CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Musculoskeletal disorders (MSDs) or injuries (MSIs) are a wide range of inflammatory and degenerative conditions affecting the muscles, tendons, ligaments, joints, peripheral nerves, and supporting blood vessels with consequent ache, pain or discomfort (Punnett *et al.,* 2004). They include clinical syndromes such as tendon inflammations and related conditions like tenosynovitis, epicondylitis, bursitis, nerve compression disorders like carpal tunnel syndrome, sciatica; osteoarthrosis, as well as conditions such as myalgia, low back pain and other regional pain syndromes not attributed to known pathology (Punnett *et al.,* 2004; Mazer *et al*., 2010). Body regions most commonly affected are the low back, neck, shoulder, forearm and hand, although recently the lower extremity has received more attention (Punnett *et al*., 2004). Musculoskeletal disorders (MSDs) have been described as the most notorious and most common causes of severe long-term pain and physical disability that affect hundreds of millions of people across the world (Adegoke *et al.,* 2009). MSDs are ranked first in prevalence as the cause of chronic health problems, long term disabilities and consultation with healthcare professionals and also ranked second for causing restricted activity days (Badley *et al*., 1994).

Musculoskeletal disorders are reported to occur in certain industries and among certain occupations with rates up to three or four times higher than the average rates across all industries (Punnett *et al.,* 2004). Common terminologies often inter-changeably used include: Repetitive Motion Injuries (RMI), Repetitive Strain Injuries (RSI), Cumulative Trauma Disorders (CTD), Overuse Syndrome (OS), Regional Musculoskeletal Disorders (RMSD) and Soft Tissue Injuries (STI) (Takala, 2008).

Work-related musculoskeletal disorders (WMSDs) are defined as musculoskeletal disorders and injuries resulting from work-related events (Salik and Ozcan, 2004). Most WMSDs are cumulative disorders, resulting from repeated exposure to high or low intensity loads over a long period of time. However, WMSDs can also result from acute traumas, such as fractures that occur during an accident. The symptoms may vary from discomfort and pain to reduced body function and invalidity (Takala, 2008). Work activities which are frequent and repetitive, or activities with awkward postures cause these disorders which may be painful during work or at rest. Epidemiological studies have shown associations between work-related risk factors such as manual material handling, heavy physical load, repetitive movement, psychological factors and musculoskeletal disorders (Barondess, 2001). Musculoskeletal pains and symptoms are usually not life threatening. Its management involves the substantial use of medical and rehabilitation services. They include the use of drugs (especially the non-steroidal anti-inflammatory drugs) and physiotherapy services. Early referral and rehabilitation have been found to prevent chronic pain and disability associated with musculoskeletal disorders and injury (Owoeye, 1998).

Driving is a multi-system activity that requires a comprehensive assessment of abilities (Chen *et al.*, 2008). It involves the act of operating a motor vehicle or machine in motion. Controlling the steering wheel and the control pedals while driving requires static muscular activities in both the cervical and lumbar regions of the spine, as well as in the large joints of the body such as the shoulders, hips and the knees (Westgaard, 2000). Previous studies have shown high prevalence rates of musculoskeletal and occupational disorders among professional drivers (Hulshof *et al.,* 2006; Szeto and Lam, 2007). A Nigerian study also reported a high prevalence of musculoskeletal pain especially of the lower and upper back regions among commercial drivers and motorcyclists in Lagos Nigeria (Akinbo *et al.*, 2008).

Crash risk factors in driving include emotional factors, bad roads, poor sleep, poor vision and irregular driving time while others are underlying medical conditions, effect of drugs, age, literacy level and musculoskeletal dysfunction (Westgaard, 2000; Gottwald, 2006). Stopped driving is associated with decreased work output, lost social activities, self-actualisation and even depression. This is even when other forms of transport are easily accessible (Legh-Smith *et al.*, 1986). Many people who stopped driving due to health or other reasons see the ability to drive again as a crucial index of recovery (Zomeren and Minderhoud, 1987). Thus returning to driving is a major concern to many individuals who had developed the driving skill prior to injury or disease.

Nearly 1.3 million lives are lost annually from road traffic crashes. More than 270, 000 pedestrians lose their lives on the world's roads while over 50 million people sustain various degrees of injuries and disability from road crashes every year (O’Neill and Mohan, 2002; WHO, 2013). As a result of this growing concern for the menace of road crashes and its far-reaching global consequences, the United Nations Organization (UN) has declared the decade of 2011-2020 as the global decade of action for road safety.

Studies have shown that road traffic crashes are on the increase in Nigeria (Oluwasanmi, 1993; Ohakwe *et al.,* 2011). This is in spite of efforts and campaigns on preventive strategies by the Federal Road Safety Commission and other non-governmental organizations (NGOs) to reduce road carnage in Nigeria. The reverse, however is the case in many developed countries where improvement in technology has resulted in commensurate reduction in road traffic crashes. In the United Kingdom, (which had introduced driving test for disabled drivers since 1930), road traffic fatality in 1934 recorded 7,343 deaths with 2.4million vehicles on Britain's roads. However, in 2007, with over 30million vehicles, death rates from road traffic crashes had drastically declined to only 3,180 (Bruce-Chwatt, 2011). Whereas many of these developed countries have legislatures and policies and regulations guiding driving safety as well as defined paths towards return to driving following some health conditions, the same cannot be said about Nigeria. This study was therefore designed to determine the predictors of return to driving after musculoskeletal disorders, injury or surgery**;** investigate the knowledge, attitude and practice of patients, healthcare practitioners and road traffic safety regulators on return to driving policy and regulation in Nigeria, and to develop a Driving Musculoskeletal Disability Index (DMDI) as an objective and clinical assessment tool to determine suitability of return to driving after musculoskeletal disorders, injury or surgery.

1.2 Statement of the Problem

Due to the heavy burden of cessation of driving on self-actualisation, many patients, including individuals recovering from musculoskeletal disorders, injury or surgery (who are often faced with pressing need to drive) resort to driving even when they are clinically unfit and unsafe. Thus the decision on when a patient can return to driving is a complex decision that should not be made lightly in view of patient and public safety implications and potential legal issues that may arise following road crashes (Chen *et al.*, 2008).

Although the developing countries (including Nigeria) own only 40% of world's motor vehicles, yet they account for 90% of global road fatalities (WHO, 2011). The cost burden of road traffic crashes in Nigeria was recently estimated at N456 billion per annum (FRSC, 2010). Similarly, the World Health Organisation (WHO) places Nigeria at 191 out of 192 countries worldwide with unsafe roads and with 162 death rates from road traffic crashes per 100,000 populations (WHO, 2011).

Not much is known about the extent to which patients and individuals return to driving and the advice or evaluations they receive before returning to driving following various health conditions. This is so as studies are sparse on return to driving assessment following such health conditions. Whereas studies are relatively more available on return to driving following some neurological conditions (Akinwuntan *et al*., 2005), same does not apply to musculoskeletal disorders, injury and surgery including amputation.

Development of return to driving guidelines, model or policy is very important as there is often significant disparity and variation in practitioners' expectations, recommendations and post-operative advice regarding return to driving which may be perceived with different priorities by some health care practitioners, and as a result, many patients remain uncertain about what to expect (Clayton and Verow, 2007).

There is need for a standard objective and generalizable outcome measure to determine suitability to return to driving by an individual who stopped driving as a result of musculoskeletal disorder, injury or musculoskeletal surgery (including amputation). Such tool or index will provide a basis for necessary clinical assessment of the musculoskeletal system and basic functions necessary for driving. The non-availability of such tool has therefore made clinical decisions on the subject of return to driving most inconsistent and difficult. This has often resulted in individuals who drove before their musculoskeletal disorders, injury or surgery resuming driving when they are clinically unfit. Many even return to drive while still on strong analgesic medications, recovering from presenting musculoskeletal conditions (Chen *et al.*, 2008). Such practice have negative effect on driving outcome and result in road traffic crashes of varying fatalities, and hence the need for this study.

1.3 Aim and Objectives

1.3.1 Overall Aim:

The overall aim of the study was to determine the factors predicting return to driving, and to develop a Nigerian Driving Musculoskeletal Disability Index

(DMDI) which is an assessment guide to determine suitability of individuals prior to return to driving after musculoskeletal disorders, injury or surgery.

1.3.2 Specific Objectives

1. To determine factors predicting return to driving following musculoskeletal disorders, injury or surgery.
2. To investigate the knowledge, attitude and practice of patients, healthcare practitioners and road traffic safety regulators on return to driving after musculoskeletal disorders, injury or surgery.
3. To develop a Driving Musculoskeletal Disability Index (DMDI), as a clinical tool to determine the suitability of an individual returning to driving following musculoskeletal disorders, injury or musculoskeletal surgery.

1.4 Significance of the Study

The Driving Musculoskeletal Disability Index (DMDI) may serve as a useful and objective tool in determining suitability of return to driving following musculoskeletal disorders. Findings from the study may lead to improved knowledge of the predicting factors of return to driving. This may further serve as a guide to the health care practitioners, road traffic safety regulators and patients on their respective roles and expectations as stake-holders in road traffic safety. Furthermore, recommendations from the study may assist the various government agencies and policy makers on road traffic safety regulation to enact and implement relevant road traffic rules, regulation and policies which may lead to improved road traffic safety in Nigeria.

1.5 Operational Definition of Terms

Musculoskeletal Disorders: A wide range of inflammatory and degenerative conditions which affect the muscles, tendons, ligaments, joints, peripheral nerves, and supporting blood vessels.

Crash Risk: The tendency of causing or leading to a road traffic crash or accident which may be as a result of engaging in vehicle driving or other means.

Driving: The act of operating a motor vehicle or a machine while in motion. It is a complex multi-system activity which requires a comprehensive assessment of abilities.

Driving Musculoskeletal Disability Index (DMDI): A set of clinical measures and assessment standards applicable for determining return to driving following musculoskeletal disorders, injury or surgery.

Return to Driving Model: A stipulated guideline or accepted pattern of return to driving activity following previous cessation of driving due to injury, disease or other reasons.

Road Traffic Crashes: A collision or incident involving at least one road vehicle in motion, on a public or private road to which the public has right of access, resulting in at least one injured or killed person. This includes collisions between road vehicles; road vehicles and pedestrians; road vehicles and animals or fixed obstacles or with one road vehicle alone or between road and rail vehicles.

1.6 List of Abbreviations/Acronyms

ACL:	Anterior Cruciate Ligament
CCDS:	Collaboration Chain for Driving Safety
DMDI:	Driving Musculoskeletal Disability Index
DVLA:	The Driver and Vehicle Licencing Agency (UK)
DWP:	The Department of Work and Pensions (UK)
FRSC:	Federal Road Safety Commission
MCAP:	Medical Commission on Accident Prevention
MSDs:	Musculoskeletal Disorders
MSIs:	Musculoskeletal Injuries
NOH:	National Orthopaedic Hospital
NSAIDS:	Non-steroidal Anti-inflammatory Drugs
OA:	Osteoarthritis
OT:	Occupational Therapist
PRS:	Policy, Research and Statistics
PT:	Physical Therapist/ Physiotherapist
RA:	Rheumatoid Arthritis
RTDG (N):	Return to Driving Guide for Nigeria
ROM:	Range of Motion
RTC:	Road Traffic Crashes
RTD-PM:	Return to Driving Questionnaire-Patient Model
RTD-PRM:	Return to Driving Questionnaire-Practitioner Model
RTD-RM:	Return to Driving Questionnaire-Regulator Model
SF-36:	Short Form-36 index
SMFA:	Short Musculoskeletal Functional Assessment Index

VIO: Vehicle Inspection Office

WCPT: World Confederation for Physical Therapy

WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index

CHAPTER TWO

LITERATURE REVIEW

2.1 The Musculoskeletal System

The musculoskeletal system is an organ system that gives humans the ability to move using the muscular and skeletal systems. It is made up of the skeleton, muscles, cartilage, tendons, ligaments, joint and other connective tissues that support and bind tissues and organs together (Charlotte, 2000).

The skeletal system is the system of bones, associated cartilages and joints of human body. It serves as a scaffold which supports organs, anchors muscles and protects organs such as the brain, lungs and heart (Miller and Joy, 2007). There are over two hundred and six bones in the adult human skeleton, a number which varies among individuals and with age (Miller and Joy, 2007).

The muscular system is an organ system consisting of skeletal, smooth and cardiac muscles which permits movement of the body, maintains posture and circulates blood throughout the body. Muscles provide strength, balance, posture, movement and heat for the body to keep warm (Miller and Joy, 2007).

2.2 Musculoskeletal Disorders (MSDs)

2.2.1 Definition

Musculoskeletal disorders (MSDs) are a wide range of inflammatory and degenerative conditions affecting the muscles, tendons, ligaments, joints, peripheral nerves, and supporting blood vessels (Punnett *et al.*, 2004). These include clinical syndromes such as tendon inflammations and related conditions (tendinitis, tenosynovitis, epicondylitis, bursitis), nerve compression disorders (carpal tunnel syndrome, sciatica) and osteoarthritis, as well as less well-standardized conditions such as myalgia, low back pain and other regional pain syndromes not attributable to known pathology (Punnett *et al*., 2004; Mazer *et al*., 2010).

Body regions most commonly involved are the low back, neck, shoulder, forearm, and hand, although recently the lower extremity has received more attention (Punnett and Wegman, 2004). MSDs may result from acute trauma, such as fractures from accident and also from degenerative conditions such as arthritis. MSDs are widespread in many countries, with substantial costs and impact on the quality of life of individuals (Punnett and Wegman, 2004). It also represents one of the leading causes of occupational injury and disability in developed and developing countries (WHO, 1985; WHO, 2009). Common terminologies often interchangeably applied include: Repetitive Motion Injuries (RMI), Repetitive Strain Injuries (RSI), Cumulative Trauma Disorders (CTD), Overuse Syndrome (OS), Regional Musculoskeletal Disorders (RMSD) and Soft Tissue Injuries (STI).

Work-related musculoskeletal disorders (WMSDs) are disorders of the muscles, skeleton and related tissues which have been empirically shown or are suspected to have been caused by workplace activities such as repetitive activity, static and awkward posture (Centres for Disease Control, 2011). They are often cumulative disorders resulting from repeated exposure to high-or low-intensity loads over a long period of time (Salik and Ozcan, 2004).

2.2.2 Prevalence of MSDs

Accurate data on the incidence and prevalence of musculoskeletal disorders are difficult to obtain and official statistics are difficult to compare across countries. However, MSDs represent the single largest category of work-related illnesses, comprising a third or more of all registered occupational diseases in the United States, the Nordic countries, and Japan (Pope *et al*., 1991; Punnett and Wegman, 2004). It causes more work absenteeism or disability than any other group of diseases (Badley *et al.*, 1994; Feeney *et al*., 1998; Punnett and Wegman, 2004). The prevalence of musculoskeletal disorders reported in the large joints, such as the hips, ankles and elbows was found to be higher with age (Porter and Gyi, 2002). However a higher prevalence was reported by Szeto and Lam, (2007) among the younger age groups.

Higher prevalence of musculoskeletal pain has been reported in women than in men (Wijnhoven *et al*., 2006; Kröner-Herwig *et al*., 2012). In a study by Wijnhoven *et al*. (2006), the prevalence rates of musculoskeletal pain were higher for women than for men in the Dutch general population aged 25 to 64 years on the basis of 2 population-based surveys. They also reported that 39% of men and 45% of women presented with chronic complaints. Highest female predominance was found for the hip and wrist/hand, whereas lowest and not statistically significant sex differences were found for the lower back and knee. All duration parameters of musculoskeletal pain showed a female predominance of musculoskeletal pain (Wijnhoven *et al*., 2006).

Work-related musculoskeletal disorders (WMSDs) affect workers in various occupations. These include physiotherapists (Adegoke *et al*., 2008; Darragah *et al*., 2012), nurses, mid wives and physicians (Long *et al*., 2012) and drivers (Szeto and Lam, 2007; Alperovitch-Najenson, 2010). Driving places an enormous challenge on the musculoskeletal system. The act of controlling the steering wheel and the control pedals during driving requires static muscular activities particularly in both the cervical and lumbar regions of the spine, as well as in many large joints of the body such as the shoulders, hips and knees (Westgaard, 2000).

2.2.3 Pathophysiology of Musculoskeletal Disorders

Several structures have been shown to cause pain: bones, nerves, discs, longitudinal ligaments, muscles, facet joint and dura are capable of evoking pain, when irritated or inflamed (Nilsson, 2002). It is however, unclear whether there are specific tissues that might be affected by certain work types. Symptoms can be classified as nociceptive or neuropathic depending on the source of pain. Nociceptive pain can be defined as local pain originating in C-fibres from muscle, bone, joint, tendon or tendon insertion. Neuropathic pains originate in nerves, exhibiting clinical manifestations such as positive symptoms like pain and paraesthesia; negative symptoms like numbness, reduction or absence of sensitivity, loss of proprioception and provocative symptoms like dysaesthetic symptoms when the nerve is stressed by compression, tapping or stretching (Nilsson, 2002).

Maintenance of static exertion for prolonged time compresses veins and capillaries inside the muscles, causing micro-lesions due to the absence of oxygenation and nutrition. All these factors can cause imbalance, fatigue, discomfort and pain due to the disruption of tissues (Bruno *et al.,* 2008).

2.2.4 Causes of MSDs

Major causes of musculoskeletal disorders and injuries include physical factors such as prolonged sitting (Pope *et al.,*1998), physical ergonomic features of work such as rapid work pace and repetitive motion, forceful exertions, poor, awkward or non-neutral body postures, vibration, heavy lifting and rapid hand and wrist movements (Massaccesi *et al.,* 2003; Punnett and Wegman, 2004). Other causes include trauma and road traffic crashes often associated with whole-body vibration for extended periods of time.

Musculoskeletal injuries resulting from road traffic crashes are often debilitating and require early assessment and treatment (Mogaka *et al*., 2011). Different body parts may be injured but the severity depends on the size and direction of the impact on the musculoskeletal system (Takala, 2008). Common musculoskeletal conditions often resulting from road traffic crashes include whiplash injuries, back and spinal injuries, joint injuries and amputation (Mogaka *et al*., 2011)**.** Other consequences of chronic degenerative conditions, such as osteoarthritis may also lead to musculoskeletal disorders (Mansfield, 2005; Mogaka *et al*., 2011).

2.2.5 Signs and Symptoms of Musculoskeletal Disorders

The signs and symptoms of musculoskeletal disorders vary from discomfort, pain, joint stiffness, decreased range of motion, loss of function, muscle tightness, inflammation, redness, sensations of "pins and needles," tenderness, muscle weakness, numbness, fatigue, reduced grip strength, skin colour changes and reduced body function (Punnett and Wegman, 2004). Other signs and symptoms may include dry itchy or sore eyes and blurring or double vision (Takala, 2008). Common sites for musculoskeletal disorders are the upper limbs (including the hands, wrists, elbows and shoulders), neck, back and the lower limbs (including the hips, knees and ankles). Findings by Leino (1989) established a relationship between symptoms of stress and musculoskeletal morbidity whereas Merlino *et al.* (2003) in their study on the symptoms of musculoskeletal disorders among apprentice construction workers identified low back pain as the most reported symptom of musculoskeletal disorders (54.4%). Similarly, low back pain was reported as the most common reason for seeking care from a physician (16.8%) and absenteeism from work (7.3%). In a cross sectional study on musculoskeletal symptoms and computer use among Finnish adolescents, the authors reported moderate to severe pain intensity in the neck-shoulders (21%); head (20%); and eyes (14%); and moderate to severe inconvenience to everyday life due to head (29%), neck/shoulders (21%), and the low back (16%) (Hakala *et al.*, 2012).

