involve significant use of a "head down" posture, such as frequent reading, marking of assignment, and writing on blackboard (Chiu & Lam, 2007). School teachers have been found to have elevated prevalence of neck, shoulder, arm and low back disorders leading to lowering the functional capacity of the affected area (Grant, Habes & Tepper, 2009). and lower extremity MSD, due to activities which require sustained periods of kneeling, stopping, or bending (Grant, Habes &Tepper, 2009).

Jeff, Angelotti and Nathan (2011) defined flexibility as the ability or capacity of a joint to move through a full range of motion. It is one of the health related components of physical fitness, as a range of movement; flexibility allows technical development and assists in the prevention of injuries. Joint stability is closely related to the muscular strength in the sense that there is an imbalance over the other injury. Therefore increase in joint flexibility without muscular strength will result in joint instability, and an increase in muscular strength without joint flexibility will result in softy tissue tears, sprains or strains and postural changes.

Kettlebell is a designed heavy piece of iron in kettle shape which ranges between 4-20Kg and usually has a thicker grip than most other workout equipment. This makes it hard to just hold onto it. Kettlebell is asymmetric, it will flip and twist and has its point of gravity outside hand and it is quite different from dumbbell. Tension is needed to easily and safely be able to work with Kettlebells. Kettlebell workouts are used to improve body flexibility, build muscle strength and endurance (Liebenson, 2011).

Flexibility is extremely important for physical fitness. Poor flexibility decreases body's ability to maintain proper posture, limits proper joint motion increasing the risk for low-back pain, joint pain, and injury during everyday activities (http://www.sharecare.com/question/flexibility-important-component-physical-fitness.).

However, flexibility can correct muscle Imbalances and improve extensibility of soft tissue which increase joint range of motion. Conversely, having adequate flexibility and mobility will help reduce joint stress decreasing general aches and pains, in addition to improving overall quality of movement (http://www.sharecare.com/question/flexibility-important-component-physical-fitness).

The shoulder is the most mobile and flexible joint in the human body. Biomechanical studies have revealed the essential requirements as the shoulder must be mobile especially in external rotation and we all depend upon our shoulder for a very important reason – the shoulder joint is what allows us to control where we can move our arms in order to use them. Shoulder pain can be one of the most frustrating problems for patients because a shoulder that is not working normally interferes with almost every part of daily life. There is a very fine balance between mobility and stability in the shoulder that allows us to have freedom of movement throughout our entire lives, with a minimal amount of pain and problems (shaecare.com).

School teachers an occupational group among which there appears to be a high prevalence of neck and or shoulder pain (NSP). The prevalence of neck/shoulder pain was reported among

chimes teachers was about 78.7%. Neck shoulder pain is very common in Africa and even in Nigeria affecting about 80-90% of teachers especially at the western region (Eric & Smith, 2010).

Stuart (2012) stated that school teachers are often involved in tasks which mean they spend a significant amount of time in a 'head down' posture such as reading, marking of assignments, and writing on a blackboard. Therefore school teachers are more likely to suffer from a wider variety of problems including pain in the back, neck and shoulder. The shoulder complex in particular has been alluded to as one of the most prevalent regions of injury and it was reviewed that up to 36% of documented related injuries and disorders occur at the shoulder complex among teachers with less than 20 years of experience (Chong & Chan, 2010). More so, Trends that increased the likelihood of injury among teachers were identified and inclusive of intrinsic risk factors such as joint and muscle imbalances and extrinsic risk factors, such as improper attention to exercise technique.

Erick and Smith (2011) articulated that the prevalence of self reported musculoskeletal disorders among school teacher ranges between 39% - 95%. The most prevalent body sites appear to be the back neck and shoulder. Factors such as gender, age, length of employment and awkward posture have been associated with higher prevalence rate of shoulder pain among teacher. Erick and Smith (2011) further concluded that teachers are at risk for developing musculoskeletal disorders. The prevalence among them is not uniform. Primary and secondary school teachers appears to be more prone to neck, shoulder and back pain. Even though, the rates may be different. Prevention of musculoskeletal disorders in the education sector should not be neglected.

Teachers perform many kinds of tasks such as repetitive mechanical load in holding or lifting implements, has been suspected to be one of main risk factors of shoulder pain problems among teachers. High prevalence of upper limb pain among female secondary school

teachers especially among those > 40 years of age is revealed to be about 38% (Huang, Hisanaga & Takeachi, 1991). More so, school teachers represent an occupational group among which there appears to be a high prevalence of neck and or shoulder pain (NSP). The prevalence of NSP was associated with prolonged standing, sitting and static posture and uncomfortable back support. It is against this background that the researcher investigated the effect of eight weeks Kettle-bell wind mill calisthenics on musculoskeletal disorder among secondary school teachers in Kano metropolis.

1.1 Statement of the Problem

Teaching profession, like other professions, involves a lot of activities that normally result in musculoskeletal disorder among teachers and this results in reduction of teachers' productivity.

In Nigeria today teachers at all levels of education are faced with the problems of large class and inappropriate and inadequate teaching facilities. These expose teachers to so many hazards such as physical, physiological and social hazards. Teachers in Nigeria spend longer hours than necessary in preparation and conduct of lessons. Large class result in long sitting as in preparation of lessons, long hours of marking exams and assignment and no enough facilities to ease the work of teachers. All these are among the factors that are responsible for the prevalence of neck shoulder problems among teachers.

Most of school teachers have been with high prevalence of muscular skeletal disorders. Also, teaching stress affects teaching performance (Stuart, 2012).

In Kano metropolis, it is observed by the researcher that schools are highly populated with students in which a class can be found with about 100 and above students. Some classes are without proper sitting arrangement for the students and the teachers. These predispose the teachers to all factors that can lead to MSD of all kinds and also un-conducive environment.

Therefore this research investigated the effects of eight weeks Kettle-bell wind mill calisthenics musculoskeletal disorders among secondary school teachers in Kano metropolis. Kettle-bell routine is used to develop functional flexibility in shoulder. It is far more effective than static stretching because dynamic flexibility exercises prepare body for real life. Muscles need to be able to both lengthen and contract. Static stretching only trains the lengthening portion. Also, dynamic movements actively engage nervous system, the "software" that controls muscle tension. Working with the nervous systems is the fastest way to make changes to muscle tone throughout the body (Rathbun, 2009). Based on the aforementioned statement, the following research questions were developed

i. Will eight weeks Kettle-bell wind mill calisthenics exercise reduce shoulder pain among the experimental group?
ii. Will eight weeks Kettle-bell wind mill calisthenics exercise improve shoulder range of motion among experimental group?

1.2 Hypotheses

The following hypotheses were formulated to guide the conduct of the study.

Major Hypotheses.

There is no significant effect of 8-week Kettle-bell wind mill calisthenics exercise on shoulder musculoskeletal disorder among secondary school teachers in Kano Metropolis.

Sub-Hypotheses

i. There is no significant effect of eight weeks Kettle-bell wind mill calisthenics exercise on shoulder pain among secondary school teachers in Kano metropolis.
ii. There is no significant effect of eight weeks Kettle-bell wind mill calisthenics exercise on shoulder range of motion among secondary school teachers in Kano metropolis.

1.3 Purpose of the Study

The purpose of this study was be to investigate the effects of 8-week Kettle-bell wind mill calisthenics exercise on musculoskeletal disorders (MSD) of secondary school teachers in Kano Metropolis, with the view of encouraging to engage in exercise that relieved musculoskeletal disorders MSD.

1.4 Significance of the Study

1. It is expected that the result of this study will help teachers to understand simple strengthening exercise that will help their shoulder range of motion.

2. It will also help in solving shoulder flexibility problems among teachers and other people who may complain of shoulder MSD.

3. The findings of this study will add to the existing literature in MSD.

1.5 Delimitation of the Study

This study was delimited to shoulder pain and shoulder range of motion among secondary school teachers in Kano metropolis with related shoulder MSD. This study has been delimited to the effect of 8-week kettle-bell wind mill calisthenics on musculoskeletal disorder of secondary school teachers in Kano metropolis. The research delimited to 3 oldest schools in Kano metropolis. The study was also delimited to teachers in each school. Finally the scope of this study has been limited to secondary school teachers with musculoskeletal disorder in Kano metropolis.

1.6 Operational Definition of Terms

Kettle-bell: cast iron weights, ranging from 5 lbs to over 100 lbs, shaped like a ball with a handle for easy gripping. It build muscle, strength and improve body flexibility

Musculoskeletal Disorders (MSD): are injuries or pain in the body's joints, ligaments, muscles, nerves, tendons.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 Introduction

This research investigated the effect of eight weeks Kettle-bell windmill calisthenics on musculoskeletal among secondary school teachers in Kano Metropolis. This chapter present review of related literature under the following headings:

- Overview Kettle-bell exercises
- Anatomy of the shoulder
- Prevalence of muscular skeletal disorder among teachers
- Musculoskeletal disorder of shoulder
- Overview of flexibility
- Exercise therapy for rehabilitation of musculoskeletal disorder
- Summary and uniqueness of the study

2.1 History of kettle-bell

The kettlebell, cannonbell or girya (Russian: ги́ря) is a cast-iron or steel weight (resembling a cannonball with a handle) used to perform ballistic exercises that combine cardiovascular, strength and flexibility training . They are also the primary equipment used in the weight lifting sport of girevoy sport. Russian kettlebells are traditionally measured in weight by pound, which (rounded to metric units) is defined as 16 kilograms (35 lb) (Helms, 2012).

Kettlebells were developed in Russia in the 1700s, primarily for weighing crops. It is said that these farmers became stronger and found them useful for showing off their strength during festivals. The Soviet army used them as part of their physical training and conditioning programs in the 20th century. They had been used for competition, training and sports throughout Russia and Europe since the 1940s. Though kettlebells had been in the United States in some form since the 1960s or earlier, Dragon Door Publications and Pavel

Tsatsouline developed the first instructor certification program in the USA in 2001 (Helms, 2012).

Unlike traditional dumbbells, the kettlebell's center of mass is extended beyond the hand, similar to Indian clubs or ishi sashi. This facilitates ballistic and swinging movements. Variants of the kettlebell include bags filled with sand, water, or steel shot (Reed, 2009). The kettlebell allows for swing movements and release moves with added safety and added grip, wrist, arm and core strengthening. The unique shape of the kettlebell provides the "unstable force" for handling - key for the effectiveness of the kettlebell exercises (Ivill, 2008).

By their nature, typical kettlebell exercises build strength and endurance, particularly in the lower back, legs, and shoulders, and increase grip strength (Liebenson, 2011). The basic movements, such as the swing, snatch, and the clean and jerk, engage the entire body at once (Rathbun, 2009), and in a way that mimics real world activities such as shoveling or farm work (Liebenson and Shaughness , 2011). Unlike the exercises with dumbbells or barbells, kettlebell exercises often involve large numbers of repetitions. Kettlebell exercises are in their nature holistic; therefore they work several muscles simultaneously and may be repeated continuously for several minutes or with short breaks. This combination makes the exercise partially aerobic and more similar to high-intensity interval training rather than to traditional weight lifting. In one study, kettlebell enthusiasts performing a 20 minute snatch workout were measured to burn, on average, 13.6 calories/minute aerobically and 6.6 calories/minute anaerobically during the entire workout - "equivalent to running a 6-minute mile pace" ((Rathbun, 2009). Because of their high repetitions, kettlebell progression should start out slowly to build muscle endurance, support the joints and prevent injury.

The movements used in kettlebell exercise can be dangerous to those who have back or shoulder problems, or a weak core. However, if done properly they can also be very

beneficial to health. They offer improved mobility, range of motion and increased strength (Wallack, 2010).

The following movements can be done with one or two kettlebells:

- Swing: The kettlebell swing is a basic kettlebell exercise that is used in training programs and gyms for improving the posterior chain muscles. The key to a good kettlebell swing is effectively hinging at the hips, creating stability through the frontal plane. Variations of kettlebell swings include Russian swings (kettlebell goes to chest level), American swings (kettlebell goes to overhead), and one-armed swings (Wallack, 2010).
- Clean
- Goblet Squat
- Front-Side Squat
- Military Press
- Push Press
- Snatch
- Jerk
- Dead Lift: Suitcase, one-leg
- Carry: Suitcase, rack, overhead
- Row
- Russian Twists

The following movements can be done with a single kettlebell:

- Halo
- Deck Squat
- Windmill
- Bent Press

Turkish Get-up (single bell only): A kettlebell exercise that combines the lunge, bridge and side plank to build strength. With a vertically-extended arm, the athlete transitions from laying supine on the floor to standing (Rathbun, 2009).

2.2 Anatomy and physiology of shoulder

The shoulder is a ball-and-socket joint and has the greatest range of motion of any joint in the body. Because of this mobility, it is at risk for injury or degenerative problems. The shoulder joint is composed of three bones: the clavicle (collarbone), the scapula (shoulder blade), and the humerus (upper arm bone). Two joints facilitate shoulder movement. The acromioclavicular (AC) joint is located between the acromion (part of the scapula that forms the highest point of the shoulder) and the clavicle (Mackenzie, 2007). The glen humeral joint, commonly called the shoulder joint, is a ball-and-socket type joint that helps move the shoulder forward and backward and allows the arm to rotate in a circular fashion or hinge out and up away from the body. (The ball is the top, rounded portion of the upper arm bone or humerus; the socket," or glenoid, is a dish-shaped part of the outer edge of the scapula into which the ball fits.) The capsule is a soft tissue envelope that encircles the glen humeral joint. It is lined by a thin, smooth synovial membrane. The bones of the shoulder are held in place by muscles, tendons, and ligaments. Tendons are tough cords of tissue that attach the shoulder muscles to bone and assist the muscles in moving the shoulder. Ligaments attach shoulder bones to each other, providing stability. For example, the front of the joint capsule is anchored by three glen humeral ligaments (Jonathan, 2010).

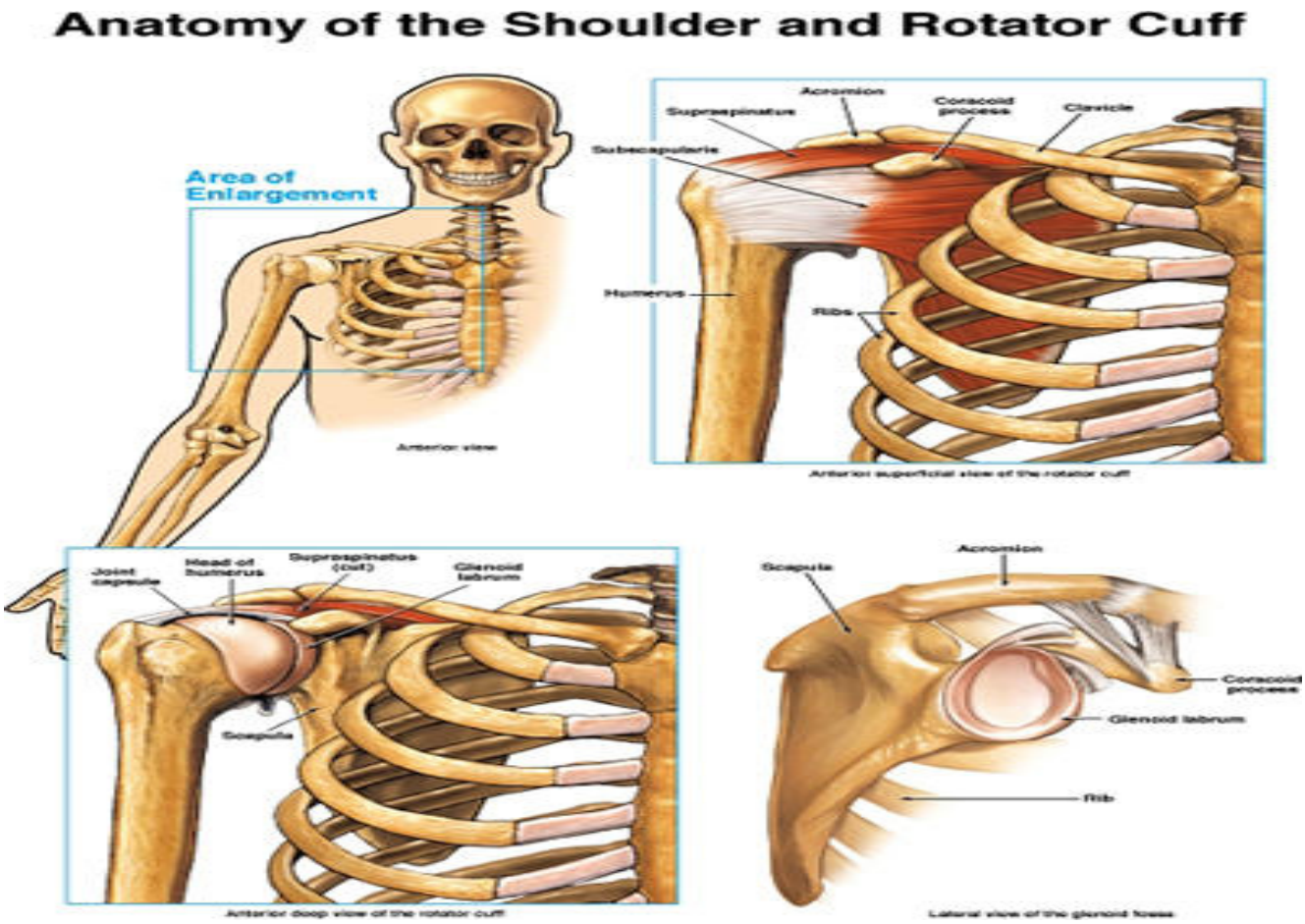
The rotator cuff is a group of four muscles and tendons that surround the glen humeral joint. It is a structure composed of tendons that, with associated muscles, holds the ball at the top of the humerus in the glenoid socket and provides mobility and strength to the shoulder joint. Two filmy sac-like structures called bursa permit smooth gliding between bone, muscle, and tendon. They cushion and protect the rotator cuff from the bony arch of the acromion

(Jonathan, 2010). The so-called rotator cuff is the conjoined tendons of the supraspinous, infraspinous, and teres minor muscles that attach to the greater tuberosity of the humeral head. In the static dependent arm, the supraspinous muscle sustains the head of the humerus in the glenoid fossa by isometric contraction. The tonus of the muscle (ie, the isometric contraction) is determined by the spindle system and the Golgi apparatus as to force (Cailliet, 1991).