2.2.6 Risk Factors For Musculoskeletal Disorders

Risk factors associated with musculoskeletal disorders are classified into physical factors and individual factors. They include age, gender, weight, height, obesity, Body Mass Index (BMI), socio-economic status, ethnicity and general health status of the individual (Hulshof *et al*., 2006). Others include smoking, muscle strength and other aspects of work capacity (Punnett and Wegman, 2004).

In addition to occupational work demands, other aspects of daily life, such as non-occupational, sports and domestic activities may present as physical stresses to the musculoskeletal tissues. Relative presentation of degenerative causes of musculoskeletal disorders such as osteoarthritis increases with age.

2.2.7 Physical Factors Associated with Musculoskeletal Disorders

2.2.7.1 Prolonged Sitting

Studies have associated prolonged sitting with the development of low back pain in individuals and as a risk factor for acute herniated lumbar disc in males (Owoeye, 1998). In a systematic review, Lis *et al.,* (2007) found that sitting itself does not increase the risk of low back pain, but that sitting for more than half a workday increases the likelihood of having low back pain and associated sciatica.

2.2.7.2 Posture

Posture is defined as a position or attitude of the body, the relative arrangement of body part for a specific activity or a characteristic manner of bearing one’s body (Smith *et al.,* 1996). Movement begins from a posture and may end in a posture as when a person is in sitting position and then moves to a standing position. Low and Reed (1996) suggested that excessive periods spent in a poor sitting position may contribute to the deterioration of lower lumbar intervertebral disc with consequent back pain. Sedentary workers have back pain due to prolonged sitting position which causes pressure on the disc, diffusion is reduced and the discs are deprived of nutrition, resulting in low back pain (Owoeye, 1998).

Sinaki and Morki (2000) defined poor posture as that which reduces the lumbar lordosis and places the ligament structures of the back under full stretch. Awkward, repeated and prolonged postures, overstressing movements, high repetition or forces can overload the tissues and exceed their threshold of intolerable stress, resulting in musculoskeletal disorders (Bruno *et al.*, 2008).

In normal posture, the line of gravity passes from C1 to C7 vertebral bodies to T10 and the lumbosacral junction and passes through the common axis of the hip joints or slightly behind it. It passes in front of the sacroiliac articulation and knee joint and then in front of the ankle joint. Posture is maintained through backward and forward swaying of the line of gravity (Braddom, 2000). Normally, this sway has only a limited range. Therefore, in comparison with other postural changes, normal postures require the least amount of paraspinal muscular recruitment (Braddom, 2000). Driving function entails a sustained (sitting) posture and controlling the steering wheel and the control pedals require static muscle activities in the cervical and lumbar spine, as well as in the large joints such as the shoulders, hips and knees (Westgaard, 2000).

2.2.7.3 Whole Body Vibration (WBV)

The term 'the whole- body vibration' means the mechanical vibration that when transmitted to the whole body, entails risks to the health and safety of workers, in particular lower back morbidity and trauma of the spine (EC, 2002). Vibrations arise when a body moves back and forth due to external and internal forces.

In five European countries (Belgium, Germany, Netherlands, France and Denmark), low back pain (LBP) and spinal disorders due to WBV are currently recognized as occupational diseases (Hulshof *et al.,* 2006). However, high exposures and adverse effects still occur as WBV is a common occupational risk or LBP, affecting 4-8% of the workforce in industrialized countries (Palmer *et al.,* 2000). The transmission of vibration to the body is dependent on body posture. The effects of vibration are therefore complex. Exposure to whole- body vibration causes motions and forces within the human body which may cause discomfort, adversely affect performance, aggravate pre- exciting back injuries and present a health and safety risk

2.2.8 Individual Factors Associated with Musculoskeletal Disorders

2.2.8.1 Age

The prevalence of musculoskeletal troubles reported in the large joints such as the hips, ankles and elbows was found to be higher with age whereas the age group with the highest rate of compensable back pain and strains are the 20-24 age groups for men and 30- 34 age groups for women (NIOSH, 2007). Szeto and Lam (2007) found that the younger age groups tended to show higher prevalence rates of back pain whereas longitudinal studies have shown the risk of neck pain to be highest at age group of 30-40years (Croft *et al.,* 1996).

2.2.8.2 Gender

Being female is often described as a “risk factor” for musculoskeletal disorders (MSDs), as many studies of the general population and large employed groups have reported prevalence twice as high among women as men (Punnett and Herbert, 2000). Ariens *et al.*, (2000) showed a prevalence of pain in more females (40%) than in males (25%). Hooftman *et al*., (2005) examined gender differences in occupational exposures contributing to WMSDs and found that women are often assigned less physically strenuous jobs in many workplaces. Some data suggested that men experienced more MSDs than women when exposed to similar levels of physical stressors although women may have a higher background risk; women may also be more likely than men to leave work due to work- related MSDs (Punnett and Herbert, 2000).

2.2.8.3 Smoking

A positive association has been found between smoking and back pain in many, but not all of the epidemiological surveys that have examined the link (Croft *et al.,* 1996).Smoking might provoke disc herniation through cough, or lead to pathological changes in the intervertebral disc through alteration in its nutrition, pH or mineral content (Palmer *et al.,* 2002). In a few studies, an association has also been described between smoking and pain at other body sites, including the neck (Makale *et al.,* 1991), shoulder (Ekberg *et al.,* 1994) and the legs (Brage and Bjerkedal, 1996).

2.2.9 Regional Musculoskeletal Disorders

2.2.9.1 Neck

Most of the epidemiological studies reviewed defined “repetitive work” for the neck as work activities which involve continuous arm or hand movement which affect the neck/ shoulder musculature and generate loads on the neck/

shoulder area while fewer studies examined relationships based on actual repetitive neck movement (NIOSH, 1997).

2.2.9.2 Shoulder

Shoulder MSDs and their relationship to work factors have had extensive review in previous studies (Westgaard and Jansen, 1992). Epidemiological literature is most convincing regarding work-relatedness of shoulder tendinitis, especially showing an increased risk for overhead and repetitive work. **Tendinitis** is inflammation (redness, soreness and swelling) of a tendon. In shoulder tendinitis, the rotator cuff and/ or biceps tendon become inflamed, usually as a result of being pinched by surrounding structures. The injury may vary from mild inflamed to involvement of most of the Rotator cuff. When the rotator cuff becomes inflamed and thickened, it may get trapped under the acromium. Such squeezing of the rotator cuff is described as impingement syndrome.

2.2.9.3 Elbow, Wrist and Hand

Upper limb pain is a problem in the industrialized countries (Bernard, 1997). In Finland, the most common occupational disease group (for which compensation is paid by an insurance company) is the repetitive strain injury of the upper limb, with a total of 1488 cases reported in 2001.

Physical risk factors associated with upper limb disorders are high demanded force (Stetson *et al.*, 1993), repetitive movements, non- neutral postures, cold temperature and hand-arm vibration. A combination of these risk factors has been associated with upper limb disorders (Silverstein *et al.*, 1987; Van der

Windt *et al.,* 2000). The specific disorder that has been studied the most is the carpal tunnel syndrome whereas fewer studies have been carried out on epicondylitis, wrist tendinitis and hand-arm vibration syndrome. Vibration has been associated with carpal tunnel syndrome even though the mechanism by which vibration contributes to the development of the syndrome is not completely understood. There is also evidence that repletion and force separately are related to the carpal tunnel syndrome (Bernard, 1997). It is also possible that a cold environment and local mechanical pressure can increase the risk for the carpal tunnel syndrome, whereas individual factors such as gender, obesity and older age have been found to increase the risk for the syndrome (Viitari-Juntura *et al*, 1996).

Epicondylitis has been reported as a work-related disease in a number of studies and that its highest incidence occurs in occupations and jobs which are manually intensive and have high work demands such as meat-packing and construction work (Kurppa *et al.,* 1991). Epidemiological studies have shown evidence of an association between forceful work and epicondylitis. Also, work task implying a combination of risk factors (force and repetition, force and posture), especially at high exposure levels, increase the risk for epicondylitis (Bernard, 1997). The only individual factor that has been associated with epicondylitis is age (Viitari-Juntara *et al.,* 1996).

Hand / wrist tendonitis: According to Bernard *et al.,* (1997) there is an association between hand / wrist tendonitis and repetition, force and posture (each of the risk factors alone and in combinations). Among the individual factors, a higher risk of hand-wrist disorders has been found among women and newly employed workers (Hakkanen *et al.*, 2001).

Hand-Arm Vibration Syndrome: People in occupations involving a high level of exposure to vibration from tools are liable to the hand- arm vibration syndrome. Studies on vibration have shown evidence of a clear association between a high level of exposure to vibration and the hand- arm vibration syndrome (Bernard, 1997; Palmer *et al.*, 2000). According to Skakibara and Yamada (1995), hand-arm vibration activates the sympathetic nervous system which induces vasoconstriction in the feet even though they are not directly exposed to vibration. However, Hagberg (2002) concluded in a review that although there is strong evidence that jobs with vibrating machines or tools are associated with musculoskeletal disorders, there is not sufficient evidence that vibration would be a risk factor for musculoskeletal disorders.

2.2.9.4 Low Back

Work-related musculoskeletal disorders, especially low back pain (LBP), cause substantial economic losses to individuals as well as to the community (Alperovitch-Najenson *et al.,* 2010). It often presents as a chronic dull aching pain of varying intensity that affects the lower spine and may spread to the lower limb(s) (Sinaki and Morki, 2000). Although very common among various jobs and industries, studies have shown that low back disorders are particularly prevalent among certain occupations (Helmkamp *et al.,* 1984; Hilman *et al.,* 1996). Early studies have indicated that sitting without lumbar support and a backrest could increase disk pressure and the electro-myographic activities of back muscles (Alperovitch-Najenson *et al.,* 2010). These findings led to the general belief that prolonged sitting is harmful to the lumbar spine.

2.3 Driving Function

2.3.1 Definition

Driving is a complex and multi-system activity that requires a comprehensive assessment of abilities (Chen *et al.*, 2008). Although the functions necessary for driving may be described individually, driving is a perceptual-motor skill which usually takes place in a complex environment and requires some functions to operate. These are together categorized as cognitive, motor, or sensory (Melvin, 2012). Driving is an act of controlling a motor vehicle in motion. Controlling the steering wheel and the control pedals while driving requires static muscular activities in both the cervical and lumbar regions of the spine, as well as in other large joints of the body such as the shoulders, hips and knees (Westgaard, 2000). The driver requires sufficient cognitive, visual and motor skills and an ability to process multiple simultaneous environmental cues in order to make rapid, accurate and safe decisions (Waller, 1980; Yale *et al*., 2003).

2.3.2 Impact of Musculoskeletal Disorders on Driving Function

Musculoskeletal disorders (MSDs) significantly impact on the quality of life and lead to lost work time due to absenteeism, increased work restriction, job transfer and disability than any other group of diseases (Badley *et al.*, 1994; Punnett *et al*., 2004); with a considerable economic toll on the individual, the organization and the society as a whole (Tinubu *et al*., 2010). Silverstein *et al.*, (1987) reported repetitive movement, awkward postures and high force levels as the three primary risk factors that have been associated with MSDs. Work-related musculoskeletal disorders (WMSDs) constitute an important occupational problem in both developed and developing countries, with rising costs of wage compensation and medical expenses, reduced productivity and lower quality of life (Chaffin *et al.*, 1993; Karwoski *et al*., 2003). WMSDs are often caused by multi-factorial interactions of various risk factors. These risk factors can be classified as individual, psychosocial and physical. Physical workload relates to body posture, repetitive and forceful activities, static muscle load, mechanical stress, vibration and cold (Kumar, 2001; Karwoski, 2003). These risk factors are often predominant during driving function.

Driving has been identified as a high risk factor towards developing musculoskeletal disorders due to prolonged sitting and vibratory exposure (Hulshof *et al*., 2006). Similar findings were reported in studies among drivers in the United States of America, Europe and Asia (Szeto and Lam, 2007) where musculoskeletal symptoms were most frequently reported on the neck, shoulders and the lower back (Krause *et al*., 1997). Musculoskeletal disorders often present with pain, swelling, loss or reduced range of joint motion and function. Therefore musculoskeletal disorders affecting body parts such as the neck, back and upper and lower limb joints, may present with pain which will affect motor function and driving coordination. A reduced range of joint motion may cause inability to rotate the neck for a full outer range view needed for driving or reversing activity. Similarly, limb stiffness as a result of long-standing effect of MSDs may make smooth driving function impossible just as a weak grip function will make the ability of a good hold of the steering-wheel difficult. Therefore the overall cumulative effect of disorders affecting a single or multiple part of the musculoskeletal system related to driving is a reduction in driving alertness, increased reaction time due to slower reaction speed which culminate in a compromised driving safety leading to a continuous rise in reported road traffic crashes.

However, the overall impact of musculoskeletal disorders may be less felt due to under-reporting of health conditions (Teutsch and Churchill, 2000). This challenge is even worse with developing and less-industrialized countries, including Nigeria due to low awareness and poor access to health care facilities and personnel, lack of facility for trauma registry, poor or non-existent health insurance policy, job insecurity and poverty. Some peculiar cultural and religious beliefs in some parts of Nigeria and other developing countries further discourage divulging certain information concerning lives or deaths, making it impossible to have a reliable birth and death registry. There is therefore a fundamental under-reporting of the impacts of musculoskeletal disorders on driving function, making it difficult to develop a reliable data base for health conditions in Nigeria.

2.3.3 Classification of Functional Impairments

Functional impairments affecting driving may be classified as follows:

(a) Persistent Impairment

This denotes an on-going or continuous impairment to a function necessary for driving. The potential impacts of persistent impairments on the functions necessary for driving are generally measurable, testable and observable. Although the condition may be progressive, the progression is usually slow and sudden deterioration is unlikely. Persistent impairments may be stable (such as in loss of a limb) or progressive (such as in arthritis).

(b) Episodic Impairment

This is as a result of a medical condition that does not have any on-going measurable, testable or observable impact on the functions necessary for driving but that may result in an unpredictable sudden or episodic impairment (Melvin, 2012).

Many health conditions may impair safe driving function to varying extents. However, conditions which may significantly affect safe driving include medical, neurological and musculoskeletal conditions. Whereas neurological conditions may affect cognitive and spatial functions, musculoskeletal conditions mainly cause impairments of motor function which are often persistent in nature (Melvin, 2012). Other medical conditions such as psychiatric and diabetic conditions are sensory and episodic in presentation while renal and respiratory conditions may affect stamina and general debility (Table 1).

Table 1: Medical Conditions and Impact on Driving Function (Melvin, 2012)

Condition	Nature of Impairment		Function Impaired						Others	
	Persistent	Episodic	Motor		Cog	Sensory		All/SI	Stamina	GD
				Sensori-motor		Vision	Hearing			
1. Diabetes- Hypoglycaemia		X			●			●		
2. Peripheral arterial diseases- severe claudication	X		●	●						
3 AAA		X						●		
4. Aortic dissection		X						●		
5. DVT- Pulmonary embolism		X								
6. Musculoskeletal disorders	X		●					●		
7. Renal diseases	X				●				●	●
8. Respiratory diseases	X				●				●	●
9. Vestibular disorders	X	X		●	●			●		
10. Cardiovascular diseases	X	X								
11. Hearing loss	X				○		●	●		
12. Psychiatric disorders		X								
13. Cerebrovascular disorders		X								
14. Vision impairment	X					●		●		
15. Syncope		X						●		
16. Seizures and epilepsy		X						●		
17. MS, Cerebral Palsy, Parkinson's	X									
18. Traumatic brain injuries	X	X	● ●			● ● ●	●	●		
19. Intracranial tumours	X	X	●			● ●	●	●		
20. Cognitive impairment including dementia	X					●				
21. Sleep apnea	X	X				●		●		
22. Narcolepsy	X	X				●		●		

Key: Cog" =Cognitive, SI" =Sudden Incapacitation, GD" General Debility

AAA= (Abdominal Aortic Aneurysm)

2.3.4 Assessment of Driving Function

Assessment of fitness to drive is often difficult because of the multiple and confounding variables, as different disease conditions vary in their severities. Furthermore due to the subjective nature of driving evaluation, an acceptable level of performance may depend upon each evaluator's judgment and threshold (Bloedow and Adler, 1992). Functional ability with regards to driving outcomes involves the following:

Cognitive: Individuals with progressive or irreversible declines in cognitive function cannot compensate for a cognitive impairment. Table 2 shows cognitive functions needed for driving.

Motor: Study results on motor function and driving indicate considerable variability in the association between the different motor functions and driving outcomes. Thus a significant level of impairment in motor functions is required before driving performance is affected to an unsafe level (Table 3).

Sensory (vision): Studies investigating the relationship between visual abilities and driving performance are, for the most part equivocal, as significant level of visual impairment will affect driving performance (Melvin, 2012). Table 4 presents some sensory functions needed for driving.

Table 2: Cognitive Functions Needed for Driving (Melvin, 2012)

Function	**Description**	**Example in the driving context**
Divided attention	The ability to attend to two or more stimuli at the same time	Attending to the roadway ahead while being able to identify stimuli in the periphery.
Selective attention	The ability to selectively attend to one or more important stimuli while ignoring competing distractions	Isolating the traffic light from among environmental stimuli
Sustained attention (vigilance)	The capacity to maintain an attentive activity over a period of time	Attending to the roadway ahead over an extended period of time
Short- term or passive memory	The temporary storage of information, or the brief retention of information, that is currently being processed in a person's mind	Remembering roadway sign information such as that related to free-way exits or construction areas; signs related to caution ahead etc
Working memory (the active component of short-term memory)	The ability to manipulate information with time constraint/ taking in and updating information	Processing environmental information related to the driving task on a busy freeway
Long term memory	Memory for personal events (autobiographical memory) and general world knowledge (semantic memory)	Knowing (a) your way from home to the grocery store (b) the meaning of traffic signs and the rules of the road
Choice/ complex reaction time	The time taken to respond differentially to two or more stimuli or events	Responding when a cat darts onto the edge of the road, at the same time a pedestrian steps onto the road way.

Table 3: Motor Functions Needed for Driving (Melvin, 2012)

Function	**Description**	**Example in the Driving Context**
Coordination	The ability to execute smooth, accurate, controlled movements	Executing a left hand turn, shifting gears etc.
Dexterity	Readiness and grace in physical activity, especially an ease in using hands	Inserting keys into the ignition; operating vehicle controls etc.
Gross motor ability		Gross range of motion and strength of upper and lower extremities, grip strength, proprioception and fine and gross motor coordination
Range of motion	The degree of movement a joint has when it is extended, flexed and rotated through all its possible movements	Range of motion of the extremities-(eg ankle flexion and extension) is needed to reach the gas pedal and brake and upper body range of motion (eg shoulder and elbow flexion) is necessary for turning the steering wheel. Range of motion of the head and neck is necessary for looking at the side and rear for vehicles and for identifying obstacles at the side of the road or cars approaching from a side street.
Strength	The amount of strength a muscle can produce	Lowering the brake pedal
Flexibility	The ability to move joints and muscles through their full range	Getting in and out of the car, operating vehicle controls, fastening seat belts

Table 4: Sensory Functions Needed for Driving (Melvin, 2012)

Function	Description	Example in the driving context
Acuity	The spatial resolving ability of the visual system, e.g., the smallest size detail that a person can see.	Reading directional signs
Visual field	An individual's entire spatial area of vision when fixation is stable, i.e., the extent of the area that an individual can see with the eyes held in a fixated position	Seeing cars approaching from the left or right
Contrast sensitivity	The ability to perceive differences between an object and its background, e.g., the ability to detect a gray object on a white background or to see a white object on a light gray background	Seeing traffic lights or cars at night
Glare recovery	The process in which eyes recover visual sensitivity following exposure to a source of glare	Adapting to the reflection of the sun from a car dashboard or oncoming headlights when driving at night
Perception	The process of acquiring, interpreting, selecting and organizing sensory information	

Assessment of suitability or fitness to drive is often subjective as no single measurement can best predict driving performance (Yale *et al*., 2003). Thus driving performance depends on the driver's experience with street signs, road conditions, time of the day and familiarity with the route of travel. Approaches utilized in driving assessment for cognitive and driving performance cutting across many health conditions include neuropsychological tests, simulators, and on-the-road tests (Yale *et al*., 2003).

Neuropsychiatric Assessment: Neuro-psychologic tests used to assess the integrity of a wide range of higher cognitive and perceptual abilities associated with driving safety include the Wechsler Adult Intelligence Scale III (WAIS III), Kaufman Brief Intelligence Test (K-BIT), Controlled Oral Word Association (COWAT) and Aphasia Screening Examination Test (Yale *et al*., 2003).

Simulation: Driving simulation provides a training environment by creating virtual realities that imitate real-life driving situations through realistic controls, gauges, transmission and instrumentation. It involves the use of rear view mirrors which limit real-road scenarios and accepting commands from the trainee which are relayed back to the machine via devices designed as vehicle parts, connected to the machine (Yale *et al.*, 2003). Driving simulators are increasingly being used in training and research as they provide useful information about how drivers act in dangerous driving conditions. A major complication of driving simulator use is simulator sickness (Fagbemi and Pfeffer, 2006). This isoften as a result of age-related cognitive adaptation challenges observed mainly among the elderly adult drivers. Benefits of simulation include that it provides a light, fast and effective driving training through different environmental conditions, such as in rain or fog. It also assists to continuously assess the progress selectively or collectively. The system continuously records the faults committed by the trainee whereas the instructor can inject on-line faults and obstacles to assess the reactions of trainees.

Off and On-Road Assessment: Off and On-road assessment methods are considered the acceptable reference standard. However this method is limited and often fails to detect subtle deficits in psychological and psychomotor skills (Galski *et al.,* 1997).

Off-road testing may be useful for screening functional ability and determining which patients should proceed to additional on-road testing. These tools are also useful in patients with disabilities for evaluating their need for adaptive equipment prior to proceeding to on-road assessment (Gianutsos *et al*., 1992).

The on-road test has been described as a safe, reliable and valid method of assessing driving skills (Shute and Woodhouse, 1990; Odenheimer *et al*., 2004) as it measures standards for qualitative and observational scoring, with internal validity, reliability and reproducibility (Yale *et al*., 2003).

2.3.5 Major Factors Influencing Driving Safety

Return to driving function may be influenced by factors which have direct impact on driving performance and safety. Such factors include pain, physical function, range of joint motion and grip strength (Kristin and MaryFran, 2009; Westropp *et al.,* 2011).

Pain: Pain is defined as an unpleasant sensory or emotional experience associated with actual or potential tissue damage, or described in terms of such damage

(WHO, 2009). It is a feeling or expression of distress, suffering, or agony, caused by stimulation of specialized nerve endings. Its purpose is chiefly protective; it acts as a warning that tissues are being damaged and induces the sufferer to remove or withdraw from the source.

Physical Function: Commonly studied physical functions include activities such as walking and climbing stairs (Kristin and MaryFran, 2009). Limitations in physical functioning are important to consider because of their widespread prevalence and their link to decreased quality of life, increased risk of disability, falls and fractures, and depression, resulting in increased health care costs (Kristin and MaryFran, 2009).

Joint Range of Motion: The range of motion of a joint is an indication of how the joint, the entire musculoskeletal system and the individual are free to function. Any limitation in joint range implies some restriction in the body's function which relatively affects performance. Depending on the function of any joints of the musculoskeletal system, standard and anatomically acceptable range of motion applies. Although slight variations may exist (especially in children and athletes), an acceptable mean range exists for every joint in the human body appropriate for varying ages (such as for children or adults). Limitations in joint range due to disease or other reasons may lead to reduced reaction or response speed in driving which constitutes crash risk. Therefore, ranges of motion of all joints should be assessed prior to return to driving.

Grip Strength: The grip strength is often an indication of the strength of individuals (Westropp *et al.,* 2011). Good grip function is necessary for safe driving in order to ensure a secure hold and control of the steering wheel. A calibrated, hand held dynamometer is a clinical tool to assess grip strength (Davis *et al*., 2000) with standard accepted mean grip strength for adult males and females respectively (Soucie *et al.*, 2010).

2.3.6 Return to Driving Following Health Conditions

Stopping driving is associated with lost social activities and depression, even when other forms of transport are easily accessible (Legh-Smith *et al*., 1986). Many people who stopped driving as a result of injury or other health conditions therefore see their ability to drive again as a crucial index of recovery (Zomeren and Minderhoud, 1987).Various health conditions may lead to stopped driving among individuals in a driving population. These may be grouped as medical, neurological and musculoskeletal. Among these, neurological conditions, especially traumatic brain injury (McMillan and Greenwood, 1991) and stroke (Yale *et al*., 2003; Akinwuntan *et al*., 2005) have received a wider attention in previous reviews, whereas musculoskeletal conditions have been least evaluated (Chen *et al*., 2008).

In the United Kingdom (UK), the British Society of Rehabilitation Medicine in 1998 estimated that the overall annual incidence of traumatic brain injury is about 300/100,000. As most victims are young, it was further estimated that as many as 500,000 persons in the UK lived with the consequences of their injury (McMillan and Greenwood, 1991). The Driver and Vehicle Licensing Agency (DVLA) in the UK requires that drivers report to it, if they have any disability which is likely to last for more than 3 months and which may affect their fitness to drive. Furthermore, the Medical Commission on Accident Prevention (MCAP) produces a guide for medical practitioners which advises that after serious head injury, patients should abstain from driving for 6 to 12 months unless clinical recovery is full and complete (Taylor, 1995). Similarly, the American Medical Association recommends that persons with cerebrovascular accidents that result in disturbances in higher cortical function should cease driving (Yale *et al*., 2003).

Although traumatic brain injury may be "a hidden disability" in which the individual may seem physically normal, they may often present with considerable cognitive, social, emotional, behavioural and long term psychosocial problems. These features may affect judgment, temperament, and tolerance towards other drivers if they do return to driving. Musculoskeletal disorders, on the other hand, often present with physical characteristics which may include pain, reduction in physical (including grip) function, range of joint motion as well as reaction speed in driving.

Wide variations exist in the recommended duration of return to driving by health care practitioners following the same or similar health conditions such as neurological (McMillan and Greenwood, 1991), surgical (Ratzon *et al*., 2006; Clayton and Verow, 2007) and musculoskeletal conditions (Clayton and Verow, 2007). The Department of Work and Pensions (DWP) in 2012, produced an evidence-based return to work guide for some surgical procedures, however, the awareness and use of these guidelines are widely unknown (Clayton and Verow, 2007). In their study, Clayton and Verow found large variations in the advice offered to patients about when they can return to work or driving. These findings reflect similar result from a more detailed retrospective study of patients who had undergone the same procedures (Clayton and Verow, 2007). Ratzon *et al*. (2006)

reported that surgeons' post-operative advice vary widely and have a direct influence on how long patients are absent from work following surgery. This finding is also in agreement with that by Clayton and Verow (2007) who explored what advice is being given to patients by health care practitioners in respect of two common surgical procedures- Benign Abdominal Hysterectomy (BAH) and Birmingham Hip Resurfacing (BHR). Health care practitioners who participated in the study included occupational physicians, general practitioners, consultant obstetricians and gynaecologists within the Sandwell and West Birmingham NHS Trust, and Consultant Orthopaedic Surgeons at the Birmingham Orthopaedic Hospital. Study finding showed that opinions of health care practitioners regarding the ability of a patient to return to heavy physical labour (such as driving) following hip surgery were inconsistent. Although 14% of the respondents advised patients that they could return to such work, (74%) expected them to return only occasionally. This was also reflected in the response from Orthopaedic surgeons, where 77% only occasionally advised patients to return to heavy physical work. Result also showed that out of eleven patient information leaflets (hip replacement/ resurfacing) examined, respondents offered advice regarding driving only in four instances. Whereas three suggested return within 5–6 weeks post-operatively; one advocated that patients refrain from driving for 3 months while one advised that the patients should feel confident to do an emergency stop, and that the patient's vehicle insurer should be informed. Further study findings showed a lack of clarity regarding the likely length of absence following surgery. This finding therefore can be an obstacle for employers and employees wishing to establish earlier rehabilitation programmes who would not wish to go against the advice of health care practitioners (Clayton and Verow, 2007). Dasinger *et al*. (2001) further reported that more pro-active communication about return to work can result in a 60% improvement in return to work times while advocating that improved awareness and pro-active advice by health care practitioners may significantly impact upon their patient's rehabilitation and recovery times. On awareness of evidence-based guidelines, Clayton and Verow, (2007) reported very little or no awareness on the BAH return to work times by hospital consultants and general practitioners. They further recommended a standardized guidance similar to that provided within the USA Official Disability Guidance in order to assist health care practitioners and employers in their efforts to facilitate more consistent and timely return to work programmes for individuals recovering from musculoskeletal conditions and surgery.

2.4 Road Safety: A Global Burden

Road traffic injuries are a major, but often neglected public health challenge requiring concerted effort for effective and sustainable prevention (Elliot, 2000). Worldwide, an estimated 1.24 million people are killed in road crashes each year and as many as 50 million others sustain various degrees of injury (WHO, 2013); About 3,000 people worldwide die each day from road traffic crashes. It is also projected that these figures will increase by 65% in the next 20 years unless there is new commitment to prevention of road crashes (O'Neill and Mohan, 2002; WHO, 2011). Without appropriate action, by 2020, road traffic injuries are predicted to become the third global burden of disease and injury (WHO, 2011). Whereas low income and middle income countries account for about 85% of these deaths, more than half of the people killed are young adults aged between 15-44 years (Hoffman *et al.*, 2005) and who often are bread winners in their family (WHO, 2011).

The economic cost of road traffic crashes and injuries is estimated at 1% of the Gross National Product (GNP) in low income countries, 1.5% in middle income countries and 2% in high income countries whereas the global cost is estimated at $518 billion annually (WHO, 2011). Low income and middle income countries account for $65 billion. According to World report on road traffic injury prevention released by WHO and World Bank in 2011, comparatively, little is spent on road traffic research and development when compared to other diseases such as HIV/AIDS. An estimated $919-985 million was spent on HIV/AIDS compared to $24-33 spent on road traffic crashes (WHO, 2011).

The WHO recently released the Global Road Safety status report for 2013. The report indicates that worldwide the total number of road traffic deaths remains unacceptably high at 1.24 million per year. It also states that only 28 countries (covering only 7% of the world's population) have comprehensive road safety laws on all five key crash risk factors which include drinking and driving, speeding, failing to use motorcycle helmets, seat belts and child restraints (WHO, 2013). This report serves as a baseline for the Decade of Action for Road Safety 2011-2020, declared by the United Nations General Assembly.

2.5 Global Decade of Action for Road Safety

Road Safety is both a development and public health priority in low and middle-income countries. By 2030, health losses from road crashes for children between the ages 5-14 years are projected to rank second only to those from HIV/AIDS (WHO, 2011). These losses have already surpassed malaria and tuberculosis as a global burden of disease. Road crashes disproportionately harm the poor, and their consequences can plunge families into poverty. It represents a substantial drain on a country's resources (WHO statement at the launch of the Global Decade for Road Safety 2011-2020).

New global figures on road safety show a stark variation in safety standards among nations as developing countries own only 40percent of World's motor vehicles but yet account for 90percent of global road fatalities. Only 57% of countries have laws requiring all car occupants to wear seat-belts while only 38% of this figure applies to low-income countries (WHO, 2011). Half of all countries do not have laws requiring the use of child restraints such as child seats and booster seats. There are laws governing child restraints in 90% of high-income countries but only in 20% of low-income countries. Furthermore, while helmet laws exist in more than 90% of countries, only 40% have laws that cover both the riders and passengers while also requiring a specified standard for the helmet (WHO, 2011).

In 2010, the United Nations General Assembly adopted resolution 64/255[1], which proclaimed a Decade of Action for Road Safety. The goal of the Decade (2011–2020) is to stabilize and reduce the increasing trend in road traffic fatalities, thereby saving an estimated 5 million lives over the period. Therefore the Global Decade for Road Safety was launched on May 11, 2011 to operate on five key pillars revolving around road and human safety. These pillars are as follows:

Pillar 1 - Road Safety Management

Pillar 2 - Safer Roads and Mobility

Pillar 3 - Safer Vehicles

Pillar 4 - Safer Road Users

Pillar 5 - Post-crash Response

2.6 Road Traffic Crashes

2.6.1 Causes of Road Traffic Crashes:

The various causes of road traffic crashes are grouped within three major headings as follows:

(a) Human Factors:

These constitute major causes of global road crashes and include factors such as drunk-driving, driving under the influence of drugs, fatigue driving, driving under pressure, stress or other psychologic factors, poor driving skill, poor vision as a result of bad eye sight, illiteracy as well as under-aged and over-aged driving (Petridou and Moustaki, 2000; Akinola, 2005). Other human factors include loss of driving concentration from the use of telephone either in talking or texting modes, playing music or watching the television screen as well as eating, drinking or smoking while driving. Other human factor causes are speed limit violation, dangerous driving, driving under aggressive temperament, reckless and careless driving and over-loading (FRSC, 2013). Other factors more peculiar to our environment include belief or reliance in metaphysical powers of immunity to accident, vandalism of road infrastructures, lack of consistent road safety policy and implementation, illegal and oppressive activities by some law enforcement agencies and poor maintenance culture. These factors therefore add to human factor causes of road traffic crashes in Nigeria.

(b) Mechanical Factors:

Mechanical factors relate to the motor vehicles and include such factors as brake failures, poorly designed vehicles, poor vehicle ergonomics, burst and worn out tyres, broken down or pulled-out propeller shaft and wheels, fake spare parts and poor mechanical expertise.

(c) Environmental Factors:

These are factors primarily relating to the environment. They include poor road design, bad roads, poor geographical road topography and poor road maintenance, absent, inadequate or inconsistent road signs and absence of basic road furniture such as traffic lights and road marks. Other factors include consequences of erosion, rainfall, windstorm and the effect of poor visibility as a result of fog and hamattan. Whatever may be the cause of road traffic crashes, the fatality may vary from mild to very severe. Figures 1 and 2 show fatal road traffic crashes with extensive loss of human and material resources.

Figure 1: Scene of a Fatal Road Crash (www.Car-Accidents.com).

Figure 2: Scene of a Road Crash of Severe Fatality (www.Car-Accidents.com)

2.6.2 Cost Burden and Impact of Road Traffic Crashes in Nigeria

Disabilities and injury from road traffic crashes are major sources of concern and a serious public health problem. Road traffic crashes are sudden violent events that devastate families for decades, if not permanently, causing direct impact on the social and physical environments and exerting significant impact on both the individual driver, family and the society. Direct costs of road traffic crashes to the economy include damage to the vehicle (replacement and repair costs), administrative costs, medical treatment and insurance costs and reduced productivity due to injury or death. Other costs include pain, grief and the risk or fear of being involved in another crash.

The World Health Organization (WHO) has rated Nigeria at 191 out of 192 countries globally with unsafe roads and with 162 death rates from road traffic crashes per 100,000 populations (WHO, 2011). The cost burden of road traffic crashes in Nigeria was recently estimated at N456 billion per annum (FRSC, 2010). The FRSC has also recently disclosed that a total of 280 people were killed in 480 road traffic crashes recorded across Nigeria within two weeks spanning between the Christmas of 2012 and the new year festivities of 2013 (FRSC, 2013). Furthermore, 36, 000 motorists were reportedly arrested by the FRSC operatives for various traffic offences in an "operation zero tolerance" declared from 19th December, 2012 to 3rd January, 2013. Over 1,600 people were also reported injured from over 480 road traffic crashes recorded within the same period. However the agency stated that this figure is a marked reduction when compared with the number of deaths arising from road crashes recorded within the same period under review in previous years (FRSC, 2013).

2.6.3 Trends of Road Traffic Fatalities in Nigeria

Prior to the creation of the Federal Road Safety Corps (FRSC) in 1988, Nigeria was rated as one of the most road traffic crashes-prone countries worldwide, being only second to Ethiopia, with a reported road traffic accidents fatality index of 302 in 1987, at 16 deaths per 1,000 vehicles (FRSC, 2010).

A similar pattern was also observed on the trends of road traffic crashes in Nigeria after independence between 1960 and 1989 which revealed a sharp increase in fatality (Oluwasanmi, 1993). The study found that between 1960 and 1969, over 18,000 deaths occurred as a result of road traffic crashes, whereas by the third decade (1980-1989), the figure had drastically increased to more than 92,000 deaths. Available data from the Nigeria Police and the Federal Road Safety Commission between 1960 and 2006 also showed a growth in the total casualties from reported road traffic crashes from 11, 299 in 1960 to 22, 334 in 2006 and a similar increase in the reported fatality from 826 in 1960 to 2, 600 in 2006 respectively (Table 5). A recent study has also reported that road traffic crashes are still on a growing trend in Nigeria (Ohakwe *et al.*, 2011).

On the contrary, a reverse trend is applicable in the United Kingdom (UK) which introduced the use of traffic light in 1927, driving test for physically challenged drivers in 1930, zebra crossing in 1949, annual test for every vehicle above 10 years old in 1958, speed cameras in 1992 and banned the use of mobile phones while driving in 2003 (Bruce-Chwatt, 2011). In 1934 alone, with just 2.4 million vehicles on Britain's roads, 7,343 people were reportedly killed in road traffic crashes. However, in 2007 with over 30 million vehicles in Britain, death rates from road crashes drastically declined to only 3,180 as shown in Figure 3.