The shoulder is the most movable joint in the body. However, it is an unstable joint because of the range of motion allowed. It is easily subject to injury because the ball of the upper arm is larger than the shoulder socket that holds it. To remain stable, the shoulder must be anchored by its muscles, tendons, and ligaments. Some shoulder problems arise from the disruption of these soft tissues as a result of injury or from overuse or underuse of the shoulder. Other problems arise from a degenerative process in which tissues break down and no longer function well.

Shoulder pain may be localized or may be referred to areas around the shoulder or down the arm. Disease within the body (such as gallbladder, liver, or heart disease, or disease of the cervical spine of the neck) also may generate pain that travels along nerves to the shoulder (Porter, 2009).

The shoulder is the most moveable and unstable joint in the body. The "ball" in the upper arm is actually larger than the socket that holds it, and with the range of motion being so great, it is susceptible to injury. To remain stable, it must be kept in place by muscles, ligaments, and



tendons. Therefore, it is very important to make sure these soft tissues are strengthened to keep the shoulder strong, flexible, more coordinated, and conditioned to handle stress (Joe, 2012) . Important small muscles that surround the shoulder joint are called the rotator cuff muscles.

They are the key muscles that keep the joint functioning properly. Weakness in any of the four muscles can cause instability, which can lead to numerous injuries. Exercises that strengthen the shoulder and the rotator cuff muscles can be done at home, work or the gym. Below are some examples for a well-rounded shoulder workout (Porter, 2009).

Internal shoulder rotation exercises

- Shoulder press w/ Swiss ball and dumbbells
- Dumbbell shoulder press
- Push-ups

External shoulder rotation exercises

- Reverse flyes w/ Swiss ball and dumbbells
- Rear delt raises w/ resistance band
- Dumbbell lateral deltoid raise.

Values of flexible shoulders:

The shoulders are very important, and often neglected, parts of the body. shoulders helps with everyday tasks, they help you reach for objects, lift objects and they also help perform exercises. Flexible shoulders are very important as they will help increase overall body strength and also decrease the amount of load that bones, ligaments and joints have to bear. Shoulder flexibility is a crucial part of body and most exercise regimes have a set of isolated stretches targeting the shoulders in particular (http://www.healthstatus.com/health_blog). Stretching exercises maintain good shoulder flexibility and reduce the risk of rotator cuff and other shoulder injuries to baseball pitchers and other throwing athletes (football quarterbacks, javelin throwers). Without a stretching program, athletes tend to develop muscle imbalances over the course of a season. Some muscles become too tight, others too weak. Stronger muscles end up overpowering good mechanics, exposing the athlete to increased risk of a shoulder injury. A balanced and flexible shoulder are thus critically important to maximizing performance and minimizing the risk of injury (Keith, 2012).

2.3 Prevalence of MSD among teacher

Darwish and Al-Zuhair (2013) conducted a research to estimate prevalence and pattern of muscular skeletal pain disorders among secondary school Saudi female teachers in Al-khobar

area and the psycho-demographic and psycho social factors that may affect them. A cross-sectional study was adopted usi-ng sample of secondary schools teachers (government and private school) in Al-Khobar area, Saudi Arabia (KSA). Data were collected using a structured self-administered questionnaire. In their result prevalence of musculoskeletal pain disorders was 79.17%. Main sites of pain were lower back (63.8%) followed by shoulder (45.4%) neck (42.1%), leg (40.0%) wrist (16.2%), and elbow joint (10.0%). Factors that showed significant relationship were types of school (P value 0.007), number of children (value 0.006), shoe type (P value 0.000), teaching years (P value 0.038. age (P value 0.001), weight (P value 0.0003), and working daily hours (P value 0.027). they concluded that secondary school female teacher showed high prevalence of musculoskeletal pain discovers in most anatomic sites, namely, the back shoulder, neck, legs, wrist and elbow join. Risk factors associated with significant pain were type of school, age weight, number of children, and number of teaching years.

Possible movement at shoulder joint

Function	***Muscles***
Flexion	Deltoid, Pectoralis Major, Coracobrachialis, Biceps Brachii
Extension	Deltoid, Teres Major, LatisimusDorsi, Triceps Brachii
Abduction	Supraspinatus, Deltoid
Adduction	Pectoralis Major, Teres Major, LatissimusDorsi
Lateral Rotation	Infraspinatus, Teres Minor, Deltoid
Medial Rotation	Subscapularis, Deltoid, Pectoralis Major, Teres Major, LatissimusDorsi

Internal Shoulder Rotation Exercises

- Shoulder press w/ Swiss ball and dumbbells
- Dumbbell shoulder press
- Push-ups.

External Shoulder Rotation Exercises

- Reverse flyes w/ Swiss ball and dumbbells
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2.4 Musculoskeletal Disorder of Shoulder

Pain is the most common symptom of which people complain. The most common cause of pain internationally is musculoskeletal disorders (Murden 1997 & Tsuboi, Takeuchi, Watanabe, Hori and Kobayashi, 2002),Musculoskeletal disorders (MDS) are put into different categories according to pain location.

One category is upper limb disorders which include any injury or disorder located from fingers to shoulder or the neck. Another category of musculoskeletal pan disorder is lower

limb disorders which include injury and disorders from hips to toes. Possibly the most common MSD is back pain (http.//www.hse/gov.statictis/causdis/musculoskeletal/index.htm).

MDS can affect the body's muscles joints, tendons, ligaments, and nerves. Most work related MSD develop over time and are caused either by the work itself or by the employees' working environment. The can also result from fractures sustained in an accident, health problems range from discomfort, minor aches, and pains to more serious medical conditions requiring time off work and even medical treatment. In more chronic cases, treatment and recovery are often unsatisfactory, and the result could, be permanent disability and loss of employment.

School teachers; in general have been demonstrated relative to other occupational groups to report a high prevalence of musculoskeletal disorder (Cardoso, Araujo, & Carvalho, 2009).

Among different populations studied it was clear that teachers are at higher risk of developing musculosketal pain although prevalence among them was not uniform and ranged between 23.7% and 95%. (Kohlmann, 2003); Cardoso, Araujo, Carvilla & Kovess, 2006).

The work of teachers does not only involve teaching students bit also preparing lessons, assessing students' work, and participating in different school committees. These may cause teachers to suffers adverse. Mental and physical health issue due to variety of job functions (Chon & Chan, 2010).

2.4.1 Types of shoulder disorder

The shoulder joint is surrounded by a group of four muscles. Refer to as the rotator sporting activities and accidents can cause injuries resulting in joint weakness inflammation and pain.

Tears

Rotator cuff tears may occur with aging overuse or from injury. Most rotator cuff problems are treated with anti-inflammatory medication and gentle strengthening exercises.

Impingement

It occurs when the space between the rotator cuff and the acromion bone becomes narrowed preventing tendons from moving freely; tendinitis may follow.

Tendinitis

Participants in sports involving overhead movement (baseball, basketball, tennis swimming volleyball) are prone to tendinitis a painful tendon inflammation.

Subluxation/Dislocation

Instability is evidenced when the shoulder feels loose. Supporting ligaments have been stretched and no longer hold the ball and socket joint firmly in place.

Full dislocation often occurs after serious trauma, resulting in the shoulder ball coming completely out of its socket fracture.

Collar bone (clavicle) fracture is another common injury in contact sports which typically involve speed.

Usually shoulder problems are treated with RICE. This stands for Rest ICE, compression and Evaluation. Other treatments include exercise, medicines to reduce pain and swelling, and surgery if other treatment doesn't work. http://www.hse.gov.statistics/causdi/musculoskeletal/index.htm

2.4.2 Shoulder flexibility problem

Pain

Pain is an unpleasant feeling often caused by intense or damaging stimuli, such as stubbing a toe, burning finger, putting alcohol on a cut, or in other way pain is an unpleasant sensory and emotional experience associated with actual of potential tissue damage or described in terms of such damage (Debono, Hoeksema & Hobbs 2013).

Classification of pain

According to Thienhaus and Cole (2002), pain is classified based on specific characteristics:

1. The region of the study involved (e.g. back, upper limbs and lower limbs)
2. System whose dysfunction may be causing the pain (e.g. nervous, gastrointestinal).
3. Duration and pattern of occurrence
4. Intensity and time since onset and
5. Etiology or cause of the pain

Spanswick and Main (2000) said that pain is classified into three (3)

- Nociceptive pain which is due to stimulation of peripheral nerve fibres that respond only to stimuli approaching
- Inflammatory pain, which is association with tissue damage and the infiltration of immune cells
- And pathological pain, which is a disease state caused by damage to the nervous system or by dysfunctional pain, like inn tension type headache

Shoulder pain

The shoulder has a wide and versatile range motion, when sometimes goes wrong with your shoulder, it hampers your ability to remove freely discomfort. The shoulder can be injured by performing manual labour, playing sports even by repetitive movement. Certain diseases can bring about pain that braves to the shoulder, such as well as liver heart or gall bladder disease (Goode & Campell, 2007).

A number of factors and conditions can contribute to shoulder pain. The most prevalent cause is rotator cuff tendinitis a condition where the tendons are inflamed. Sometimes shoulder pain is the result of injury to another location in the body usually the neck or the biceps this is called referred pain. Another causes to repetitive use or over use injury of the shoulder or neck by areas (Oode & Campell, 2007).

Shoulder stability

One of the many remarkable features of the normal shoulder is that (the ball and socket joint between the upper arm bone and shoulder blade) is very stable in spite of the vast range of motion available to the joint.