Table 5: Trends of Reported Road Traffic Crashes in Nigeria (1960- 2006)

(The Nigeria Police/Federal Road Safety Commission)

YR	FATAL	SERIOUS	MINOR	TOTAL CASES	NO. KILLED	NO. INJURED	TOTAL CASUALTY
1960	826	9065	4239	14130	1083	10216	**11299**
1965	1029	7762	8113	16904	1918	12024	**13942**
1970	1999	6666	7991	16666	2893	13154	**16047**
1975	2834	9446	11331	23651	5552	20132	**25684**
1980	1856	14855	15427	32138	8736	25484	**34220**
1985	3597	11991	14380	29978	9221	23853	**33074**
1990	6140	8796	6998	21934	8154	22786	**30940**
1995	4701	7276	5053	17030	6647	14561	**21208**
2000	5287	6820	4499	16606	8473	20677	**29150**
2006	**2600**	**5550**	**964**	**9114**	**4944**	**17390**	**22334**

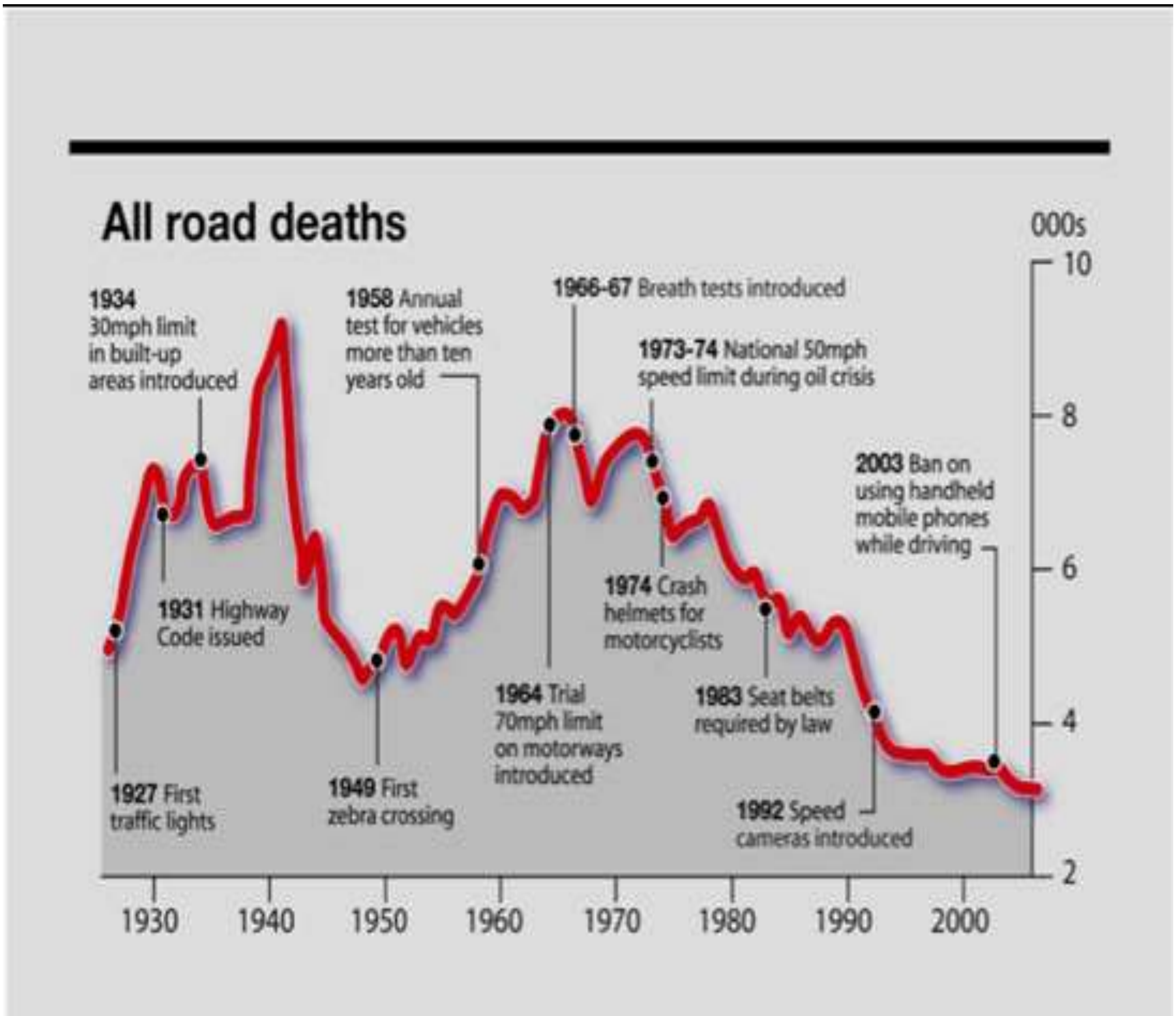

Figure 3: Road Crashes in the United Kingdom (1930-2007) (Bruce-Chwatt, 2011)

2.7 Road Traffic Safety Regulation in Nigeria

2.7.1 History and Structure of the Federal Road Safety Commission

The road traffic situation in Nigeria before the establishment of the Federal Road Safety Commission (FRSC) could best be described as chaotic, unpredictable and indeed dangerous as it was characterized by unprecedented wave of road traffic crashes with attendant colossal human and material losses (FRSC, 2010). Within this era, there was minimal public awareness and interest in road safety, with no deliberate policies and concerted effort at enforcing regulations. Prior to the establishment of the FRSC, road traffic accidents fatality index (as at 1987) was 302 at 16 deaths per 1,000 vehicles (FRSC, 2010).

Early efforts at road safety campaigns in Nigeria were pioneered by the Shell Petroleum Development Company of Nigeria (SPDC) between 1960 and 1965, and the Nigerian Army who initiated the first Public Road Safety Campaign in 1972 through an annual Road Safety Week. The first deliberate policy on road safety was the creation of the National Road Safety Commission (NRSC) in 1974 by the then Military Government (FRSC, 2010). The impact of the Commission was however, not sustained. In 1977, the Military Administration in Oyo State established the Oyo State Road Safety Corps which made some local significant improvement in Road Safety and road discipline in the State. This, however, only lasted until 1983 when it the corps was disbanded by the Federal Government.

The Federal Road Safety Commission (FRSC) was set up in February 1988 by the Federal Government of Nigeria through the decree No. 45 of 1988 as amended by the decree No. 35 of 1992 referred to in the statute books as the FRSC Act cap 141, Laws of the Federation of Nigeria (LFN) and passed by the National Assembly as

Federal Road Safety Commission (establishment) Act 2007. It was charged primarily with the responsibility of prevention and reduction of road traffic crashes and improving road safety in Nigeria by making the highways safer for motorists and other road users.

At inception, the Commission had its first National Headquarters at Ibadan and later at Gbagada-Lagos with 5 Zonal Commands located in Kaduna, Bauchi, Benin, Aba and Ibadan. The Headquarters was later moved to Abuja in 1992 from where it currently operates with 12 Zonal Commands, 37 Sector Commands and 181 Unit Commands throughout Nigeria. At inception, the Corps was headed by a Director of Organization and Chief Executive who oversaw its day to day administration. However, through statutory amendments, this designation has now changed to Corps Marshal and Chief Executive. The FRSC comprises officers and men of both commissioned and non-commissioned officer cadres. The current numerical structure of the FRSC Commands is presented in Table 6 while the Corps Commissioned Officer Cadres are as shown in Table 7.

Table 6: Numerical Structure of FRSC Commands as at December 2011 (FRSC, 2011)

S/N	**NAME OF ZONE**	**NO. OF ZONAL COMMANDS**	**NO. OF SECTOR COMMANDS**	**NO. OF UNIT COMMANDS**	**TOTAL NO. OF COMMANDS**
1.	RS1HQ, Kaduna	1	4	20	25
2.	RS2HQ, Lagos	1	2	22	25
3.	RS3HQ, Yola	1	3	8	12
4.	RS4HQ, Jos	1	3	14	18
5.	RS5HQ, Benin	1	3	15	19
6.	RS6HQ, PortHarcourt	1	4	11	16
7.	RS7HQ, Abuja	1	2	19	22
8.	RS8HQ, Ilorin	1	3	14	18
9.	RS9HQ, Enugu	1	4	15	20
10.	RS10HQ, Sokoto	1	3	7	11
11.	RS11HQ, Osogbo	1	3	20	24
12.	RS12HQ, Bauchi	1	3	10	14
	Total	**12**	**37**	**175**	**224**

Key: RS= Road Safety, HQ = Headquarters

Table 7: **Officer Cadres of the FRSC**

S/No	**RANK**	**CODE**
1	Assistant Route Commander	**ARC**
2	Deputy Route Commander	**DRC**
3.	Route Commander	**RC**
4	Superintendent Route Commander	**SRC**
5	Chief Route Commander	**CRC**
6.	Assistant Corps Commander	**ACC**
7.	Deputy Corps Commander	**DCC**
8.	Corps Commander	**CC**
9.	Assistant Corps Marshal	**ACM**
10.	Deputy Corps Marshal	**DCM**
11.	Corps Marshal/ Chief Executive	**COMACE**

2.7.2 Driver's License and Driving Re-certification

Most countries and states require a license before driving can be permitted, although criteria for issuance vary with each country or state. In the USA and Canada, from the age of 16, an individual may commence driving after he may have passed some requisite tests which may include an initial guided driving accompanied by an adult driver until he progresses to driving without supervision. In Mexico, a driver is allowed a permit from age 15 for a one year duration at the cost of $100, to drive with an adult at all times. Beyond this stage, and on the payment of half the initial amount annually, he may be allowed to drive alone.

In Nigeria, the process of issuance of driver's license involves a tripartite arrangement involving the road traffic regulators, in particular the FRSC (being the lead regulatory agency in Nigeria) and other related agencies including the various State Government Revenue Departments. An individual is therefore qualified by law to drive on attaining the age of 18 years when he or she may apply for a driver's license by completing appropriate application forms (National Road Traffic Regulations, 2004). This is followed by a driving test and certification conducted by the road traffic safety regulators (usually by the Vehicle Inspection Unit) before a driver's license may be issued by the Federal Road Safety Corps. Recent regulation further requires each applicant to be recommended by a government approved driving school and to appear physically for biometric capture by the FRSC before a licence is obtained. It is therefore an offence to drive in Nigeria below 18 years, or without a valid driver's licence. However, over the years, this system has been marred by poor, inefficient and inconsistent policy implementation and corruption. These factors therefore make it a common sight to find many under-aged and other drivers without certification and valid license on Nigerian roads.

Various countries, states and cities operate differently on driving recertification. In the United States of America, while 42 states require vision testing, 10 states have practical testing requirements after a certain age, while 7 have written test requirements. However, 22 states do not have any age-based procedures for re-certification and renewal of driver's license (Chen *et al*., 2008).Readily available mechanisms to expedite re-certification of a patient following recovery from musculoskeletal injury by means of a practical driving test following recommendation by a healthcare practitioner will be of benefit to address patient and public safety in driving (Chen *et al.*, 2008). However, such mechanisms do not always exist. In America, 38 states have established medical assessment boards that can address return to driving issues on a case-by-case basis. However, only 19 states operate a readily available testing pathway that a patient can follow on recovering from injury or surgery whereby medical advisory boards base their decisions on a patient's ability to drive on medical certification by the treating physician or healthcare practitioner. Similar path of driving re-test and re-certification is also in common practice in the United Kingdom and some other developed countries (Chen *at al*., 2008). However, such mechanisms do not exist and therefore not practice in most developing countries, including Nigeria.

2.7.3 Challenges of an Ideal Road Safety Culture and Practice in Nigeria

Major challenges and hindrances towards achieving a desired road safety culture and practice in Nigeria include bad and poorly maintained roads, non-roadworthy vehicles, lack of political will to enact policies on road and public safety or to implement existing road traffic laws, lack of effective and efficient vehicle inspection programmes, absence of pedestrian walk ways, poor land use which permits markets and worship centres to be located along or near the high ways, inadequate road furniture (such as street lights, road signs and road markings, corruption and lack of road safety audits, regulator apathy and indiscipline on the path of the driving population. Other challenges include poor enforcement and compliance to the use of seat-belts, child restraints and crash helmets by motorized two-wheelers, inadequate post-crash rescue scheme (due to the absence of needed collaboration between the road traffic safety regulators and the healthcare practitioners).

Other major hindrances and limitations towards achieving an ideal road safety culture in Nigeria include under-funding of road safety initiatives, lack of National data base (as Nigeria currently has no trauma registry), excessive speeding and the use of alcohol and strong analgesics. These factors increase crash risk in driving.

2.8 Physiotherapy Advocacy in Global Road Safety

2.8.1 Background:

Physiotherapy or Physical Therapy is concerned with identifying and maximizing quality of life and movement potentials within the spheres of promotion, prevention, treatment/intervention, habilitation and rehabilitation. This encompasses physical, psychological, emotional, and social wellbeing (WCPT, 2011). Physiotherapy involves the interaction between the physical therapist, patients/clients, other health care professionals, families, care givers and communities in a process where movement potential is assessed and goals are agreed upon, using the knowledge and skills unique to physiotherapists (WCPT, 2011). It further provides services to individuals and populations to develop, maintain and restore maximum movement and functional ability throughout the lifespan. This includes providing services in circumstances where movement and function are threatened by ageing, injury, diseases, disorders, conditions or environmental factors.

The World Confederation for Physical Therapy (WCPT) supports the World Health Organization's efforts to draw attention to the devastating toll of road traffic crashes and the need to implement comprehensive road safety measures. Physiotherapists greatly appreciate the devastating consequences of road crashes - not just in terms of bereavement, but long-term disability (WCPT, 2011). Member-countries of the WCPT are therefore encouraged to be involved in developing new integrated approaches to road safety at their National levels (WCPT, 2011). The physiotherapist's extensive knowledge of the body and its movement needs and potential is central to determining strategies for diagnosis and intervention. The practice settings will vary according to the aspect of care required as physiotherapists are often involved in health promotion, prevention, assessment, treatment and rehabilitation of health conditions which result from road traffic injuries as they often affect the musculoskeletal system (WCPT, 2011).

Assessment of health recovery and ultimate suitability to return to driving may thus be best carried out by the physiotherapist in conjunction with other health care practitioners such as the orthopaedic surgeons and occupational therapists who by their in-depth knowledge and experience through training and practice of health care and rehabilitation are best equipped. Therefore, it may be common place to find physiotherapists as advocates in various aspects of road and public safety.

2.9 Indices of Musculoskeletal Disability

Disorders and injury to the musculoskeletal system affect performance and return to work in various aspects ranging from pain, impairment of physical function and range of motion. Driving requires optimal function of the musculoskeletal, visual and neuromuscular systems and therefore timely return requires an assessment of these components. Some validated tools for assessment of pain, physical function and stiffness exist. These include the Western Ontario and McMaster Universities (WOMAC) Osteoarthritis Index, the Short Musculoskeletal Functional Assessment (SMFA) index, the Short Form (SF-36) index, (Ponzer *et al.*, 2003; Obremskey *et al.*, 2007) and the Ibadan Knee/Hip Osteoarthritis Outcome Measure (IKHOAM)- (Akinpelu *et al.*, 2011). The WOMAC Index is composed of 24 items with three subscales of pain, physical function and stiffness. These indices are primarily disease-specific and therefore do not address musculoskeletal functions relating to driving. Thus literature is sparse on available activity-specific indices, tools and measures to determine suitability of individuals returning to driving following musculoskeletal disorders, injury or surgery.

CHAPTER THREE

METHODOLOGY

The study was divided into two phases.

Study phase 1:

3.1 Materials

This phase titled '**Return to Driving after Musculoskeletal Disorders'** comprised three independent surveys and involved three categories of participants as follows:

3.1.1 Subjects Selection

(1) Male and female patients who were recovering from musculoskeletal disorders including traumatic and degenerative musculoskeletal conditions, injury, surgery and amputations at the out-patient physiotherapy, surgery and occupational therapy departments of the National Orthopaedic Hospitals in Igbobi-Lagos, Kano and Enugu, Nigeria.

(2) Healthcare practitioners in care of patients recovering from musculoskeletal and orthopaedic conditions, comprising Orthopaedic surgeons and Senior Registrars in orthopaedics, Physiotherapists, and Occupational Therapists.

(3) Road traffic safety regulators who are Senior Field Operations and Research Officers of the Federal Road Safety Commission (FRSC), Nigeria, not below the rank of Assistant Route Commander with at least 2 years of field experience in the corps.

3.1.2 Inclusion Criteria

(A) Patient Survey:

(1) Male and female patients between the ages of 18-80years

(2) Patients who presented with musculoskeletal disorders or injury (including orthopaedic surgeries and amputation),

(3) Patients who drove before their presenting musculoskeletal condition

(4) Patients who had either returned or were yet to return to driving as at the time of this study.

(B) Practitioner Survey:

(1) Orthopaedic Surgeons and Senior Registrars in current practice (with at least two years' experience in their specialization programme in Orthopaedics and Trauma Medicine)

(2) Physiotherapists in current practice with a minimum of 2 years post-qualification experience

(3) Occupational Therapists in current practice with a minimum of 2 years post qualification experience.

(C) **Regulator Survey**:

Senior Field Operations / Research Officers of the Federal Road Safety Commission (FRSC) who are not below the rank of Assistant Route Commander, and who have a minimum of 2 years field experience in the corps.

3.1.3 Exclusion Criteria

(A) Patient Survey:

(1) Male and female patients not within the age group of 18-80 years

(2) Patients who did not present with musculoskeletal disorders, injury or orthopaedic surgeries and amputation

(3) Patients who did not drive before their presenting musculoskeletal condition

(4) Patients with known medical co-morbidities such as diabetes and epilepsy

(5) Patients with previous health conditions that have caused contractures or permanent loss of range of joint motor function

(6) Patients with diagnosed neurological impairment or psychiatric sub-normality.

(B) Practitioner Survey:

(1) Medical doctors who are not in current practice

(2) Medical doctors not in the specialty of orthopaedic surgery

(3) Orthopaedic surgeons, Physiotherapists and Occupational Therapists not in current practice

(4) Non senior Orthopaedic Registrars

(5) Physiotherapists and Occupational Therapists with less than 2 years post-qualification experience

(D) **Regulator Survey**:

(1) Officers of the Federal Road Safety Commission (FRSC) who are not Senior Field Operations / Research Officers above the rank of Assistant Route Commander.

(2) Senior Field Operations / Research Officers of the FRSC who have a minimum of 2 years field experience in the corps.

3.2 Ethical Consideration

Ethical approval was obtained from the Research Grants and Experimentation Ethics Committee of the College of Medicine, University of Lagos. Approval was also sought in writing and obtained from the institutions where patient-respondents were recruited (the three National Orthopaedic Hospitals in Nigeria) namely: (1) National Orthopaedic Hospital, Igbobi-Lagos (2) National Orthopaedic Hospital, Kano and (3) National Orthopaedic Hospital, Enugu. Permission was equally obtained from the office of the Corps Marshal and Chief Executive (FRSC) through the Head of Policy, Research and Statistics (PRS), FRSC Headquarters, Abuja. Written informed consent was also obtained from each respondent in each of the three surveys by completing a consent form on the front page of each questionnaire, while assuring them of confidentiality and voluntary nature of their participation in the study.

3.3 Instrumentation

The study utilized three independent questionnaires described as 'Return to Driving (RTD) Questionnaires' which were specifically designed and adapted to collect data relating to each of the three survey categories.

3.3.1 Development of the Return to Driving Questionnaires

The initial drafts of the questionnaires for the three surveys were variously improved upon and appropriately modified to suit the current study objectives and the Nigerian environment by a seven-man focus group. This group which comprised physiotherapy academics, clinicians and surgeons who are experts in questionnaire design produced the final draft of the instrument.

3.3.2 Description of Return to Driving Questionnaires

(A) Return to Driving Questionnaire-Patient Model (RTD-PM): This 43-items self-administered questionnaire was adapted from a study by Chen *et al.* (2008). The final study questionnaire was divided into four sections A-D (Appendix i).

Section A = Socio-demographic Data of Patient-respondents

Section B = Nature of Musculoskeletal Injury

Section C = Burden of Stopped Driving after Musculoskeletal Disorders

Section D = Return to Driving after Injury

(B) Return to Driving Questionnaire-Practitioner Model (RTD-PRM): This is a 25-items self-administered questionnaire adapted from Chen *et al.* (2008). The final study questionnaire was divided into four sections A-D (Appendix ii).

Section A = Socio-demographic Data of Practitioner-respondents

Section B = Predicting Factors to Return to Driving

Section C = Effect of Strong Analgesics/Medications on Driving

Section D = Return to Driving (Re-test) Model

(C) **Return to Driving Questionnaire-Regulator Model (RTD-RM):** This is a 26-items self-administered questionnaire developed primarily for this study. The final study questionnaire was divided into four sections A-D (Appendix iii).

Section A = Socio-demographic Data of Regulator-respondents

Section B = Crash Risk Predictors

Section C = Crash Risk Following Return to Driving

Section D = Return to Driving (Re-test) Model

3.3.3. Validation/ Piloting of the Return to Driving Questionnaires

A copy each of the final draft questionnaires produced by the focus group was sent to five people who were not among the prospective respondents in each of the survey categories to identify potential difficulties or ambiguity with the questions. The questionnaires were further pilot-tested among 20 patients in the out-patient department of the National Orthopaedic Hospital, Igbobi, Lagos, 20 Healthcare practitioners at the National Orthopaedic Hospital, Igbobi, Lagos and 20 Road traffic safety regulators in the Lagos Sector Command of the FRSC who met the respective inclusion criteria set out in the study phase 1.

3.4 Methods

3.4.1 Research Design: The study design was a cross sectional, multi-centre, descriptive survey.

3.4.2 Sample Size Determination

The Cochran's formula for sample size determination was used for the study:

$$n = \frac{z^2pq}{d^2}$$

(Israel, 1992).

Where n = minimum sample size for statistically significant survey.

For Patient survey:

z = the standard normal deviation, usually set at 1.96 which corresponds to 95% confidence interval.

p = proportion of patients who returned to driving from a previous study (Chen *et al*., 2008) = (0.30)

D = degree of accuracy usually set at 0.05

q = 1- p = 1-0.30 = 0.7

Hence: $n = \frac{(1.96)^2 (0.3)(0.7)}{(0.05)^2}$

$= 309.65$

≈ 310

For minimal sample size: nf = desired sample size when population is < 10, 000

$$nf = \frac{n}{1 + \frac{n}{N}}$$

$$\frac{310}{1 + \frac{310}{560}} = 199.54.$$

Hence minimum sample size required for the patient study was **200**.

Sample size determination for Practitioner and Regulator Surveys:

p = prevalence rate was set at 0.5 (since the prevalence is unknown)

q = 1-p

d = degree of accuracy usually set at 0.05

$$= \frac{(1.96)^2 \times (0.5) \times (1-0.5)}{(0.05)^2}$$

= 384.16

Since the population size was less than 10,000, therefore the following formula was applied:

$$n_f = \frac{n}{1 + \frac{n}{N}}$$

Where n_f = the derived sample size when population is less than 10,000

N = the estimate of the population size

n = calculated sample size

For Practitioner survey:

Substituting 384.16 for n and 1302 for N in the formula:

(Where 1302 represents the healthcare practitioners (Orthopaedic surgeons/ Senior Registrars, PTs and OTs)

$$= \frac{384.16}{1 + \frac{384.16}{1302}}$$

$$= 296$$

Therefore minimum sample size for the practitioners was **296**

(20 % provision was made for cases of non-response).

For Regulator survey:

Substituting 384.16 for n and 721 for N in the formula:

(Where 721 represents the number of regulators within the inclusion criteria)

$$= \frac{384.16}{1 + \frac{384.16}{721}} = 250$$

Therefore minimum sample size for regulators was **250.**

(20% provision was made for cases of non-response).

3.4.3 Sampling Technique

Patient Survey: Proportionate sampling technique was employed for the study. Samples were selected proportionately from the three National Orthopaedic hospitals (in Lagos, Kano and Enugu, Nigeria) and the respondents in the study locations were interviewed based on the number of cases within the inclusion criteria seen in each of the study centres within the study period (September–December, 2011). The total number of new cases within the inclusion criteria who reported at the three study centres within the study period was 560 in the ratio presented below:

NOHI, Lagos = 280 = 280/ 560 x 100 = 50.0%

NOH, Kano = 150 = 150/ 560 x 100 = 26.8%

NOH, Enugu = 130 = 130/ 560 x 100 = 23.2%

Practitioner Survey: Eighteen (18) hospitals were selected through computer-generated random sampling among 51 tertiary health institutions (Teaching hospitals, Specialist/ orthopaedic hospitals and Federal Medical Centres) across Nigeria's six geo-political zones. Two hundred and ninety-nine (299) practitioners were recruited for the study from the 18 selected hospitals. Sample size for all practitioner groups reflected the available number of each professional group in Nigeria.

Regulator Survey: Balloting was used to select 8 out of 12 FRSC Zonal Commands across Nigeria's six geo-political zones including FRSC headquarters, Abuja. Through an existing template employed by the Policy, Research and Statistics (PRS) department of the FRSC, simple random sampling was applied to select respondents among officers who met the inclusion criteria. Completed responses were retrieved through the same central route of administration.

3.5 Procedure for Data Collection

Patient survey

A total of three hundred and twenty (320) patients completed the Return to Driving Questionnaires-Patient Model (RTD-PM). They were patients who met the inclusion criteria set out for the phase 1 study and who were receiving treatment at the out-patient departments of orthopaedic surgery, physiotherapy and occupational therapy at any of Nigeria's three National Orthopaedic Hospitals in Enugu, Kano and Igbobi-Lagos as at the time of the study between September and December, 2011. The questionnaires which were self-administered were handed out by the researcher or his research assistants.

Practitioner survey

A total of three hundred and fifty five (355) healthcare practitioners who were orthopaedic surgeons or senior registrars in orthopaedic surgery, physiotherapists and occupational therapists in current practice in 18 out of Nigeria's 51 tertiary health institutions (at the time of this study) completed the Return to Driving Questionnaires-Practitioner-Model (RTD-PRM). The 18 selected hospitals were spread over the 6 geo-political regions of the country. The self-administered questionnaires were handed out to each respondent by the researcher or his research assistants.

Regulator survey

A total of three hundred (300) senior field operations and research officers of the FRSC who met the inclusion criteria set out for the phase 1 study completed the Return to Driving Questionnaires-Regulator Model (RTD-RM). Copies of the questionnaires were distributed among the respondents in 8 out of the 12 Zonal Commands of the FRSC spread across the 6 geo-political zones of Nigeria through the internal research template of the Policy, Research and Strategy Department of the FRSC. The researcher, his assistant and trained staff of the PRS department handed out the self-administered questionnaires to the respondents in the zones as well as the Command Headquarters at Abuja. Completed questionnaires were also retrieved through the internal mechanism of the PRS Department at the Command Headquarters.

3.6 Data Analyses

Data were analysed using the Statistical Package for Social Sciences (SPSS) software (Version 17; SPSS, Chicago, IL, USA). Descriptive statistics was used for all variables. For continuous variables, mean and standard deviation were calculated. Frequency distribution, bar and pie charts were used to present the results. Chi-square analysis was applied to find association between variables while logistic regression analysis identified variables predicting return to driving. Level of significance was set at $p < 0.05$.

Scoring to Determine Level of Knowledge on Return to Driving:

Four (4) questions that tested knowledge were utilized; each question carried one (1) mark, thus the highest possible score was 4, while the lowest was zero (0). A score between 0- 1 = poor, 2-3 =fair, while a score of 4 =good.

Scoring to Determine Level of Attitude towards Return to Driving:

Three (3) questions that tested attitude were utilized; each question carried one (1) mark, thus the highest possible score was 3, while the lowest was zero (0). A score between 0-1 was considered negative while a score of 2-3 was considered positive.

Scoring to Determine Level of Practice of Return to Driving:

Four (4) questions that tested practice were utilized; each question carried one (1) mark, thus the highest possible score was 4, while the lowest was zero (0). A score between 0-1= poor, 2-3=fair while a score of 4= good.

3.7 Study phase 2: Development of the DMDI

This phase was titled 'Development of the Driving Musculoskeletal Disability Index' (DMDI).

3.7.1 Justification for the Development of the DMDI:

A detailed review of the literature revealed paucity of data on the subject area as no specific driving assessment index was found for determining suitability of return to driving after musculoskeletal disorders. A few studies have previously addressed return to driving following various health conditions. Akinwuntan *et al.* (2005) utilized simulation technique to facilitate driving return among persons recovering from cerebrovascular accident (stroke). However, this and other related studies did not address assessment of return following musculoskeletal conditions. Although some musculoskeletal-related indices exist in literature such as the Western Ontario and McMaster Universities (WOMAC) Osteoarthritis Index, the Short Musculoskeletal Functional Assessment (SMFA) index and the Short Form-36 index (Ponzer *et al.,* 2003; Obremskey *et al*., 2007), however, these are primarily disease-specific and do not address driving-specific aspects of musculoskeletal function. The DMDI was therefore developed following review of existing related indices and empirical findings from the study (phase 1) as a function-specific outcome measure (tool) which can evaluate driving-related domains of pain, physical function, range of joint motion and grip strength. The initial draft of the instrument titled 'The Nigerian Driving Musculoskeletal Disability Index' (NDMDI) was thus developed in line with previous related studies and indices (Ponzer *et al.,* 2003; Obremskey *et al*., 2007). This served as a working document for a 6-man focus group comprising orthopaedic surgeons, physiotherapists and occupational therapist) towards the production of the final draft of the instrument.

3.7.2 Domains of the DMDI

The design of the DMDI considered the inclusion of four major domains A, B,C and D for assessment with direct relevance to driving function. These include:

(A) **Pain Domain:** This comprises 5 items with 5 sub-scales of 0-4 and a question testing how much pain the patient has had in the past 72 hours. A score of zero (0) indicates no pain while 4 signifies the worst or extreme pain.

(B) **Physical Function:** This comprises 10 items with 5 sub-scales of 0-4 and a question testing how much difficulty the patient has experienced carrying out specific physical functions in the past 72 hours. A score of zero (0) indicates no difficulty while 4 signifies the worst or extreme difficulty.

(C1) **Range of Motion Domain:** This comprises 2items with 5 sub-scales of 0-4 and a question testing how much stiffness the patient has experienced in the past 72 hours. A score of zero (0) indicates no stiffness while 4 signifies the worst or extreme stiffness.

(C2) **Range of Motion Domain:** This comprises 27 items with 5 sub-scales of 1-5. This domain assesses the joint range of motion necessary for driving function from the spine through the upper and lower limbs. A score of one (1) indicates the best score while 5 signifies the worst score. This domain is to be completed by the clinician using the universal goniometer calibrated in degrees (^{0}).

(D) **Grip Strength:** This comprises 1 item with 5 sub-scales of 1-5. This domain assesses the grip strength necessary for driving function. A score of one (1) indicates an excellent score while 5 represents the poorest score. This domain is to be completed by the clinician using the hand grip dynamometer calibrated in kilogrammes (kg).

CHAPTER FOUR

RESULTS

4.1 Socio-demographic Data of all Respondents

4.1.1 Patient-respondents

A total of 201 validly completed copies of the patient survey questionnaire were analysed out of 320 questionnaires that were distributed (response rate of 62.8%). Respondents' ages ranged from 21 to 80 (45.08 ±1 3.23) years. The most affected age range was 31-40 years (30.3%). One hundred and thirty four (66.7%) were males while 137 (68.2%) were married (Table 8).

4.1.2 Practitioner-respondents

This comprised 299 validly completed out of a total of 355 questionnaires that were distributed (response rate of 84.2%). They comprised orthopaedic surgeons and senior registrars in orthopaedics and trauma medicine (96, 32.1%), physiotherapists (193, 64.5%), and occupational therapists (10, 3.3%). Practitioners with practice experience between 2-5 years (123, 41.1%) and 6-10 years (80, 26.8%) made up the largest number in this category. Orthopaedic/Specialist Hospitals (130, 43.5%) and Teaching Hospitals (118, 39.5%) were the most common work settings among these respondents (Table 9).

4.1.3 Regulator-respondents

This comprised 252 senior field operations and research officers of the Federal Road Safety Corps (FRSC) who returned validly completed questionnaires out of 300 copies distributed out (response rate of 84.0%). Among these, 152 (60.3%)

had 6-9 years of experience in the corps while the respondents' ranks ranged between Assistant Route Commander (ARC) and Deputy Corps Marshal (DCM) – (Table 10).

Table 8: Socio-demographic Characteristics of Patient-respondents

Variables	Frequency (n)	Percentage (%)
Age (years)		
21-30	26	12.9
31-40	61	30.4
41-50	53	26.4
51-60	26	12.9
61-70	27	13.4
71-80	8	4.0
Gender		
Male	134	66.7
Female	67	33.3
Marital Status		
Married	137	68.2
Single	53	26.3
Widowed	9	4.5
Separated	1	0.5
Divorced	1	0.5
Education		
Tertiary	152	75.6
Secondary	39	19.4
Primary & below	10	5.0
Occupation		
Unemployed	13	6.5
Professional	37	18.4
Skilled	62	30.8
Unskilled	42	20.9
Retired	13	6.5

Table 9: Socio-demographic Characteristics of Practitioner-respondents

Variables	Frequency (n)	Percentage (%)
Gender		
Male	214	71.6
Female	85	28.4
Total	299	100.0
Professional group		
Physiotherapist	193	64.5
Orthopaedic Surgeon/Senior Registrar	96	32.2
Occupational Therapist	10	3.3
Total	299	100.0
Years of experience		
2-5	123	41.1
6-10	80	26.8
11-15	46	15.4
16 and above	50	16.7
Total	299	100.0
Work settings		
Orthopaedic / Specialist hospital	130	43.5
Teaching hospital	118	39.5
Federal Medical Centre	34	11.2
General hospital	14	4.7
Others	3	1.1
Total	299	100.0

Table 10: Socio-demographic Characteristics of Regulator-respondents

Variables	Frequency (n)	Percentage (%)
Gender		
Male	189	75.0
Female	63	25.0
Total	252	100.0
Years in F.R.S.C		
2-5	92	36.5
6-9	152	60.3
≥ 10	8	3.2
Total	252	100.0
Rank		
ARC	53	21.0
RC	29	11.5
SRC	31	12.3
CRC	37	14.7
ACC	42	16.7
DCC	20	7.9
CC	3	1.2
DCM	1	0.4
Total	252	100.0

KEY:

1. ARC: Assistant Route Commander
2. DRC: Deputy Route Commander
3. RC: Route Commander
4. SRC: Superintendent Route Commander
5. CRC: Chief Route Commander
6. ACC: Assistant Corps Commander
7. DCC: Deputy Corps Commander
8. CC: Corps Commander
9. DCM: Deputy Corps Marshal

4.2 Summary of Surveys

4.2.1 Causes and Pattern of Musculoskeletal Disorders/Injury

The cause of injury among one hundred and twenty three (61.1%) was road traffic crashes (RTC). Eighty six (70.0%) sustained motor vehicle crashes, while 30 (24.2%) were involved in motorcycle crashes (Table 12). Among those involved in road traffic crashes, 89 (67.4%) were passengers whereas 43 (32.6%) drove at the time of their crash. One hundred and forty-two (70.6%) sustained bone injury/fractures while the lower limb was the most affected body part 130 (64.7%) (Table 11). On the pattern of musculoskeletal disorders and injury observed among drivers, one hundred and thirty one (52%) regulator-respondents reported they have observed individuals who drove while still recovering from musculoskeletal conditions who present with varying degrees of physical impairments. Commonest among these were those who drove while wearing cervical collars or bandages (118, 46.8%). Individuals who drove with limb shortening were the least observed (27, 10.7%) (Table 12).

4.2.2 Impact of Stopped Driving

A total of 68 (33.8%) of patient-respondents had returned to driving after their injury (Table 13). On reasons for not returning yet to driving, 76 (57.1%) felt their present pain and discomfort could not permit them to drive yet. One hundred and eleven patient-respondents (55.2%) reported that inability to drive was a major problem which caused them much financial difficulty (Table 13). One hundred and forty-eight (73.6%) of patient-respondents lived in the city, 25.4% in suburban while 1% lived in rural areas (Table 13).

Eighty one (40.3%) coped with transportation by depending on the support of family members and friends, 53 (26.4%) depended on public transportation, while 41 (20.4%) had to hire a driver. Five (2.5%) of respondents were professional drivers who lost their jobs as a result of their injury (Table 13).

4.2.3 Attitude and Coping Strategies of Patient-respondents

Although 169 (84.1%) claimed they were willing to seek healthcare practitioner's approval before return, forty eight (70.6%) of those who had returned to driving stated that they did return on their own without consulting a healthcare practitioner. Only 28 (41.2%) of the returned respondents had approval from their healthcare practitioner before their return to driving (Table 14).

Only six (3%) had driving evaluation recommended by their healthcare practitioners while only 2 (1%) applied for a special driver's license before returning to driving. Just one respondent (0.5%) reported that he had his vehicle modified before he could drive again.

Table 11: Causes, Types and Distribution of Musculoskeletal Disorders/ Injury

Variables	Frequency (n)	Percentage (%)
Causes of Musculoskeletal Injury		
Road traffic crashes	123	61.1
Domestic injuries	60	29.9
Industrial accident	16	8.0
Others	2	1.0
Total	201	100.0
Type of Auto Crash		
Motor vehicle	86	70.0
Motor cycle	30	24.3
Tricycle	7	5.7
Total	123	100.0
Nature of Injury		
Bone injury/fracture	142	70.6
Spinal cord injury	4	2.0
Head injury	6	3.1
Soft tissue /Disc injury	25	12.4
Degenerative/ OA	24	11.9
Total	201	100.0
Body part involved		
Lower limb	130	64.7
Upper limb	52	25.8
Back/spine	9	4.5
Head	1	0.5
Others	9	4.5
Total	201	100.0

Table 12: Pattern of Musculoskeletal Disorders Observed by Regulators

Variables	Frequency (n)	Percentage
Observed Drivers with Musculoskeletal Disorders		
Yes	131	52.0
No	121	48.0
Drivers With Limb Amputation	56	22.2
Drivers With Leg/Arm Shortening	27	10.7
Drivers Wearing POP/Arm Sling	36	14.3
Drivers Wearing Prosthesis/ Devices	80	31.7
Drivers Wearing Neck Collar / Bandages	118	46.8

Table 13: Impact of Stopped Driving and Community Setting of Patient-respondents

Variables	Frequency (n)	Percentage (%)
Financial difficulty due to inability to drive		
Yes	111	55.2
No	80	39.8
Indifferent	10	5.0
Total	201	100.0
Impact of stopped driving on respondents		
As professional driver, it took me out of job	5	2.5
I had no means so I stayed at home	14	7.0
Respondents who have returned to driving		
Yes	68	33.8
No	133	66.2
Respondents' community setting		
City	148	73.6
Suburban	51	25.4
Rural	2	1.0
Total	201	100.0

Table 14: Attitude and Coping Strategies of Patient-respondents Towards Return to Driving

Variables	Frequency (n)	Percentage (%)
Willing to seek healthcare practitioner's approval		
Yes	169	84.1
No	22	10.9
Indifferent	10	5.0
Health practitioner approved my return to driving		
Yes	28	41.2
No	40	58.8
Total	68	100.0
I just felt like and resumed driving on my own		
Yes	48	70.6
No	15	22.1
Indifferent	5	7.3
Total	68	100.0
Practitioner gave me drug dose advice		
Yes	26	12.9
No	175	87.1
I will drive even with explanation of the side-effect		
Yes	31	15.4
No	170	84.6
Coping strategies as a result of stopped driving		
I had to hire a driver	41	20.4
I depended on public transportation	53	26.4
I depended on support from family members	81	40.3
I coped through other means (unspecified)	26	12.9

4.2.4 Decision on Patients' Return to Driving

One hundred and seventy four (58.2%) of the practitioner-respondents stated that they determined when their patients returned to driving after injury. Two hundred and thirty five (78.6%) advised patients to resume driving following clinical evidence that injury/surgery had resolved while 54 (18.1%) allowed their patients to resume when they expressed readiness. Only 10 (3.3%) approved their patients' return at the point of hospital discharge. On their opinions on who should decide on patients' return to driving after musculoskeletal disorders, injury or surgery, 137 (68.2%) among patient-respondents recommended the decision should be a collaboration between healthcare practitioners and the road traffic safety regulators (Figure 4) whereas one hundred and ninety nine (66.6%) practitioner-respondents recommended a collaboration among healthcare practitioners, particularly the orthopaedic surgeons, physiotherapists and occupational therapists in deciding return to driving after musculoskeletal disorders, injury or surgery (Figure 4).