Joint stability

This refers to the resistance offered by various musculoskeletal tissue that surround a skeletal joint. Several subsystem ensure the stability of a joint, these are the passive, active and neural systems (Panjabi, 1992).

The opposite of stability is instability. It is believed that one or more of the subsystems must have failed if joint instability occur (Cocchiarella & Andersson, 1993)

Shoulder instability

The shoulder is the most movable joint in the body it helps to lift the arm, to rotate it, and to reach up over the head and be able to turn in many directions. This greater range of motion, however, can cause instability (Nachemson, 1992).

Shoulder stability occurs when the head of the upper arm bone is forced out of the shoulder socket and this can happen as a result of a sudden injury or from overuse. When the shoulder is loose and slips out of place repeatedly, it is called shoulder instability.

Causes of shoulder instability

There are three (3) common ways a shoulder can become unstable, thus;

1. shoulder dislocation, this happens when there is a severe injury or trauma which will often be the cause of an initial shoulder dislocation, and a severe first dislocation can lead to continued dislocations, giving out and a feeling of instability
2. Repetitive strain, some people have never had a dislocation. Most of these patients have looser ligaments in their shoulders as a result of repetitive overhead motion. Motion jobs like teachers and weight lifters requires repetitive overhead motion that

can stretch out the shoulder ligaments. Swimming, tennis and volleyball are also among the sports that requires overhead work.

3. Multidirectional instability, in a small minority of people, the shoulder can become unstable without any injury or repetitive strain, in such people the shoulder may feel loose or dislocate in multiple directions.

Range of motion (ROM): Is the distance (linear or angular) that a movable may normality travel while properly attached to another. It is also called range of travel, particularly when talking about mechanical devices and in mechanical engineering fields.

As used in the biomedical and weight lifting communities, range of motion refers to the distance and direction a joint can move between the flexed position and the extended position. The act of attempting to increase this distance through therapeutic exercises (range of motion therapy – stretching from flexion to extension for physiological gain) is also sometimes called range of motion (Pederson, 2001).

Measuring range of motion

Each specific joint has a normal range of motion that is expressed in degress, the devices used to measure range of motion in the joint f the body include the “goniometry” and “indinometre” which used a stationary arm, protractor, fulcrum and movement arm to measure angle from axis of the joint. As measurement results will vary by the degree of resistance, two levels of range of motion results are recorded in most cases.

Limited range of motion refers to a joint that has a reduction in its ability to move. The reduced motion may be a mechanical problem with the specific joint or it may be caused by injury or diseases such as osteoarthritis, rheumatoid arthritis, pains, swelling and stiffness associated with arthritis can limit the range of motion of a particular joint and impaired function and the ability to perform usual daily activities (Pederson, 2001).

2.7 Overview of flexibility

Physical fitness is one of the most important things in life and one of the most valuable assets one can ever have. Health is one of the pre-requisite for a happy, well-balanced life. Physical fitness is defined as the state or condition of being physically sound and healthy, especially as a result of exercise and proper nutrition. It is, thus, a state of general well-being, marked by physical health as well as mental stability. Physical fitness is not just about having a lean body, it is about having cardiovascular, overall muscular endurance, Flexibility as well a strong immunity system and most importantly, a satisfied and happy state of mind (Kennedy, 2011).

Flexibility is the ability to move joints through a maximum range of motion without undue strain. Generally speaking, a joint range of motion (ROM) refers to the angle through which a joint moves from the anatomical position to the extreme limit of the motion in a particular direction. This means a distance and direction in which a joint can move to its full potential. Each specific joint has a normal ROM that is expressed in degrees after being measured with goniometer. Limited range of motion (LROM) means a joint that has reduction in its ability to move. It may be because due to mechanical problems or diseases or pain. Having an optimal ROM allows an individual to move freely without pain or stiffness and perform activities and work without injury (Susan, 2003; McGill, 2007; Norkin& White, 1998).

However, Flexibility really depends on the soft tissues (muscle, tendon, ligaments) of a joint rather than the bony structure. However, the structure of the bones in certain joints can place limitations on range of motion (Jeff, Tina, &Nathan, 2012). Flexibility is defined as the ability to move joints or muscles through their full-range of motion. Flexibility is the range of motion in a joint or group of joints, or, the ability to move joints effectively. Flexibility is related to muscle strength. Flexibility can be improved with stretching exercises (Jeff, Angelotti & Nathan, 2011). Flexibility may also be specific to the joint or individual,

allowing some people's joints to naturally surpass the range of motion in the same joint in another person. Flexibility is one of the five components of physical fitness. Flexibility is the key that unlocks an athlete's physical ability. Without a progressive flexibility program, athlete will not be able to apply his/her other physical attributes to their greatest effectiveness when competing (Bill, 2011).

Importance of flexibility

Improving flexibility allows performing nearly all activities more effectively, can prevent injury, improving balance and coordination and enhancing athletic or recreational sports performance. Improved flexibility can also make exercise more effective-especially weight or resistance training-because it allows to perform exercises through muscles full-range of motion, encouraging greater strength and growth (Norkin & White, 1998).

Factors affecting flexibility

Flexibility is very different from person to person. An individual with very good flexibility in the hips may not have good flexibility in the shoulders. There are many factors that can influence one's flexibility. First is body size, meaning that usually people with high amounts of body fat have a harder time moving their joints through a full range of motion. Usually these people have a sedentary lifestyle so they do not have a significant amount of strength, which as mentioned before is necessary to move body limbs. Age and Gender are another factor . During early childhood years, kids show an increased aptitude for flexibility. Upon reaching adolescence, however, that aptitude begins to level off. Gender can be considered a factor in flexibility as well. In general, females are more flexible than males. It is thought that this is due to a hormonal effect. Males have higher levels of testosterone, which can lead to muscle growth and shortening. And inactivity and Injuries experience also affect flexibility(Jeff, Angelotti & Nathan, 2011). Keith (2012) outlined the following factors that can influence a person's flexibility viz:

- Genetics
- Connective tissue elasticity
- Composition of tendons or skin surrounding the joint
- Joint structure
- Strength of opposing muscle groups
- Body composition/type
- Gender
- Age
- Activity level
- Previous injuries or existing medical issues

Furthermore, the term ‘upper limb’ relates to the part of the body extending from the tips of the fingers to the shoulder and extending to the neck. It includes the soft tissues and connective tissues (tendons and ligaments) and the bony structures as well as the skin, along with the circulatory and nerve supply to the limb. The symptoms of upper limb disorders can include pain, reduction in the ability to use the affected part of the limb and restrictions in the speed or range of movement. There are a number of risk factors that may result in upper limb disorders, and these include the following:

- **Repetition:** work is repetitive when it requires the same muscle groups to be used over and over again during the working day. Such repetition may not allow sufficient time for recovery and can cause muscle fatigue.
- **Poor Work Posture:** certain jobs require a worker to assume a variety of awkward postures, including fixed or constrained body positions, that cause significant biomechanical stress to the joints of the upper extremity and surrounding soft tissues.

- **Sustained Force:** the level of force that is generated by the muscles is affected by a number of factors, including work posture, size of objects handled and speed of movement.
- **Poor Work Environment:** examples would be poor lighting or temperature control.
- **Duration of Exposure:** as upper limb disorders are cumulative the length of time or duration of a task can increase the risk of injury.

Measuring flexibility

According to Norkin & White (1998) Flexibility is measured using two primary methods:

Indirect Flexibility Measures: Indirect Flexibility Measures deals with performing specific, prescribed manual movements and then measure relative flexibility while performing those motions. Examples include the Sit & Reach Test, V-Sit Reach Test, Trunk Rotation Test, and Groin Flexibility Test.

Direct Flexibility Measures: Direct methods of measuring flexibility use calibrated measuring instruments like the Goniometer or a Flex meter to measure the flexibility of a joint.

Method of increasing flexibility

The best method to increase flexibility is progressively stretching the muscles surrounding a joint. This include,

Dynamic stretching:

Onekata, Musa and Arongbonlo (2001) asserted that dynamic stretching involves repeated, fluid, gentle, movements that create mild tension, but are not painful or exhaustive. Dynamic stretching is typically used during warm up and cool down periods. Dynamic stretching can be specific, sports related (like swinging a golf club or bat), or a lower intensity activity like walking. Dynamic stretching can also be incorporated into a light warm-up set during weight

or resistance training, using a small amount of resistance through the exercises full range-of-motion (for example, squats or bench press).

Static Stretching: Static stretching involves holding the muscle in a stretched position for a period of time. The actual stretching movement should be slow and controlled. It is usually held from 15-60 seconds. Static stretching is typically used to improve flexibility in tight muscles by gradually and progressively stretching and lengthening the muscle (Onekata, Musa & Arongbonlo, 2001).

Contract-Relax Method: The contract-relax method involves contracting against resistance from a partner then stretching. This works by inhibiting the stretch reflex and allows for stretch further than normal (Onekata, Musa & Arongbonlo, 2001).

Some shoulder flexibility tests

Shoulder circumduction test

The shoulder circumduction test is a simple test of shoulder flexibility. This test is part of the protocol for the Groningen Fitness Test for the Elderly (GFTE). The purpose is to measure shoulder flexibility. And the equipment required are cord that has a fixed handle on one end and a sliding handle on the other. The elderly population are specifically target population(Koen, Lemmink, Mathieu & Steven, 2001).