4.2.5 Effect of Strong Analgesic Medication on Driving

Sixty two (20.7%) of the practitioners agreed that the side effects of strong analgesic medication may constitute crash risks. Only 85 (28.4%) of the practitioners educated their patients on possible side effects of strong analgesics on driving whereas only 12.9% of the patients said they were given drug dosage advise by their healthcare practitioner.

4.2.6 Return to Driving Policy / Re-test Model

Two hundred and sixty five (88.6%) of the practitioner-respondents claimed to be aware of the existence of return to driving policy or re-test model in other countries, especially in Europe and America, even though two hundred and eighty (93.6%) were unaware of the existence of such policy or model in Nigeria (Figure 5). Ninety-eight (32.8%) recommended a model where the healthcare practitioner alone should certify a patient suitable to return while 149 (49.8%) preferred that the healthcare practitioner's certification should be followed by a driving re-test which is to be carried out by the road traffic safety regulators (Figure 5). On strict return policy, 117 (39.1%) supported a driving re-test model for all musculoskeletal injuries while 166 (55.5%) supported a model where driving re-test should apply only to patients who had been out of driving for at least 6 months as a result of musculoskeletal disorders, injury or surgery (Figure 5).

Among regulator-respondents, whereas 226 (89.7%) observed the non-availability of any Nigerian return policy or re-test model, two hundred and one (88.9%) welcomed an indigenous return policy and re-test model for patients recovering from musculoskeletal disorders, injury or surgery in Nigeria (Figure 6).

4.2.7 Traffic Laws/Regulation in Nigeria

Two hundred and forty three (81.3%) practitioner-respondents claimed to be familiar with traffic laws in Nigeria while 291 (97.3%) agreed that improved traffic regulation will enhance road safety in Nigeria. Only 14 (4.7%) admitted knowledge of any Nigerian driving law offering legal immunity to a healthcare practitioner who reports medically unfit drivers. One hundred and seventy six (69.8%) respondents reported the non-existence of any Nigerian traffic law requiring the healthcare practitioner to stop or report impaired drivers. Although 102 (40.5%) reported knowledge of a Nigerian traffic law requiring the healthcare practitioner to certify patients fit before return, they did not provide information on the health conditions covered by such law. Two hundred and thirty eight (94.4%) suggested that healthcare practitioners should evaluate their patients' ability to return to driving after musculoskeletal conditions (Figure 7) while 233 (92.5%) agreed that an indigenous return policy and re-test model will improve driving safety and lead to significant improvement in road safety in Nigeria.

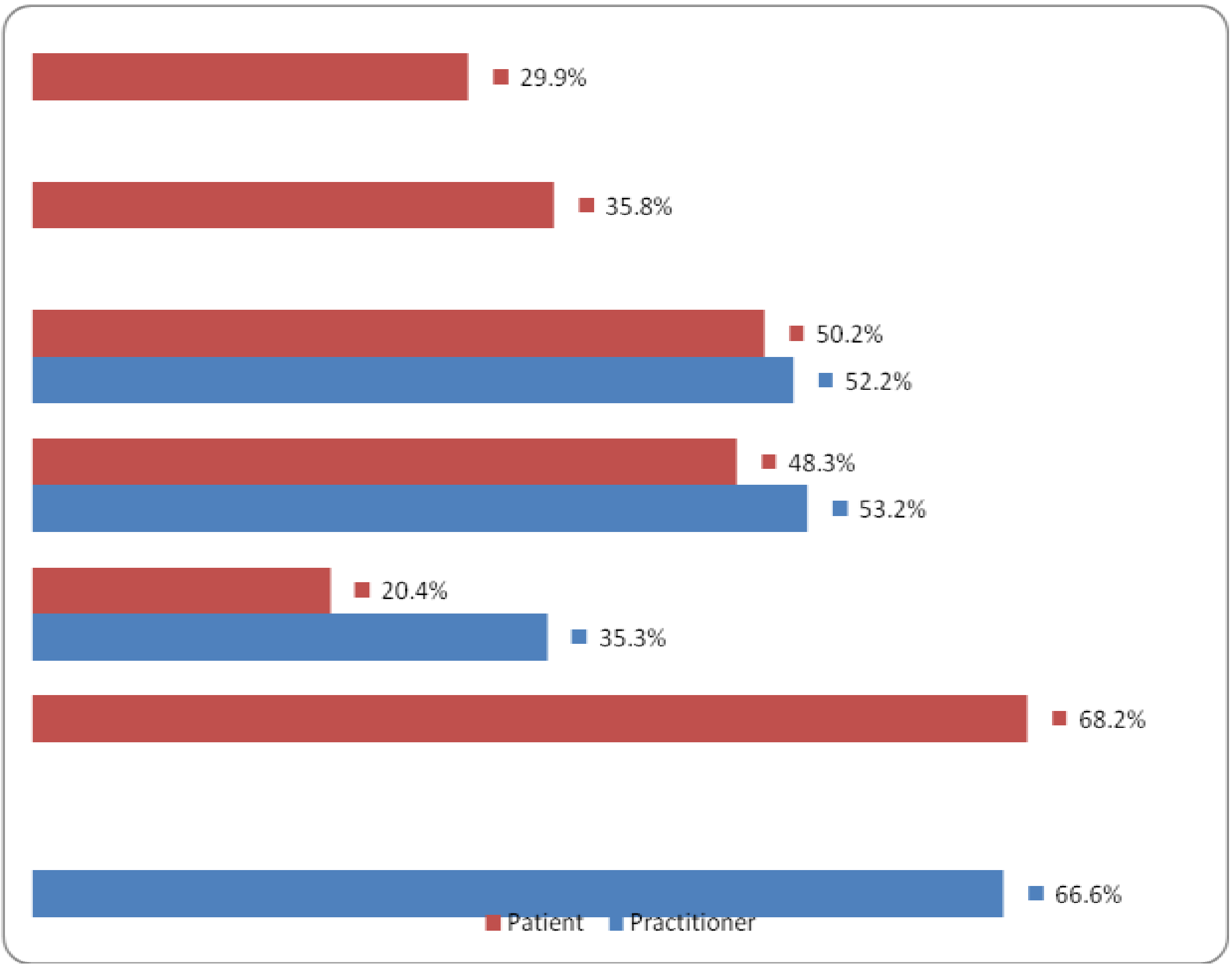

Figure 4: Patient and Practitioners' Opinions on Deciding Return to Driving

KEY: Red= Patients' opinion, Blue= Practitioners' opinion

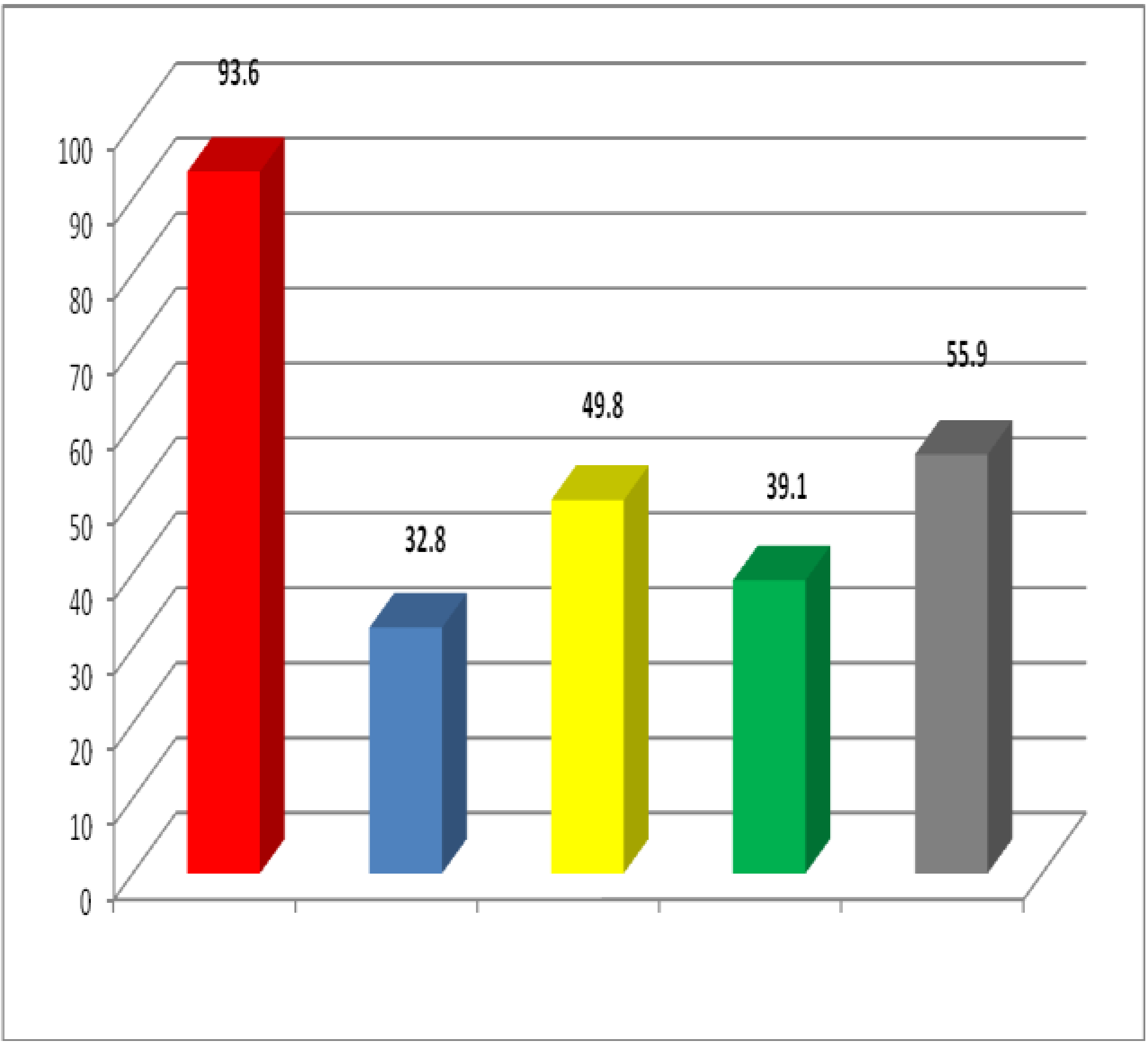

Figure 5: Awareness and Recommendation of a Nigerian Return / Re-test Model

KEY:

- (red) Unaware of any re-test model in Nigeria
- (blue) Practitioner certification only
- (yellow) Certification should be followed by driving re-test
- (green) Driving re-test for all MSDs
- (grey) Driving re-test for MSDs after six months of stopped driving

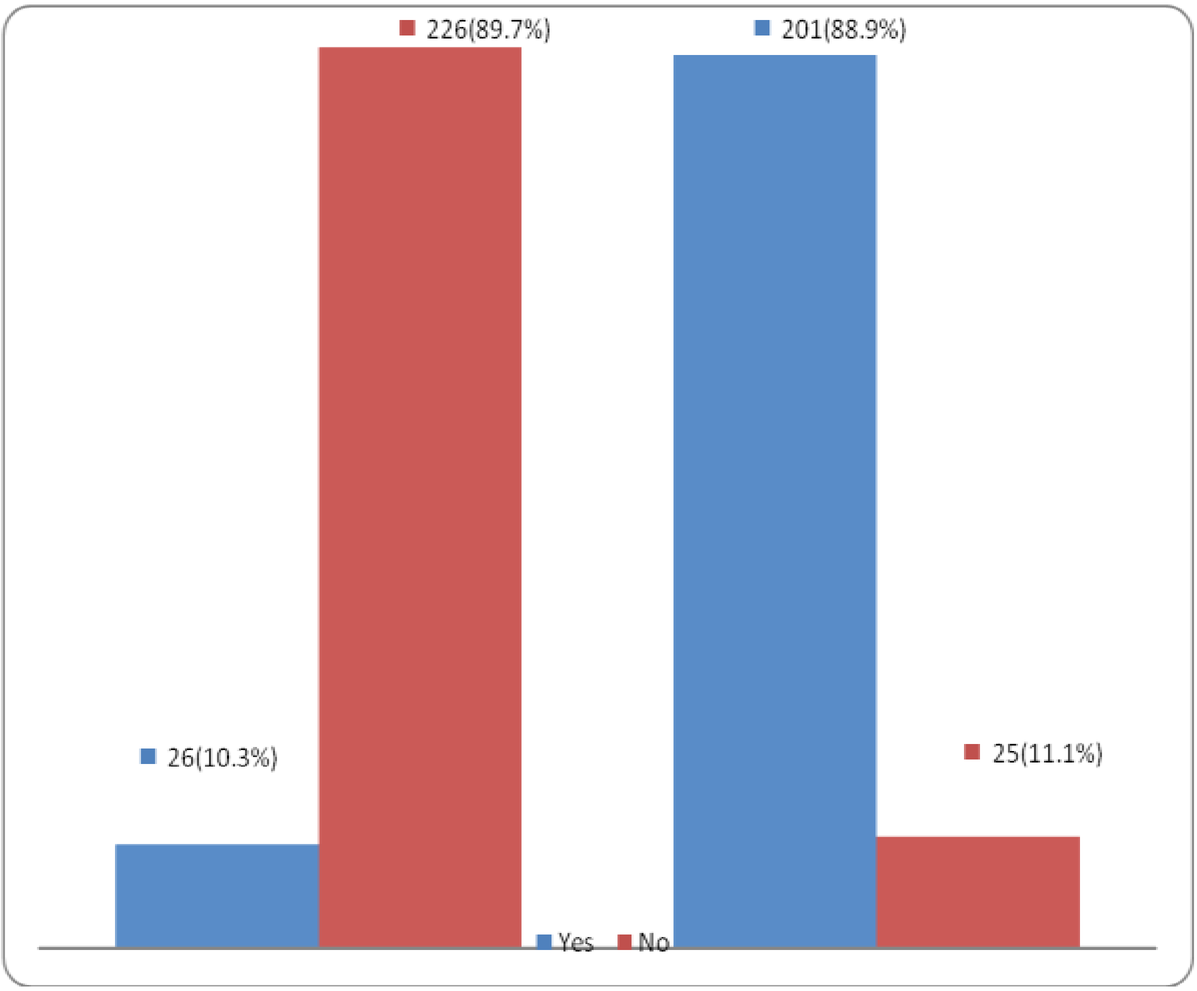

Figure 6: Availability and Willingness to Have a Nigerian Indigenous Return Model

Key: 1=Availability, 2 =Willingness

Blue=YES, Red= NO

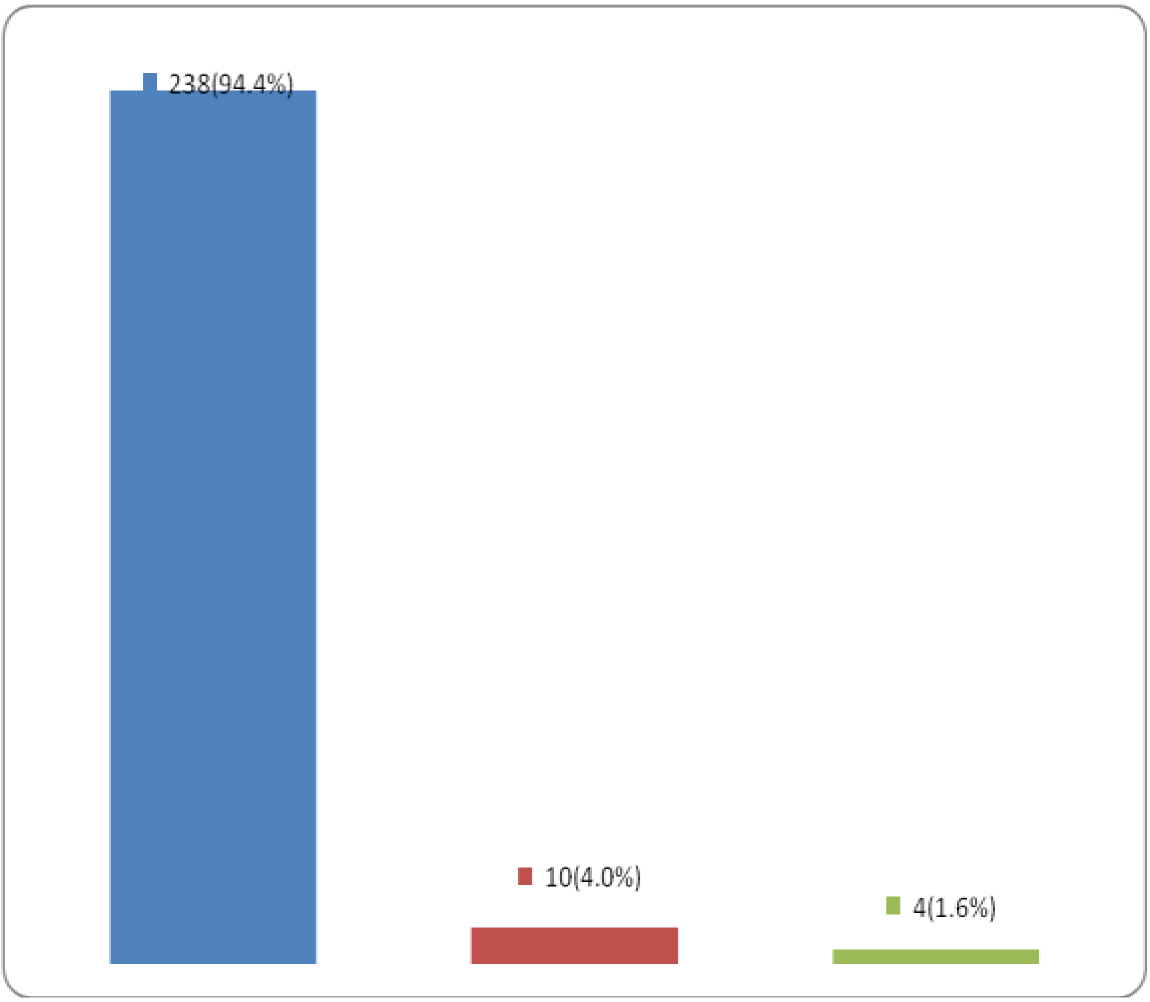

Figure 7: Evaluation of Patients by Healthcare Practitioners before Return to Driving

4.2.8 Crash Risk Following Return to Driving

Two hundred and thirty two (92.1%) of the regulator-respondents agreed that driving under the influence of strong analgesics constitute crash risk. One hundred and twelve (44.4%) stated that the road traffic safety regulators have means to detect drivers under drug influence whereas 216 (85.7%) claimed that punishment exists for such road traffic offenders. Two hundred and forty four (96.8%) agreed that pain and reduced range of joint motion could lead to decreased reaction speed and increased reaction time thus constituting crash risk. Although 226 (89.7%) admitted the non-existence of handicap parking permit in Nigeria, 230 (91.3%) stated that road traffic safety regulators do issue special (Class J) driver’s license to drivers with physical impairment and deformities. Ninety eight (38.9%) respondents had observed traffic violations among drivers who returned to driving after musculoskeletal disorders. Although only 71 (28.2%) observed road traffic crashes among such drivers, 59 (83.1%) of them reported that such drivers were often at fault when involved in such crashes.

4.2.9 Knowledge, Attitude and Practice of Return to Driving

The knowledge scores on return to driving policy and regulation after musculoskeletal disorders in Nigeria showed that healthcare practitioners had a fair knowledge (125, 41.8%), the practitioners and regulators had a positive attitude whereas a good practice score was shown by the practitioners (259, 86.6%). The patients exhibited poor knowledge (122, 60.7%), negative attitude (126, 62.4%) and poor practice (160, 79.6%) towards return to driving regulation in Nigeria (p= 0.0001) (Table 15).

Table 15: Knowledge, Attitude and Practice Scores of All Respondents

Variables	Patients		Practitioners		Regulators			
	n	**%**	**n**	**%**	**N**	**%**	**X^2**	***P***
Knowledge								
Good	32	15.9	125	41.8	86	34.1		
Fair	47	23.4	86	28.8	135	53.6		
Poor	122	60.7	88	29.4	31	12.3		
Total	201	100.0	299	100.0	252	100.0	143.26	0.0001*
Attitude								
Positive	75	37.6	280	93.6	187	74.2		
Negative	126	62.4	19	6.4	65	25.8		
Total	201	100.0	299	100.0	252	100.0	190.36	0.0001*
Practice								
Good	21	10.4	259	86.6	103	40.9		
Fair	20	10.0	20	6.7	10	4.0		
Poor	160	79.6	20	6.7	139	55.1		
Total	201	100.0	299	100.0	252	100.0	310.30	0.0001*

Key: * Statistical significance

4.2.10 Factors Predicting Return to Driving

Logistic regression analysis was applied to determine factors predicting return to driving after musculoskeletal conditions as presented in Table 16. Among these, only gender and severity of injury showed statistical significance whereas age, level of income, educational status, cause and nature of injury and type of treatment received did not predict return to driving after musculoskeletal conditions among the Nigerian driving population.

Table 16: Logistic Regression Analysis of Factors Predicting Return to Driving

		Return to driving		
Factors		**OR**	**95% CI**	**P value**
Gender	Male	1.0		
	Female	0.4	1.035 - 3.523	0.005*
Education	Post-secondary	1.0		
	Below secondary	4.902	0.608 - 39.5308	0.148
Income	<50	1.0	0.2716 - 1.0903	0.106
	>50	0.54		
Cause of Injury	Traumatic	1.0		
	Non traumatic	1.35	0.7426 - 2.436	0.220
Nature of Injury	Bone injuries/fractures	1.0	0.520 - 2.275	0.171
	Soft tissue/degenerative	1.08		
Severity	Mild	1.0	0.283 - 0.982	0.002*
	Severe	0.53		
Age (years)	<40	1.0	0.832 - 2.724	0.510
	>40	1.5		
Treatment received	Drugs only	1.0	0.2943 - 113.276	0.354
	Drugs and others	5.77		

Key:

*Significant, OR =Odds Ratio, CI= Confidence Interval, Income: (N50,000/month)

Coding: Returned to driving = 1, Not returned = 0

4.3 Study Phase 2- Result

Major findings from the study (phase 1) formed the baseline in the construct of the DMDI. Result showed that the road traffic safety regulators observed many among Nigeria's driving population who drove with various musculoskeletal disorders and presentations which include amputation, limb length discrepancies or driving while wearing cervical collars, bandages, arm slings, prosthesis and orthotic devices.Ninety eight (38.9%) also reported traffic violations among drivers who returned to driving following musculoskeletal disordersand injuries. Results also showed that 89% of the regulator-respondents reported the absence of a Nigerian re-test model. Furthermore, logistic regression analysis showed that gender predicted return to driving (Male: Female gender ratio =1:0.4). The observed earlier return to driving by the male gender when compared to the females as shown in the result (while clinically unfit) constitutes major crash risk in driving. This therefore calls for an urgent need and justification for a uniform and generalizable tool which can objectively assess an individual's suitability to return to driving following musculoskeletal disorders, injury or surgery.

The result of logistic regression analysis further showed that the severity score is inversely related to suitability of return to driving (that is, the higher the severity score, the less suitability to return; whereas the lower the severity score, the higher the suitability to return. Severity encompasses diverse indices of functional recovery such as level of pain, physical function and joint range of motion. From this finding therefore, the construct of the DMDI reflects that the lower the sum of an individual's (severity) scores on these domains, the higher his or her suitability to return to driving). Conversely, the higher the sum of the scores on the domains, the lower the individual’s suitability to return to driving following musculoskeletal disorders, injury or surgery.

4.4 The Driving Musculoskeletal Disability Index (DMDI)

4.4.1 Description of the DMDI

The DMDI is a 45-item scale with four domains, namely pain (5-items), physical function (10-items), range of joint motion (29-items) and grip strength (1-item). Each domain consists of 5 subscales: (0-4) for pain and physical function and (1-5) for range of joint motion and grip strength. For domains A, B and C1, a score of 0 indicates no effect whereas a score of 4 indicates the worst (maximal) effect. For domains C2 and D, a score of 1 represents the least effect whereas a score of 5 represents the worst (maximal) effect. Domains A, B and C1 are to be completed by patients desiring to return to driving after musculoskeletal disorders, injury or surgery while domains C2 and D are to be completed by the clinician assessing the musculoskeletal system.

4.4.2 Validation/ Piloting of the DMDI

The final draft of the DMDI was sent to two physiotherapy academics who are experts in study design and outcome measures to determine the content validity.

Predictive validity was carried out to test the sensitivity and specificity of the DMDI among 30 patient-respondents who were receiving treatment following musculoskeletal disorders in the out-patient department of the National Orthopaedic Hospital, Igbobi-Lagos, Nigeria. They were divided into two equal groups of (A) - Returned group, and (B) - Not returned groups.

Participants’ demographic and other data were as follows: Male: Female ratio of 22:8, Causes of Injury: road traffic crashes (19), domestic accidents (5), industrial accidents (4), others (2). On the nature of injury: bone injury/fractures (21), soft tissue/ disc injury (4) and degenerative disorders/osteoarthritis (5). On the affected body part: lower limb 18, upper limb (8) and back/spine (4).

Thirteen out of fifteen respondents in group A had total scores on all tested domains corresponding to the score range of the ‘Returned’ category. Conversely, twelve respondents in the second group (B) had total sum in all tested domains corresponding to the score range of ‘Not returned’ category. The sensitivity and specificity of the instrument was statistically calculated at 86% and 80% respectively as shown in Table 17. The positive predictive value was 81% while negative predictive value was 86% respectively.

Table 17: Result of Validation of the DMDI

	Returned	Not Returned	%
Test positive	13 (a)	3 (b)	
Test negative	2 (c)	12 (d)	
Sensitivity	a/a+c=13/13+2=0.86		86%
Specificity	d/b+d=12/3+12=0.80		80%
Positive Predictive Value	a/a+b=13/13+3=0.81		81%
Negative Predictive Value	d/c+d=12/2+12=0.86		86%

Key: a = True positive, b = False negative, c = True negative, d = False positive.

Table 18: The Driving Musculoskeletal Disability Index (DMDI)

A	**DOMAIN A: PAIN** Question: How much **pain** did you have in the past 72 hours?					
		None **0**	**Mild** **1**	**Moderate** **2**	**Severe** **3**	**Extreme** **4**
1.	Pain on waking up					
2	Pain while sitting					
3	Pain on standing up					
4	Pain on walking on a flat surface					
5	Pain climbing or descending stairs					
	TOTAL					
B	**DOMAIN B: PHYSICAL FUNCTION** Question: How much **difficulty** did you have in the past 72 hours?					
			Mild **1**	**Moderate** **2**	**Severe** **3**	**Extreme** **4**
1	Self-care (bathing, combing hair etc)					
2	Rising from the bed					
3	Sitting for about 1 hour					
4	Standing from sitting					
5	Standing for about 1hour					
6.	Bending to the floor					
7.	Walking on a flat surface					
8.	Climbing /descending the stairs					
9	Getting in/out of the car					
10	Getting on/off the toilet					
	TOTAL					

C1	**DOMAIN C1: RANGE OF MOTION** Question: How much **stiffness** did you have in the past 72 hours?					
		None **0**	**Mild** **1**	**Moderate** **2**	**Severe** **3**	**Extreme** **4**
1	Joint (s) stiffness on waking up					
2	Stiffness after sitting/ resting later in the day					
	TOTAL					

C2	**DOMAIN C2: JOINTRANGE OF MOTION** (Assessed by Clinician using a Universal Goniometer)							
	Joint (s)	**Movement**	**Mean ROM**	**Score Range (** in degrees**)**				
			(degree)	**1**	**2**	**3**	**4**	**5**
1-4	Cervical /Neck	Flexion Extension Lat. flexion (lt&rt) Rotation	50 60 45 80	41 – 50 49 – 60 37 – 45 65 – 80	31– 40 37 – 48 28 – 36 49 – 64	21 – 30 25 – 36 19 – 27 33 – 48	11 – 20 13 – 24 10 – 18 17 – 32	0-10 0-12 0-9 0-16
		TOTAL						
5-7	Lumbar/ Low back	Flexion Extension Lateral flexion (lt&rt)	60 25 25	49 – 60 21 – 25 21 – 25	37 – 48 16 – 20 16-20	25 – 36 11– 15 11-15	13 – 24 6 - 10 6-10	0-12 0-5 0-5
	TOTAL							
8-12	Shoulder	Flexion Extension Abduction Internal rotation External rotation	175 60 175 90 100	141 – 175 49 – 60 141-175 73 - 90 81 – 100	106-140 37 – 48 106-140 55-72 61-80	71– 105 25 – 36 71-105 37-54 41-60	36– 70 13 – 24 36- 70 19-36 21-40	0-35 0-12 0-35 0-18 0-20
	TOTAL							

13-14	Elbow/ Forearm	Flexion	150	121-150	91-120	61-90	31-60	0-30
		Supination/ Pronation	90	73-90	55-72	37-54	19-36	0-18
15-16	Wrist	Flexion	90	73– 90	55– 72	37 – 54	19-36	0-18
		Extension	85	69-85	52– 68	35-51	18-34	0-17
	TOTAL							
17-22	Hip	Flexion	130	105–130	79--104	53-78	27-52	0-26
		Extension	20	17-20	13-16	9-12	5-8	0-4
		Abduction	45	37 – 45	28-36	19-27	10-18	0-9
		Adduction	30	25 – 30	19-24	13-18	7-12	0-6
		Internal rotation	45	37 – 4 5	28-36	19-27	10-18	0-9
		External rotation	50	41 – 50	31-40	21-30	11-20	0-10
	TOTAL							
23	Knee	Flexion/Extension	145	117-145	88-116	59-87	30-58	0-29
	TOTAL							
24-27	Ankle	Plantar-flexion	50	41 – 50	31-40	21-30	11-20	0-10
		Dorsi-flexion	20	17– 20	13-16	9-12	5-8	0-4
		Inversion	20	17 – 20	13-16	9-12	5-8	0-4
		Eversion	5	4-5	3-4	2-3	1-2	0
	TOTAL							

DOMAIN D Grip Strength (Assessed by Clinician using a hand-held Dynamometer)

(1) Gripping an object (on dynamometer /kg)	**Gender**	**Excellent 1**	**Good 2**	**Average 3**	**Fair 4**	**Poor 5**
	Male	>56	51-56	45-50	39-44	<39
	Female	>36	31-36	25-30	19-24	<19

Interpretation of Scores:

Domain	Scale	Score	Interpretation
A: Pain	0-10		may return to driving
	11-20		may not return yet
B: Physical function	0-20		may return
	21-40		may not return yet
C1: ROM	0-4		may return
	5-8		may not return yet
C2: ROM	27-78		may return
	79-135		may not return yet
D: Grip strength	1-3		may return
	4-5		may not return yet

- An individual may return to driving if he/she meets the criteria in at least 3 out of the 4 domains.
- The criteria for pain and grip strength are mandatory for return
- Inability to return to driving may require further treatment and re-evaluation.

CHAPTER FIVE

DISCUSSION

5.1 Discussion

The study showed the highest predisposition to musculoskeletal injury within the age group 31-40 years. This range represents a peak functional age-group for most individuals where they are often exposed to various levels of danger and job hazards, which may often be work related. The age group of 15-44 years was also reported in a previous study by Hoffman *et al.* (2005) as being mostly affected age group by musculoskeletal injuries. A Nigerian study had also reported that the age group most involved in driving is between 18-35 years (FRSC, 2010). The male gender was more affected at a ratio of 2**:**1 to the female gender. This observation may be because in both developed and developing countries, men are often more involved in routine daily activities including driving, which may expose them to various musculoskeletal injuries more than the female gender. Similar gender trends have also been previously reported for road traffic crashes in different countries. Peden *et al.* (2005) reported 73%**:**27% in Pakistan; Ghaffara *et al.* (2004) reported 22.4**:**6.9 whereas a Saudi Arabian survey reported a male: female ratio of 9**:**1 (Moutaery and Akhdar, 2004). However, this extremely high ratio may not be unconnected with the fact that in Saudi Arabia, females are to a large extent restricted from driving and other such physical activities which as a result may make them less exposed to trauma and resulting musculoskeletal injuries.

The finding that 61.1% of the patient-respondents sustained their injuries through road traffic crashes of which motor vehicle (70%) and motorcycle (24.3%) crashes respectively were the major causes implied that road traffic crashes make up the highest individual causes of musculoskeletal injury. This result corroborates the findings by Ohakwe *et al.* (2011) who reported that road traffic crashes are on the increase in Nigeria. Among 480 road traffic crashes reported by the FRSC within a two week peak traffic period in Nigeria (between December 19th 2012 and January 3rd, 2013), 280 deaths were recorded. The frequency of incidental causes as published by the FRSC included the following: Speed Limit Violation (SLV) 107, Loss of Control (LOC) 51, Dangerous Driving (DGD) 38, Tyre Burst (TBT) 34 and Brake Failure (BFL) 10 (FRSC, 2013).

The high incidence (24.2%) of reported motorcycle crashes may be attributed to the recent astronomical increase in the use of motorcycles as a means of commercial transportation in Nigeria as a result of the worsening economic situation (Akinbo *et al.,* 2008; Kortor *et al*., 2010; Ohakwe *et al.,* 2011). It was also observed by the road traffic regulators that many respondents drove with musculoskeletal injuries and physical impairments. This finding is not strange but supports the obvious daily features on Nigerian roads which may account for the high rate of road crashes observed in Nigeria.

On the pattern of injury sustained and body parts affected, bone injury, particularly fractures of the lower limbs ranked highest. This finding is in agreement with Chen *et al.* (2008) who in a similar study also reported that the lower limbs were mostly affected. This finding may be explained by the fact that the lower limbs which are mainly long bones which maintain the body’s skeletal and postural framework may be more prone to external injuries. Again, the lower limb, by its weight bearing and mobility functions may be more exposed to fracture from trauma.

On the nature of musculoskeletal disorders observed among the drivers by the regulators, individuals who drove while wearing neck collars and bandages were mostly observed. This finding also corroborates earlier findings by Chen *et al.* (2008).

The study found that 11 (5.5%) of the respondents who drove at the time of their crashes had no valid driver's license. Driving without a license is a major traffic offence globally. Many countries and cities have different requirements for obtaining a driver's license. In Nigeria, a person not below the age of 18 years who desires to obtain a driver's license shall subject to the provisions of the National Road Traffic Regulations complete appropriate application forms (National Road Traffic Regulations, 2004). This is followed by a driving test and certification by the road traffic safety regulators and vehicle inspection office before a driver's license is issued. It is therefore an offence in Nigeria to drive without a valid driver's license or to drive at an age below 18 years. However, this system has over time been marred by inefficient and inconsistent policy implementation and corruption, thereby making it a common sight to find under aged drivers and other drivers without valid driver's license.

As at the time of the study, one hundred and thirty three (66.2%) patient-respondents were yet to resume driving following their musculoskeletal conditions. The reason proffered for not driving yet by 76 (57.1%) respondents was due to their present level of pain and discomfort. Similar reasons were also reported by participants in the study by Chen *et al.* (2008). Inability to drive again resulted in a major financial burden which caused many respondents to depend on public transportation (53, 26.4%); family members or friends (81, 40.3%) or had to stay at home all the time (14, 7.0%). These adopted coping strategies were also similar to those reported by respondents in the study by Chen *et al.* (2008). Five (2.5%) of the patient-respondents who were professional drivers lost their jobs as a result of their inability to drive again following their musculoskeletal condition, while 41 (20.4%) had to hire a driver. In Nigeria, where current unemployment rates have been on a steady rise, job loss as a result of stopped driving following musculoskeletal injury will increase the economic burden of such citizens and worsen their perceived socio-economic challenges.

Many patient-respondents reported that they were still on strong analgesic medications when they resumed driving. The most common adverse effects of such strong analgesic drugs include drowsiness and dizziness which often lead to reduced driving alertness, precision and reaction speed (Hau *et al.,* 2000); and impaired vision (Verster and Mets, 2009). These consequences constitute crash risks. It is therefore dangerous to drive while on strong analgesic medications. Chen *et al.,* in their study also reported that 35% of respondents resumed driving while still on strong analgesic medications (Chen *et al*., 2008).

The finding that 24 (11.9%) of the patient-respondents received traditional medicine treatment rather than orthodox treatment indicates a low level of awareness and poor access to healthcare services among many patients in Nigeria. As a result, musculoskeletal disorders often do not present early enough to the hospitals for specialist care. This often results in poor health outcomes with increased risk of musculoskeletal complications such as contractures, stiffness and other deformities which constitute crash risks in driving. This observed poor awareness to health care is in spite of the fact that 148 (73.6%) of patient-respondents lived or drove in the city setting.

Only six (3%) of the respondents reported being asked to go for a driving re-test by their healthcare practitioners whereas only 2 (1%) had to apply for a special driver's license before they returned to driving. In Nigeria, although the road traffic safety regulators issue special (Class J) driver's license to drivers with special needs and physical impairments, negative social attitude towards such category of individual drivers may have contributed to the low utilization of this provision.

On who should decide patients' return to driving, majority (199, 66.6%) of the practitioner-respondents recommended collaboration among healthcare practitioners particularly the orthopaedic surgeons, physiotherapists and occupational therapists. Similarly, majority (137, 68.2%) of the patient-respondents recommended collaboration among healthcare practitioners and the road traffic safety regulators. This finding is in partial agreement with Chen *et al*. (2008) who had recommended collaboration among members of the healthcare profession alone in deciding return to driving following MSDs.

The agreement by most of the respondents that pain and reduced range of joint motion may lead to reduced reaction speed and increased reaction time corroborates the findings by Hau *et al.*, (2000) that pain is a major factor in the determination of return to driving.