Back scratch test

The back scratch test, or simply the scratch test, measures how close the hands can be brought together behind the back. This test is part of the Senior Fitness Test Protocol (SFTP), and is designed to test the functional fitness of seniors. The purpose of this test is to measure general shoulder range of motion. Equipment required are ruler or a yardstick (Anna, PiotrKocur, Małgorzata & Piotr, 2006).

Purpose: to measures general shoulder range of motion.

Procedure

- Have the client/patient in standing. Reach over the head and then down the back (palm towards the body). Reach the other hand behind the back with the palm
- Facing out and reach up the back as far as possible. 2. The tip of the middle fingers touching is considered "0". Overlapping is considered "+" and not touching

Men's Norms (inches)			
Age	Below Average	Average	Above average
60-64	>6.5	6.5	< 0
65-69	>7.5	7.5 to 0	<-1.0
70-74	>8.0	8.0 to -1.0	<-1.0
75-79	>9.0	9.0 to -2.0	<-2.0
80-84	>9.5	9.5 to -2.0	<-2.0
85-89	>10.0	10.5 to -3.0	<-3.0
90-94	>10.5	10.5 to -4.0	<-4.0
Women's Norms (inches)			
Age	Below Average	Average	Above average
60-64	>3.0	3.0 to1.5	< 1.5
65-69	>3.5	3.5 to 1.5	< 1.5
70-74	>4.0	4.0 to 1.0	< 1.0
75-79	>5.0	5.0 to 0.5	<0.5
80-84	>5.5	5.5 to 0	< 0
85-89	>7.0	7.0 to -1.0	< -1.0
90-94	>8.0	8.0 to -1.0	< -1.0

Source: Jones and Rikli (2002).

Acuflex III shoulder rotation test

This is a simple shoulder rotation flexibility test, using just a long solid object. A similar, though more complex flexibility test of the shoulder, which accounts for the shoulder width, is the Acuflex III shoulder rotation test. The purpose is to test the flexibility of the shoulder joint, which is important for injury prevention and in particular is important in swimming, racquet sports and throwing sports. The equipment required is stick or towel, ruler or tape measure.

Zippiest test

1. Place the right hand over the back of the neck (palm against the back) and the left hand around and up the small of the back (palm up).

2. Attempt to touch or overlap the fingers and hands behind the back. Measure the distance between the finger tips to the nearest half-inch and record it. Repeat this on the other side.

Scores sheet:

Right arm over shoulder _____ inches

Left arm over shoulder _____inches

3. Use the table below to interpret the results.

Interpretation: **Table 2. 1 Scores Table**

	Right Up		**Left Up**	
	Male	Female	Male	Female
High Performance Zone	≥7	≥8	≥7	≥8
Good Fitness Zone	6	6-7	3-6	3-7
Marginal Zone	4-5	5-5	0-2	0-2
Low Fitness Zone	<1	<1	<0	<0

Corbin and Lindsay (1991).

Static flexibility test - shoulder

Testing and measurement are the means of collecting information upon which subsequent performance evaluations and decisions are made but in the analysis we need to bear in mind the factors that may influence the results. The Objective of this test is to monitor the development of the athlete's shoulder flexibility. required resources include-piece of rope approx. 1 metre in length, tape measure and assistant (Mackenzie, 2007 and Johnson & Nelson, 1986).

2.8 Exercises therapy for rehabilitation of shoulder flexibility

The shoulder is a ball-and-socket joint composed of three bones and a combination of muscles, tendons and joints that enable mobility in the arms. The shoulders have the greatest range of motion in the body and, as a result, have an increased risk of instability, soft tissue injury, pain and degenerative diseases such as arthritis, according to the American Academy of Orthopaedic Surgeons. Shoulder stretches and range-of-motion exercises are recommended to maintain strength and flexibility in the shoulders and upper arms (Ndubisi, 2011). Shoulder flexibility can become a concern as a person gets older and he or she realizes they don’t have the same range of motion as before. It’s also important for athletes and people with physically demanding jobs to maintain flexibility in their shoulders because of the demands placed on the upper body. Several types of stretching can increase shoulder flexibility, including shoulder rotations, cat stretches, and triceps shoulder stretches. A person can lose shoulder flexibility when a protein, called collagen, in connective tissue changes; the collagen fibers start to stick together, reducing flexibility and range of motion. Flexibility also can be lost when joints become stiff due to inactivity. Stretching on a regular basis provides a way to combat stiff joints and increase shoulder flexibility (Jenn, 2012).

Moreover, A good way to avoid shoulder injuries is to make sure your upper body strength sessions are balanced. This means that every push or press exercise must be balanced with a

pull exercise. As a consequence, the 'non-mirror muscles', lower trapezius, rhomboids, latissimusdorsi and rear deltoid, are underdeveloped. This leads to a muscular imbalance about the shoulder, which results in poor scapular stabilization. Since the non-mirror muscles are the ones that work to stabilize the scapula. In addition, over-developed mirror muscles can lead to a round-shouldered posture, which incorrectly places the scapula up and forward. Redressing this imbalance is very important for the prevention and rehabilitation of shoulder impingement injuries. The following is an example of a balanced upper body workout:

- Bench press (pectorals, anterior deltoid)
- Seated row (rhomboids, mid trapezius, latissimus)
- Flies (pectorals)
- Rear lying prone flies (rhomboids, mid trapezius, rear deltoid)
- Lat raises (anterior mid deltoid, upper trapezius) and
- Lat pull downs wide grip (latissimus, lower trapezius) (Onekata, Musa, &Arongbonlo, 2001)

Shoulder adduction exercise

Athletic injuries, overuse injuries or medical conditions such as frozen shoulder result in shoulder pain, stiffness and reduced mobility. This exercise may be recommended by your physician or physical therapist to reduce the pain and restore shoulder flexibility. Begin by placing your affected arm over your opposite shoulder. Ensuring that your elbow is pointing away from your body, begin raising your elbow to your shoulder height. Using your unaffected arm, push your extended elbow toward the opposite shoulder. Hold this stretch for five seconds, and return your arm to the starting position. Perform three sets of 10 repetitions three times daily, and gradually increase your hold time to 30 to 60 seconds as your shoulder flexibility increases (Porter, 2009).

External rotation exercise

This exercise may be recommended by your physical therapist to increase flexibility and range of motion in your shoulder. Begin this exercise by standing in a door. Grab the doorjamb with your affected shoulder and bend that elbow to a 90-degree angle. Use your unaffected arm to grab the elbow of the affected arm. Hold that elbow firmly against your body, and begin to rotate your body away from the doorjamb. Continue this external rotation until you feel a stretch in your affected shoulder. Hold this stretch for five seconds and return to the starting position. Perform three sets of 10 repetitions, three times daily. Gradually increase the amount of the rotation as well as your hold time to 30 to 60 seconds (Porter, 2009).

Pendular exercises

This range-of-motion exercise maintains strength, flexibility and movement in the joints and muscles of the shoulders. Begin by leaning forward on a table or bench with the forearm of the unaffected shoulder. Keep back and neck straight, relax shoulders and loosely hang affected arm. Begin to gently move your affected arm forward and backward. Continue this exercise, but do not strain or overuse your shoulders. Perform one set of 10 repetitions daily. As you progress and regain flexibility in your shoulders, progress to pendular circles. To perform this exercise, enter the starting position with your affected arm relaxed and hanging. Keeping your back and shoulder relaxed, slowly swing your arm in small, clockwise circles. Repeat this exercise, swinging your arm in small, counter-clockwise circles (Porter, 2009) .

Shoulder flexion exercise

To perform this stretch, you will need a stable frame, such as a bookcase. Begin by standing near a bookcase or any stable structure you have available. Raise the arm of your affected shoulder as high as possible and grab the surface of the stable structure with your stretched arm. Keeping your affected arm stretched, slowly lower your body by bending your knees.

Continue this extension until you feel a stretch in your shoulder. Hold this position for five seconds, and repeat this exercise 10 more times. Gradually increase the duration of your hold to 30 seconds, and progress to performing three sets of 10 repetitions, once daily (Porter, 2009).

Benefits of windmill calisthenics exercise

- It builds muscle strength and tone. Humans lose 5 pounds of muscle every decade after age 30.
- The number of muscle fibers declines with age. From age 30 to age 70 we can lose more than 25% of the type 2 muscle fibers in our bodies (type 2 fibers are our strength fibers). Windmill calisthenics exercise can slow down or even reverse the aging process by building muscle mass and strength.
- It's been shown to build bone. Osteoporosis, a condition of accelerated bone mineral loss which leads to fractures, can be a crippling disease, particularly in women (although men get it, too), and research on shoulder exercise suggests that it can build bone even in the elderly.
- There is some evidence that shoulder exercise helps lower moderately high blood pressure.
- More strength can lead to fewer falls in the elderly.
- Windmill calisthenics exercise can raise metabolic rate, an important factor in maintaining body weight (http://www.webmd.com/healthy-aging/medical-cost-disability-11/sports-injuries). Accessed on 14th February 2013.

Health benefits of calisthenics exercises

There are a variety of physical and mental health benefits that can be achieved through strength training:

- Improved muscle strength and tone

- Weight management
- Prevention and control of health conditions such as diabetes, heart disease and arthritis
- Pain management
- Improved mobility and balance
- Improved posture
- Decreased risk of injury
- Increased bone density and strength
- Reduced body fat
- Increased muscle-to-fat ratio
- Boosted metabolism (burning more kilojoules when at rest)
- Improved sleep patterns
- Increased self-esteem
- Enhanced performance of everyday tasks

Windmill and Kettle-bell training techniques

The American Council on Exercise (2011) Recommends beginners to start a regimen with eight to 12 repetitions, working the muscles until they are fatigued. Remember to breathe regularly throughout the exercise. Resist the weight with a slow, controlled, full range of motion. General safety guidelines only use safe and well-maintained equipment. Faulty equipment will significantly increase your risk of injury. Warm up and cool down thoroughly. Incorporate slow, sustained stretches. Wear appropriate clothing, natural fibers 'breathe' better than synthetics, and multiple layers of clothing are preferable to one bulky layer. Don't forget to breathe - exhale at the point of greatest exertion rather than holding your breath. Control the weights at all times - don't throw them up and down, or use momentum to 'swing' the weights through their range of motion. Make sure you use correct

lifting technique. If you are unsure, consult with a qualified gym instructor or physiotherapist. Incorrect technique can slow your progress, or even cause injuries. Ensure you move the weight through your joint's full range of motion. This not only works the muscle fully, but reduces the risk of joint injury (Kolber, &Beekhuizen, 2010).

In a study on the impact of osteopathy, Stuart (2012) reported that school teachers have a high risk of developing disorders in the neck, back and shoulders. The report found that stressful working conditions due to large classes, a lack of educational resources, and limited reward for their work was a likely cause of the high prevalence rates of self-reported musculoskeletal disorders (MSD) among teachers.

Despite this, the impact of MSD specifically within the teaching profession has not been given sufficient attention in most of the literature. Furthermore, comparatively little research has investigated the prevalence of MSD in the teaching profession.

A number of international studies on musculoskeletal disorder (MSD) among school teachers have shown a high prevalence. a study of school teachers in Hong Kong, for example, found that 95.1% had experienced some form of pain in the previous month (Chong & Chan, 2010). In a study carried out in Estonia which looked at physical activity, MSD and cardiovascular risk factors in male physical education teachers (PETs), 66.7% of teachers reported the problems MSD in the previous 12 months, compared to 51.2% of PETS who reported MSD for the same period (PihlMatsin & Jurimae, 2002). In another Swedish study, 40% of school teachers and nursery school teachers were found to have reported (Brulin, Goine, Edlund & Knutsson, 1998). In comparison, PETs tended to have low risk of MSD, while pre-school teacher have been reported to be at an increased risk of MSD (Grant, Habes & Tepper, 1995).

Most study have measured neck and shoulder pain separately as being ‘neck pain’ or ‘shoulder pain’ The highest shoulder pain prevalence (73.4%) for the previous months has

been reported by Chinese school teachers (Chong & Chan 2010). While in Turkey, 28.7% of school teachers had experienced MSD symptoms in the shoulder area (Korkmaz, Cavlak & Telci 2011). Furthermore, the prevalence of shoulder pain varied greatly between 28% and 55% in studied of Swedish music teachers carried out between 1988 and 2009 (Pihl, Matsin & Jurimae, 2002). (Fjellman- Wiklund, Sundelin, Fjellman-Wiklund, Brulin, Sundelin, Edling&Fjellman-Wiklund, 2009). In Estonia, 7.8% of non PETs and 18.6% of PETs reported pain on their shoulders (Pihl, Mtsin & Jurimae, 2002). In Japan, 25% to 35.4% of pre-school teachers had experienced neck or shoulder pain problem. (Ono, Imaeda, Shimaoka, Itiruta, Itattori, Ando, Hori & Tatsumi, 2002) .comparable to these findings are the results of a US study in which 33% of preschool teachers reported neck and shoulder pain (Grant, Habes & Tepper, 1995).

Various studies have reported that poor psychosocial factors were potential risk factors for MSD. In a Chinese study of secondary school teachers, low colleague support and high workload have been significantly associated with shoulder pain (Chiu & Lam, 2007). Other studies have also demonstrated a significant association of psychosocial factors and MSD. Furthermore, psychosocial factors such as mental health among Maley school teachers (Samaid, Abdullah, Moin, Tamrin&Hashim, 2010) .and anxieties Chinese teachers (Chiu & Lam, 2007). Have been associated with their higher MSD prevalence rates.

2.9 Summary

MDS can affect the body's muscles joints, tendons, ligaments, and nerves. Most work related MSD develop over time and are caused either by the work itself or by the employees' working environment. The can also result from fractures sustained in an accident, health problems range from discomfort, minor aches, and pains to more serious medical conditions requiring time off work and even medical treatment. In more chronic cases, treatment and

recovery are often unsatisfactory, and the result could, be permanent disability and loss of employment.

School teachers; in general have been demonstrated relative to other occupational groups to report a high prevalence of musculoskeletal disorder Cardoso, Araujo & Carvalho, 2009).

Darwish and Al-Zuhair (2013) conducted a research to estimate prevalence and pattern of muscular skeletal pain disorders among secondary school Saudi female teachers in Al-khobar area and the psycho-demographic and psycho social factors that may affect them. A cross-sectional study was adopted usi-ng sample of secondary schools teachers (government and private school) in Al-Khobar area, Saudi Arabia (KSA). Data were collected using a structured self-administered questionnaire. In their result prevalence of musculoskeletal pain disorders was 79.17%. Main sites of pain were lower back (63.8%) followed by shoulder (45.4%) neck (42.1%), leg (40.0%) wrist (16.2%), and elbow joint (10.0%). Factors that showed significant relationship were types of school (P value 0.007), number of children (value 0.006), shoe type (P value 0.000), teaching years (P value 0.038. age (P value 0.001), weight (P value 0.0003), and working daily hours (P value 0.027). they concluded that secondary school female teacher showed high prevalence of musculoskeletal pain discovers in most anatomic sites, namely, the back shoulder, neck, legs, wrist and elbow join. Risk factors associated with significant pain were type of school, age weight, number of children, and number of teaching years.

The kettlebell, cannonbell or girya (Russian: ги́ря) is a cast-iron or steel weight (resembling a cannonball with a handle) used to perform ballistic exercises that combine cardiovascular, strength and flexibility training . They are also the primary equipment used in the weight lifting sport of girevoy sport. Russian kettlebells are traditionally measured in weight by pound, which (rounded to metric units) is defined as 16 kilograms (35 lb) (Helms, 2012).

Kettlebells were developed in Russia in the 1700s, primarily for weighing crops. It is said that these farmers became stronger and found them useful for showing off their strength during festivals. The Soviet army used them as part of their physical training and conditioning programs in the 20th century . They had been used for competition, training and sports throughout Russia and Europe since the 1940s. Though kettlebells had been in the United States in some form since the 1960s or earlier, Dragon Door Publications and Pavel Tsatsouline developed the first instructor certification program in the USA in 2001 (Helms, 2012).

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This research investigated the effects of eight weeks Kettle-bell wind mill calisthenics on musculoskeletal disorder among secondary school teachers with shoulder flexibility problem in Kano metropolis, Kano State, The methodology was organized as follows: Research design, population of the study, sample and sampling technique, data collection instrument, data collection procedure and data analysis.

3.1 Research Design

Experimental design of pre-test and post-test was used. This design involves control and experimental groups in order to determine the amount of change produced by the treatment. In this method, a pretest measurement and posttest measurement of both control and treatment groups were taken. This is in conformity with method advanced by Thomas and Nelson (2001).

3.2 Population of the Study

The population of this study consists of all secondary school teachers found in three (3) oldest secondary schools from three (3) education zones in Kano metropolis. The population was estimated to be 217 teachers.

3.3 Sample and Sampling Technique

The sample of this study was 33 subjects drawn randomly from 66 teachers with musculoskeletal problems from the total population of 217 teachers from (3) educational zones in Kano metropolis. A multistage sampling technique was used to select 33 subjects. In Cluster sampling the sample units contain groups of elements (clusters) instead of individual members or items in the population. Cluster sampling is easy and economical (Singh, 2006). In Kano metropolis there are three (3) education zones. Each zonal education zone was

considered to be a cluster. In each education zone, one (1) school was selected purposively, because these schools are the oldest in metropolis, hence a large number of old experienced teachers are expected. That is, Dala zone: Government Girl's College Dala. Municipal zone; Rumfa College, and Nasarawa zone; Government Senior Secondary School Stadium (Kano state senior secondary school management board KSSSMB, 2011). Teachers with musculoskeletal problem were selected randomly from each school. The 33 sample of this study were equally and randomly assigned into group "A" (experimental) and group "B" (control).

Sampling Technique Table

Education Zone	**School selected**	**Population of the teachers**	**Population of teachers with MSD**
Dala zone	GGC Dala	96	30
Municipal	Rumfa college	70	17
Nssarawa zone	GSSS stadium	51	19
Total		**217**	**66**

Source: Kano State Senior Secondary School Management Board (2011).

Inclusion Criteria

The inclusion criteria included those aged between 25 to 50 years, with a history of any musculoskeletal disorder not less than 6 months duration and who have not had any surgical operation, fully ambulatory and are cognitively stable. Only those signed the informed consent were used.

Exclusion Criteria

Participants excluded were those with the presence of red 'flag condition' such as cauda equina syndrome, major or rapidly progressing neurological deficit, fractures, Cancer, Infection Systemic disease, Osteoporosis , Pregnancy, Systemic rheumatic disease. Only patients who decline signing the written informed consent were excluded.

3.4 Data Collection Instruments

Instruments used in this study for the purpose of data collection include:

i. Kettle-bell: a weight-like kettle in shape, of and 2, 3 and 5 kilograms in weight

ii. Measuring tape: the dough fang measuring steel is used in measuring the height of the subjects (m) as suggested by Wilmore & Costill (1999).

iii. Bathroom scale: W. Sca model BR 1911, with the capacity of 120kg made in China is used to measure body weight of subjects to the nearest kg as suggest by Australia Health and Fitness survey 1985.

iv. Shoulder Rating Questionnaire (SRQ). The SRQ (Appendix A) adopted from Charles & Ryan (1994) will be use to measure extent of pain. The SRQ questionnaire consists of 20 items, rated on 5 or 10- points scale. The SRQ provides information on the intensity and the degree to which pain interferes with function.

v. A Goniometre, which is a protractor-like device commonly with a 180 degree range and used to measure a joint's range of motion or its position when stationary.It was invented in 1900 by Samuel Lewis Penfield(1856-1906) a geology Professor at Yale University who earned his Ph. B from Yale in 1877 (Norkin&White,1998).

3.5 Procedure for Data Collection

An introductory letter from PHE Department Bayero University Kano was taken to the management of the schools involved. A familiarization visit was done to meet the subjects and inform them about the procedure, objectives, benefits and purpose of the work so as to be aware of voluntary nature of the experiment. An informed consent form was given to each subject. Research assistants who are Physical and Health Education teachers of each selected school were trained on the whole procedure.

3.5.1 Measurement Procedure

Measuring of Participants Physical Characteristics

Participants were assessed for their heights and weights prior to the commencement of the study. The weights of the patients were measured with the aid of a portable bathroom scale with provision for calibration. The patients was asked to stand bare footed and erect over the centre of the weighing scale with body weight evenly distributed between the two legs. They will be asked to look forward and their arms by the sides, palm facing the thighs. Precise reading will be taken to the nearest 0.5kg. The height will be measured using a calibrated wall measured in meters. Patients stand in bare footed against the wall with the feet together and the head in upright position, the point of greatest height will be marked and then measured with a flexible tape.

Measuring Range of Motion

Measurement before assessment: test administrator measured subjects hand length (distance from distal wrist crease to tip of middle finger).

Instructions

The subject were instructed to raise one arm, bend the elbow, and reach down across back with palm facing upper back; Position opposite arm down behind back and reach up across back with back of hand against back; place thumbs on palms and make a fist with each hand.

Execution

In one movement the subjects fold the fists back as close as possible to one another and repeated with arms apart.

Measurement

Administrator measured distance between both fists using measuring ruler. Record lower score of both sides. Note any pain or discomfort during movement.

Evaluation of Pain

Participants were evaluated for level of pain at baseline (pre-test) and subsequently following the intervention exercise (post test). The evaluations were conducted using Shoulder Rating

Questionnaire (SRQ) by asking patients to tick values on the Shoulder Rating Questionnaire (SRQ). Similarly, the Shoulder Rating Questionnaire (SRQ) was administered pre and post intervention to determine patient's functional abilities.

3.5.2 Training Program

The training programme consisting of wind mill calisthenics exercise and work on kettle-bell. The training programme start with wind mill calisthenics exercises for the 1st week. This 1st week was for familiarization of the exercise training procedure. A 2nd week was for both wind mill and kettle-bell exercise training. The subjects apart from the wind mill exercise execute the kettle-bell of 2kg. After the wind mill exercise, subjects in the experimental group performed the kettle-bell by lifting up the kb and bringing it down for 10 minutes which serve as one bout then 3 minutes rest interval before the next repetition. A set lasted for 20minutes which consist of four bouts. This lifting lasted for two successful week, then progressive increase in the weight of kb from 2-3kg for the next two weeks till the last two weeks.

The progressive increase in the kb weight was done every two – two weeks of the training which start in the second weeks of training ie 2nd two weeks 2kg, 3rd weeks 3kg, 4th weeks 4kg, 5th weeks 5kg and 6th weeks 6kg. The number of repetition increase as the weight of the kettle-bell increase ie starting from 2nd weeks repetition increase from 20, 25, 30, 35, 40 and 45 respectively.

3.7 Data Analysis

The statistical techniques used consist of both descriptive and inferential statistics. Descriptive statistics were employed to find out the mean, mode, median and standard deviation of the tested variable and ANCOVA inferential statistics were used to analyze the difference between experimental and control group with their pre and post test results. The 0.05 alpha level was used to test for significance in the differences found.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

This research investigated the effects of eight weeks Kettle-bell wind mill calisthenics on musculoskeletal disorder among secondary school teachers with shoulder flexibility problem in Kano metropolis, Kano State. This chapter presented the results and discussion of the analyzed data.

4.1 Result

The e result found were used for analysis and presented in the table below.

Table 4.1.1: Physical Characteristics of the Respondents

Variable	Exp-G (n=27)		Control –G X ± SD (n=27)	
	Pre x̄± S.D	Post x̄± S.D	Pre x̄± S.D	Post x̄± S.D
Age (Yrs)	30.5±1.04	30.5±1.04	34.5±1.71	34.5±1.71
Weight (Kg)	66.03±7.72	63.74±7.69	63.65±12.63	65.46±7.63
Height (M)	1.69±0.06	1.69±0.06	1.57±0.08	1.57±0.08
BMI (Kg/M^2)	26.67±2.98	25.90±2.87	26.99±3.01	27.01±3.12

The subjects as presented in Table 4.1.1 were randomized into experimental and control groups. The result showed that participants in both groups were not found to differ significantly in age, weight and height, which their homogeneity among the respondents.

Hypothesis testing:

Sub-hypothesis 1:

There is no significant effect of eight weeks Kettle-bell wind mill calisthenics exercise on shoulder pain among secondary school teachers in Kano metropolis.

Table 4.1.3 ANCOVA result of effect of eight weeks Kettle-bell exercise on shoulder pain among secondary school teachers

Variable	Exp-G (n=27) $\bar{x}$ ± SD
Shoulder Pain	
Pretest	72.16±10.31
Post-test	62.45±9.63

* F= 186.544, P (< 0.05)

The result as presented in table 4.3 indicated that the mean of experimental pre-test was 72.16 ±10.31 and the mean for post test was 62.45±9.63 while the mean for control pre-test was 73.32±6.98 and post test mean was 77.22±7.71. The statistical computation of ANCOVA after adjusting the covariant (pretest scores) was F 186.54, df: 26 (P<0.05). This means that 8weeks Kettle-bell exercise had significant effect on the shoulder pain of experimental control group subjects. Therefore, the null hypothesis is rejected on the basis that there was significant effect on shoulder pain among the subject.

Sub-hypothesis 2:

There is no significant effect of eight weeks Kettle-bell wind mill calisthenics exercise on shoulder range of motion among secondary school teachers in Kano metropolis.

Table 4.1.2: ANCOVA summary table on the result of eight weeks Kettle-bell exercise on shoulder range of motion among secondary school teachers

Variable	Exp-G (n=27) ± SD	Control-G (n=27) ± SD	df	F	Pr
Range of motion	46.75±3.53 36.91±4.57	49.56±15.28 49.93±9.55	2 24	2 0 . 0 9 3 * 0 . 0	

n	0
P	1
r	
e	
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*F = (2,24) 20.093, P (<0.05)

The result as presented in table 4.2 showed that the mean of pretest was 46.75±3.53 and the mean for post test was 36.91±4.57 while the mean for control pre test was 49.56±15.28 and post test mean was 49.93±9.55. The statistical computation after adjusting the covariant (pretest scores) indicated F= 20.093, df 2, 24 (P<0.05). This means that 8-weeks Kettle-bell exercise had significant effect on the shoulder range of motion of experimental subject. Therefore the null hypothesis is rejected on the basis that the significant effect exists between the groups.

4.2 Discussion

This study investigated the effect of eight weeks Kettle-bell windmill calisthenics on musculoskeletal among secondary school teachers in Kano Metropolis.

The finding of this study indicated that there was significant increase in shoulder range of motion df 26 among teachers with musculoskeletal disorder of shoulder type after

the intervention. This finding is in line with study conducted by Ivill (2008), who found that Kettle-bell workout is effective on reducing shoulder pain after eight weeks of the exercise

RANGE OF MOTION

Range of motion refers to activity aimed at improving movement of a specific joint. This motion is influenced by several structures: configuration of bone surfaces within the joint, joint capsule, ligaments, tendons, and muscles acting on the joint. There are three types of range of motion passive, active, and active assists. Passive range of motion is movement applied to a joint solely by another person or persons or a passive motion machine. When passive range of motion is applied, the joint of an individual receiving exercise is completely relaxed while the outside force moves the body part, such as a leg or arm, throughout the available range. Injury, surgery, or immobilization of a joint may affect the normal joint range of motion. Active range of motion is movement of a joint provided entirely by the individual performing the exercise. In this case, there is no outside force aiding in the movement. Active assist range of motion is described as a joint receiving partial assistance from an outside force. This range of motion may result from the majority of motion applied by an exercise or by the person or persons assisting the individual. It also may be a half-and-half effort on the joint from each source.

A certain level of muscle strength is needed to perform daily activities such as walking, running, and climbing stairs. Strengthening exercises increase muscle strength by putting more strain on a muscle than it is normally accustomed to receiving. This increased load stimulates the growth of proteins inside each muscle cell that allow the muscle as a whole to contract. There is evidence indicating that strength training may be better than aerobic exercise alone for improving self-esteem and body image. Weight training allows one immediate feedback, through observation of progress in muscle growth and improved muscle

tone. Strengthening exercise can take the form of isometric, isotonic and is kinetic strengthening. Isometric exercise During isometric exercises, muscles contract. However, there is no motion in the affected joints. The muscle fibers maintain a constant length throughout the entire contraction. The exercises usually are performed against an immovable surface or object such as pressing one's hand against a wall. The muscles of the arm are contracting but the wall is not reacting or moving in response to the physical effort. Isometric training is effective for developing total strength of a particular muscle or group of muscles. It often is used for rehabilitation since the exact area of muscle weakness can be isolated and strengthening can be administered at the proper joint angle. This kind of training can provide a relatively quick and convenient method for overloading and strengthening muscles without any special equipment and with little chance of injury. Isotonic exercise Isotonic exercise differs from isometric exercise in that there is movement of a joint during the muscle contraction. A classic example of an isotonic exercise is weight training with dumbbells and barbells. As the weight is lifted throughout the range of motion, the muscle shortens and lengthens. Calisthenics are also an example of isotonic exercise. These would include chin-ups, push-ups, and sit-ups, all of which use body weight as the resistance force. Isokinetic exercise Isokinetic exercise utilizes machines that control the speed of contraction within the range of motion. Isokinetic exercise attempts to combine the best features of both isometrics and weight training. It provides muscular overload at a constant preset speed while a muscle mobilizes its force through the full range of motion. For example, an isokinetic stationary bicycle set at 90 revolutions per minute means that no matter how hard and fast the exerciser works, the isokinetic properties of the bicycle will allow the exerciser to pedal only as fast as 90 revolutions per minute. Machines known as Cybex and Biodex provide isokinetic results; they generally are used by physical therapists.

The findings of this study indicated that there was significant increase in shoulder range of motion df 26 among teachers with musculoskeletal disorder of shoulder. After the intervention this findings is in line with study conducted by Ivill (2008), who found that Kettlebell workout is effective on reducing shoulder range of motion after eight weeks of the exercise.

Pain

Pain is a sensation that hurts. It may cause discomfort, distress or agony. It may be steady or throbbing. It may be stabbing, aching, or pinching. However you feel pain, only you can describe it or define it. Because pain is so individual, your pain cannot be "checked out" by anyone else. Pain may be acute or chronic. Acute pain is severe and lasts a relatively short time. It is usually a signal that body tissue is being injured in some way, and the pain generally disappears when the injury heals. Chronic pain may range from mild to severe, and it is present to some degree for long periods of time.

The result is contrary to the findings of Porcari, and Anders (2010) concluded that eight weeks of Kettle-bell swing and Kettle-bell dead lift training improved. The researcher also conclude that the training increase the muscular strength of the trunk extensors but did not significantly improve aerobic fitness or strength of the shoulder and trunk flexors.

However Bret and Chris (2012) concluded that pain intensity of lower back and muscular strength of the back extensors improve more in the intervention group than in control group. However, trunk flexion strength, shoulder elevation strength and aerobic fitness did not differ between groups. This may be advantageous for developing both sport-specific strength and power for increased performance as well as injury resistance. Again this may be helpful for sprinters or athletes.

This justifies the benefit of Kettle-bells calisthenics exercise such as:

- Increase neurological strength learning to tap in to every muscle of your body to complete a lift.
- Improve mobility each movement improves flexion while building strength.
- Decrease daily pain and chronic injury, body weight training has proven to take people out of pain by reinforcing the body's proper bracing sequence and progressing joint and tendon strength before loading heavy.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

This study was carried out to determine effects of 8 weeks Kettle-bell exercise on musculoskeletal disorder among secondary school teachers in Kano metropolis. This chapter is organised under the following subheadings:

- Conclusions
- Recommendations

5.1 Summary

The study was carried out to investigate the effects of 8-weeks Kettle-bell exercise on musculoskeletal disorder among secondary school teachers in Kano metropolis. A total of fifty four 54 teachers, both male and female within the age range of 30-60 years old recruited from the population of teachers with musculoskeletal disorder among secondary school participated in the study. The subjects were randomly assigned into two groups; the first group is the controlled group which received no treatment while the experimental group received the following treatments. Subjects were asked to carry the 2, 3 or 5kg kettle-bell up and down for 10 times or more and rested for 3 minutes then repeated for to 20 minutes (Erick, 1996). The repetition was progressive after week one (1) and week two, that is, 20, 25, 30, 35, 40, and 45, for twelve week. .The data obtained were analysed using independent ANOVA; and discussed.

Findings of the study showed a significant difference between experimental and control group after effect of eight weeks Kettle-bell exercise on shoulder pain among secondary school

teachers in Kano metropolis ($P<0.05$), also, significant effect after eight weeks Kettle-bell exercise on shoulder range of motion among experimental secondary school teachers in Kano metropolis. It was therefore concluded that kettle-bell windmill calisthenics exercise improved shoulder musculoskeletal disorder among secondary school teachers in Kano metropolis.

5.2 Conclusion

The outcome of the study revealed that 8 weeks kettlebell windmill calisthenics exercise has effect on range of motion and shoulder pain among secondary school teachers in Kano metropolis

5.3 Recommendations

From the findings of this research the following recommendations are made:

i. Kettle-bell windmill calisthenics exercise should be incorporated in management of teachers with shoulder flexibility.

ii. Exercise scientist and other health personnel should be enlightened on the benefits of this exercise on shoulder flexibility and pain.

iii. Teachers should be educated on the effects of the exercise and how to carry it out as the exercise is safe and easy to administer at home.

Recommendation for further studies

Further studies should be carried out with a larger sample size on different types of shoulder flexibility to help generalization of the outcome of the study on to the general population.

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APPENDIX

Shoulder Rating Questionnaire

Please answer the following questions regarding the shoulder for which you have been evaluated or treated. If a question does not apply to you, leave that question blank. If you indicated that both shoulders have been evaluated or treated, please complete a separate questionnaire for each shoulder and mark the corresponding side (right or left) at the top of each form.

1. Considering all the ways that your shoulder affects you, circle a number on the scale below for how well you are

doing. Very poorly { 1 2 3 4 5 6 7 8 9 10 } Very well

The following questions refer to pain.

2. During the past month, how would you describe the usual pain in your shoulder at rest?

(A) Very severe

(B) Severe

(C) Moderate

(D) Mild

(E) None

3. During the past month, how would you describe the usual pain in your shoulder during activities?

(A) Very severe

(B) Severe

(C) Moderate

(D) Mild

(E) None

4. During the past month, how often did the pain in your shoulder make it difficult for you to sleep at night?

(A) Every day

(B) Several days per week

(C) One day per week

(D) Less than one day per week

(E) Never

5. During the past month, how often have you had severe pain in your shoulder? The following questions refer to daily activities.

6. Considering all the ways you use your shoulder during daily personal and household activities (i.e. dressing, washing, driving,

household chores, etc), how would you describe your ability to use your shoulder?

(A) Very severe limitation; unable

(B) Severe limitation

(C) Moderate limitation

(D) Mild limitation

(E) No limitation

Questions 7–11: During the past month, how much difficulty have you had in each of the following activities due to your shoulder?

7. Putting on or removing a pullover, sweater or shirt:

(A) Unable

(B) Severe difficulty

(C) Moderate difficulty

(D) Mild difficulty

(E) No difficulty

8. Combing or brushing your hair.

9. Reaching shelves that are above your head.

10. Scratching or washing your lower back with your hand.

11. Lifting or carrying a full bag of groceries (8–10 pounds). The following questions refer to recreational or athletic activities.

12. Considering all the ways you use your shoulder during recreational or athletic activities (i.e. baseball, golf, aerobics, gardening, etc), how would you describe the function of your shoulder?

(A) Very severe limitation; unable

(B) Severe limitation

(C) Moderate limitation

(D) Mild limitation

(E) No limitation

13. During the past month, how much difficulty have you had throwing a ball overhand or serving in tennis due to your shoulder?

14. List one activity (recreational or athletic) that you particularly enjoy and then select the degree of limitation you have, if any, due to your shoulder. Activity ……..

The following questions refer to wor. k

15. During the past month, what has been your main form of work?

(A) Paid work (list type of work) …….

(B) Housework

(C) Schoolwork

(D) Unemployed

(E) Disabled due to your shoulder

(F) Disabled secondary to other causes

(G) Retired

If you answered D, E, F, or G to the above question, please

skip questions 16–19 and go on to question 20.

16. During the past month, how often were you unable to do any of your usual work because of your shoulder?

(A) All days

(B) Several days per week

(C) One day per week

(D) Less than one day per week

(E) Never

17. During the past month, on the days that you did work, how often were you unable to do your work as carefully or as efficiently as you would like because of your shoulder?

18. During the past month, on the days that you did work, how often did you have to work a shorter day because of your shoulder?

19. During the past month, on the days that you did work, how often did you have to change the way that your usual work is done ecause of your shoulder?

The following questions refer to satisfaction and areas for improvement.

20. During the past month, how would you rate your overall degree of satisfaction with your shoulder?

(A) Poor

(B) Fair

(C) Good

(D) Very good

(E) Excellent

21. Please rank the two areas in which you would most like to see improvement (place a 1 for the most important, a 2 for the second most important).

Pain ……

Daily personal and household activities ……..

Recreational or athletic activities ……..

Work ……..