There is a growing concern among healthcare practitioners in developed countries about being sued by a third party (Chen *et al.*, 2008). This may arise when a patient, duly cleared by a practitioner to resume driving gets involved in a road traffic crash with a third party. Although this study observed a similar concern among Nigerian healthcare practitioners, majority of these practitioners still recommended the development and practice of a return to driving policy and re-test model in Nigeria.

The study findings established that gender and severity of injury are predictors of return to driving after musculoskeletal disorders, injury or surgery. Conversely, age, level of education, income, cause and nature of injury or type of treatment received did not show any statistical significance as predictors. This finding may be due to the fact that men, often as their family bread-winners, may be pressured by socio-economic and family circumstances to return to work (or driving) earlier than their musculoskeletal conditions would permit them. The study also showed that severity of injury is inversely related to clinical fitness as logistic regression analysis showed that the less severe an injury, the earlier an individual is likely to resume driving function.

CHAPTER SIX

SUMMARY OF FINDINGS, CONCLUSION AND CONTRIBUTIONS TO KNOWLEDGE

6.1 Summary of Findings

Specific Objectives	Summary of Findings
1. To determine factors predicting return to driving following musculoskeletal disorders, injury or surgery.	Gender and severity of injury were found to predict return to driving after musculoskeletal disorders, injury or surgery.
2.To investigate the knowledge, attitude and practice of patients, healthcare practitioners and road traffic safety regulators towards return to driving policy and regulation in Nigeria after musculoskeletal disorders, injury or surgery	Healthcare practitioners had a fair knowledge; practitioners and regulators showed a positive attitude while the patients exhibited poor knowledge, attitude and practice.
3. To develop a Driving Musculoskeletal Disability Index (DMDI) as a clinical tool to determine the suitability of an individual returning to driving following musculoskeletal disorders, injury or musculoskeletal surgery	The study has developed a DMDI (which has not been in place before now) as an outcome measure with psychometric property for the assessment of pain, physical function, joint range of motion and grip strength in patients returning to driving after musculoskeletal disorders, injury or musculoskeletal surgery

6.2 Conclusion

Road traffic crashes constitute one of the major causes of mortality, deformities and socio-economic losses globally. Although many causes of road traffic crashes are well established and understood, the potential effect of driving while clinically unfit as a result of musculoskeletal disorders, physical deformities and injury including surgery and amputation are yet to be fully explored. Musculoskeletal disorders often result in pain, impaired physical function and loss of joint range of motion. These often lead to reduced reaction speed and therefore increased reaction time. Return to driving policy and re-test models exist for different health conditions in many developed countries. In the United Kingdom, the Medical Commission on Accidents Prevention (MCAP) produces a guide for medical practitioners which advises that after a serious injury such as head injury, a patient should abstain from driving for 6 to 12 months until there is clinical evidence of full recovery.

Results from the respective surveys show the absence of a return to driving policy or re-test model in Nigeria for musculoskeletal or other health conditions. This study has also shown that most of the respondents welcomed an indigenous re-test model for patients after musculoskeletal disorders, whereby healthcare practitioners should evaluate their patient's ability to return. The preferred model among the respondent groups suggested that the healthcare practitioner's evaluation should be followed by a driving re-test by the road traffic safety regulators. The study recommends a re-test especially for musculoskeletal conditions that have kept an individual out of driving for at least six months. This is a model practised in some developed countries and cities. Furthermore, the non-availability of a uniform and objective assessment tool to recommend return to driving has led to the development of a driving musculoskeletal disability index. This is a clinical assessment tool to determine suitability of return to driving following musculoskeletal disorders, injury or surgery.

6.3 Contributions to Knowledge

(1) This study has developed a Driving Musculoskeletal Disability Index which is an objective outcome measure with psychometric properties to determine suitability of return to driving following musculoskeletal disorders, injury or musculoskeletal surgery.

(2) The study has established that gender and severity of injury are predictors of return to driving. This finding re-emphasizes the need for routine clinical assessment before return to driving which will ultimately lead to reduction in road traffic crashes in Nigeria.

(3) The study findings have established that collaboration between the healthcare practitioners and road traffic safety regulators will enhance post-crash response while establishing a much needed communication channel between them on a patient's health recovery following musculoskeletal disorders, injury or surgery, thereby improving road safety practice in Nigeria.

(4) The outcome of the study has established the basis for a needed public awareness campaign to educate all stakeholders including healthcare practitioners, road traffic safety regulators, patients and other drivers on the dangers involved in

returning to driving when clinically unfit and while still on strong analgesic medications.

6.4 Recommendations

The study presents two recommendations (1) Return to Driving Guide for Nigeria and (2) Collaboration Chain for Driving Safety. These aim at realizing a safer road safety culture thereby achieving a significant reduction in road traffic crashes in Nigeria, in line with the objectives of the global decade of Action for Road Safety.

6.4.1 Return to Driving Guide for Nigeria (RTDG-N)

Background: Following musculoskeletal disorders, injury or surgery including amputation, a patient’s fitness to return to driving is a common safety concern to the individual, health care practitioners and the road traffic safety regulators. Determination of suitability to drive is therefore of paramount importance in view of its safety implication to the patient, other road users and the society. Most musculoskeletal injuries from trauma and degenerative conditions present with pain, weakness, joint stiffness, limb length and girth discrepancies and sometimes neurological complications causing temporary or long term disturbance of physical function, such as driving. Such conditions include fractures, rheumatoid arthritis, osteoarthritis (and other degenerative joint disorders), ankylosing spondylitis, injuries to the spinal cord, limb amputation, paraplegia and hemiplegia. Although some of these conditions are common in the general population, they may affect driving function and safety to varying extents. They are therefore classified into three main groups (1) Conditions affecting the limbs specifically (2) Disabilities of the spine and (3) General or specific impairments of driving ability arising from weakness and impaired mobility.

Assessment of Fitness to Drive: Factors to consider in assessing return to driving include the type, cause and severity of the injury, its impact on an individual's performance as well as the type of vehicle used by the individual (whether manual or automatic). To date, studies are sparse on the relationship between specific musculoskeletal conditions and the risk of motor vehicle crashes or their impact on driving function and safety. Major factors to be considered in assessment before return therefore include (1) presence and degree of pain that may impede easy movement (2) physical function (3) joint range of motion to permit safe driving and (4) grip strength.

Musculoskeletal Conditions: The suitability of an individual with a musculoskeletal disorder to drive is not entirely a medical decision. However, the following conditions may require a separate assessment as some may contradict driving activity:

Pain and Discomfort may be sufficiently severe to distract an individual's attention and therefore pose a danger on the road. They include acute neck pain (causing inability to look down over the shoulders), use of orthopaedic braces (including neck collars), severe back pain, knee or elbow problems, especially when associated with locking.

Immobilization in Casts and Splints: Even though temporary, this may affect driving function. It is often common for individuals to drive themselves to hospital and leave with a limb in a plaster cast. Conditions also likely to affect safe driving include Total Joint Arthroplasty, Artificial limbs and Permanent Joint Stiffness.

Vehicle modifications such as automatic transmission, spinner knobs and hand controls may be required in some cases.

Other Common Musculoskeletal Presentations include: (1) Fractures and Casts (2) Amputation (3) Arthritis: Both degenerative and inflammatory arthritis often result in pain, loss of muscle strength, range of joint motion and function of the involved joint (s) (4) Spinal Injuries: Cervical injuries may present with significant loss of movement of the head and neck. Such patient should be restricted to driving vehicles equipped with panoramic mirrors. Patients with complaints in the thoracic and lumbar spine applying for a license to drive a passenger transport or heavy commercial vehicle must be free of back pain that limits movement, attention or judgement.

Driving after surgery: (a) General anaesthesia: Effects of anaesthesia include poor concentration, excessive sleepiness and slower reaction time. Therefore patients who had general anaesthesia should not drive within 12 hours after surgery. Patients who had local and regional anaesthesia are not likely to have impaired safe driving ability except if the anaesthetised region impairs motor or cognitive functioning (b) Post-musculoskeletal surgical conditions requiring assessment before return to driving include Hip and knee arthroplasty, Anterior Cruciate Ligament (ACL) and Fixation of displaced ankle fracture.

Alcohol and Drugs: Potential road safety risks from alcohol and drugs include: (i.) sedation effects- risk of somnolence (sleepiness), (ii) impaired reactions or ability to process information, (iii) euphoria (similar effect as illicit drugs), (iv) motor effects such as impaired co-ordination, (v) Specific side effects such as blurring of vision, hypotension or dizziness, (vi) Exacerbation of other medical related risks, such as epilepsy. Many countries have adopted strict legislation on driving and alcohol consumption, and it is recommended Nigeria should too.

Studies have shown increased risk of road crashes associated with the use of drugs such as antidepressants, strong analgesic and hypoglycaemic therapy. Some medications may also interact with others to exacerbate effects on driving performance and safety. Similarly, the combination of alcohol with a wide range of medications may impair performance to the extent that a crash may result. Individuals with drug or alcohol dependence should therefore be discouraged from driving.

Summary: In all cases of clinically significant musculoskeletal conditions, a patient desiring to return to driving needs to demonstrate an ability to drive properly. Both off-road and on-road driving assessments are necessary to determine fitness to resume driving. In cases where modified vehicles are required, this should be stated clearly following the clinician's assessment, including how the vehicles should be modified. Individuals should not drive when on strong medications until they are sure of any side-effects, should not drink and drive, should not drive if feeling unwell or within 48 hours of a general anaesthesia.

When Driving Should Cease: It is recommended that driving should be discontinued in the following conditions:

(1) In severe pain: Routine re-assessment is necessary.

(2) Spinal conditions that severely limit the degree of movement, especially of the neck.

(3) Amputation or congenital loss of a limb required to operate a hand or foot control where no modification is practicable.

(4) Amputation or congenital loss resulting in functional loss of both upper or both lower limbs

(5) Immobilized limbs causing significant limitation in joint range of motion

When Driving May Resume (following assessment after musculoskeletal injury):

(1) Unilateral muscle/ or joint weakness affecting one upper limb.

(2) Individuals with a single below-the-knee amputation with full strength and movement in the back, hips and knee joints, with properly fitted prostheses.

(3) Individuals with left upper limb amputation, on prosthesis.

(4) Absence of both thumbs

(5) Inflammation and moderate pain in any joint, the spine or muscle group

(6) Reduction in rotation of the cervical spine that allows rotation to up to certain range.

When Vehicle Modification May Be Necessary:

(1) In bilateral above-the-knee amputation

(2) In forefoot amputation.

(3) When there is complete absence of the fingers

When a driver may be required to submit to a medical evaluation:

(1) He has impairments which are observed during the licensing process,

(2) He is involved in a crash involving a fatality,

(3) He is involved in a given number of crashes over a certain time period.

A more stringent commercial driving model is recommended to ensure a strict guide to returning to driving after musculoskeletal or other health conditions by commercial drivers in Nigeria.

Deciding Medical Fitness to Drive: After the healthcare practitioner may have assessed the suitability or fitness of a patient to drive following musculoskeletal conditions, further evaluation is required by the regulators (through the licensing agency) in whom rests the final responsibility for decisions regarding an individual's driving qualifications and licensure. This is through a recommended Special Drive Test (SDT) which can be used to determine if an applicant can be safely licensed. The SDT should therefore be used as final approval before fitness certification is issued. However, where a standard driving test is not adequate, the agency may evaluate based on the driver's ability to compensate for some type of disability or medical condition.

6.4.2 Collaboration Chain for Driving Safety (CCDS)

This recommendation is necessary in order to improve road traffic safety through a needed collaboration between the healthcare practitioners (who manage injuries and deformities and are in the best position to advise when a health condition may not be compatible with driving safety) and the regulators (who are often the first to respond in post-crash situation).A wide gap exists in the field of post-crash medical management of crash survivors, thus prompting the inclusion of post-crash response among the five pillars by the United Nation's global decade of action for road safety. Currently, no policy exists in Nigeria which mandates the healthcare practitioner to report his patient's health or musculoskeletal fitness to drive or to stop his patient who is recovering from certain health conditions not compatible with driving safety. Similarly, road traffic safety regulators are not mandated to arrest drivers with musculoskeletal conditions, as there is no return to driving policy in Nigeria.

A collaboration chain therefore places the patient at the centre with the practitioner and the regulator at the opposite ends of the chain. This creates an effective post-crash response networking while encouraging information sharing between them concerning a patient’s health condition and suitability of returning to driving.With such collaboration chain, regulators will be better trained on identifying health conditions that may affect driving function as well as better emergency handling techniques for crash victims before they are moved to the hospital. This will further minimize complications arising from poor handling of post-crash cases and ensure that patients desiring to return to driving after musculoskeletal conditions undergo mandatory clinical assessment by the practitioner. This is then followed by an on or off-the road driving assessment by the regulators. This way, a patient may be referred back to the practitioner within the chain for further treatment and re-evaluation when his driving performance is unsatisfactory to the regulator.

REFERENCES

Adegoke BO, Akodu AK, Oyeyemi AL (2008). Work related Musculoskeletal Disorders among Nigerian Physiotherapists. *BMC Musculoskeletal Disorders.* 18;9:112. doi: 10.1186/1471-2474-9-112. Accessed 22-3-2011.

Akinbo SR, Odebiyi DO, Osasan AA (2008). Characteristics of Back Pain Among Commercial Drivers and Motorcyclists in Lagos, Nigeria. *West Afr J. Med.*27 (2) 87-91.

Akinola A (2005). Road traffic accidents in Nigeria: Cases, causes and control. D&G International Limited

Akinpelu A, Akinwole M, Odole A, Gbiri C (2011). The Reliability of the English Version of Ibadan Knee/Hip Osteoarthritis Outcome Measure (IKHOAM) *Physical & Occupational Therapy in Geriatrics* 29 (3) 181-188.

Akinwuntan AE, De Weerdt W, Feys H, Kiekens C (2005). Effect of simulator training on driving after stroke: a randomized controlled trial. *Neurology* 65:843-846

Alperovitch- Najenson D, Santo Y, Masharawi Y, Katz- Leurer M, Ushvaev D, Kalichman L (2010).Low back pain among professional bus drivers: ergonomic and occupational-psychosocial risk factors. *Isr Med. Assoc. Journal* 12 (1):26-31.

Artens G, Van Mechelen W, Bongers P, Bouter L and Vom der wal G (2000). Physical Risk Factors for Neck Pain. *Scandinavian Journal of Work, Environment and Health* 26: 7-9.

Badley EM, Rasooly I, Webster GK (1994). Relative importance of musculoskeletal disorders as a cause of chronic health problems, disability, and health care utilization: Findings from the 1990 Ontario Health Survey, *The Journal of Rheumatology* 21 (3) 505–514.

Barondess JA (2001) ed. Musculoskeletal Disorders and the Workplace. National Academy of Sciences.

Bernard B (1997). Musculoskeletal Disorders and Workplace Factor, a Critical Review of Epidemiological Evidence for Work-related Musculoskeletal Disorders of the Neck, Upper Extremities and Low back. US department of Health and Human Services, *National Institute for Occupational Safety and Health* Publication no 97: 141.

Bloedow RA, Adler G (1992). Driving and dementia: perspectives from an outpatient clinic. *Soc Work Health Care*;17:31–43

Braddom RL (2000) ed. Low Back Pain in Physical Medicine (12^{th} Ed.) Philadelphia, London WB Saunders: 853-893

British Society of Rehabilitation Medicine (1998). Rehabilitation after Traumatic Brain Injury. London: Royal College of Physicians 8 (3)

Bruce-Chwatt RM (2011). A fatal Motorcycle Accident, UK Road Traffic Legislation Since 1903 and Recent Changes in the Law. *Journal of Forensic Research* 2 (4) 1-3.

Bruno R, Vierra ER (2008). Stretching to Reduce Work-related Musculoskeletal Disorders: A systematic Review. *Journal of Rehabilitation Medicine* 40: 321-328.

Centers for Disease Control and Prevention (2011). Workplace Health Promotion.http://www.cdc.gov/workplacehealthpromotion/evaluation/topics/disorders.html. Accessed 2-8-2011.

Chaffin DB, Anderson GBJ (1993) eds. Occupational Biomechanics (3rd Ed.) New York. NY, USA

Charlotte L (2000). Musculoskeletal Injuries in Performing Artists. *Medical Science Sports Exercise* 81:855-860.

Chen V, Chacko AT, Costello FV, Desrosiers N, Appleton P and Rodriguez EK (2008).Return to Driving after Musculoskeletal Iinjury: Addressing Patient and Surgeon Concerns in an Urban Orthopaedic Practice. The *Journal of Bone and Joint Surgery* 90: 2791-2797

Clayton M and Verow P (2007). Advice given to patients about return to work and driving following surgery. *Occup Med* (Lond) 57 (7):488-91.

Croft PR, Papageorgin AC, Ferry S (1996). Psychological Distress and Low Back Pain: Evidence from a Prospective Study in the General Population. *Spine* 20: 2731-7

Darragh AR, Campo M, King P (2012). Work related activities associated with injury in Occupational and Physical Therapists; 42 (3):373-84. doi: 10.3233/WOR-2012-1430. Accessed 8-3-13.

Dasinger LK, Krause N, Thompson PJ, Brand RJ, Rudolph L (2001). Doctor proactive communication, return-to-work recommendation, and duration of disability after a workers' compensation low back injury. *J. Occup Environ Med*; 43:515–525.

Davis, B. *et al*. (2000). Physical fitness and fitness testing, In: DAVIS, B. *et al*. *Physical Education and the study of sport*. 4th ed. Spain: Harcourt 123-7.

Department of Work and Pensions (2012). Desk Aid 2. Advising Patients of Working Age' a Guide to the Completion of Med 3, Med 4 and Med 5 Statements with 'Evidence Based' Recovery Times for Some Surgical Procedures. Originally Distributed as the 2002 CMA Bulletin.http://www.dwp.gov.uk/medical/ deskaids.asp. Accessed 3-1-13.

Ekberg K, Bjorkqvist B, Malm P, Bjerre-Kiely B, Karlsson M, Axelson O (1994). Case control study of risk factors for disease in the neck and shoulder area. *Occupational Environmental Medicine* 51 (4): 262-266.

EC (2002).Directive 2002/44/ec of the European Parliament and of the Council of 25 June 2002.*Offic Journ. European Community*

Elliot R (2000). Principles and Practice of Public Health Surveillance Page 159 *Google Books*. Ca/books/isbn=0195138279. Accessed 3-2-2013.

Fagbemi OS and Pfeffer K (2006).The relationship between sleep patterns and the experience of simulator sickness and motion sickness. *Advances in Transportation Studies*-an international Journal, Special Issue *63. 201-3*

Federal Road Safety Corps (2010). FRSC estimates annual cost of road crashes in Nigeria. *Road Mirror*: Research Monograph 2.

Federal Road Safety Corps Annual Report (2011).Available on www.frsc.gov.ng. Accessed 2-5-2012

Federal Road Safety Corps (2013). Available on www.frsc.gov.ng. Accessed 5-1- 2013.

Feeney A, North F, Head J, Canner R, Marmot M (1998).Socioeconomic and sex differentials in reason for sickness absence from the Whitehall II study, *Occupational and Environmental Medicine* 55 (2) 91–98.

Galski T, Ehle HT, Williams JB (1997). Off-road driving evaluations for persons with cerebral injury: a factor analytic study of pre-driver and simulator testing. *Am J.Occup Ther*.51:352–359

Ghaffara A, Hyderc AA and Masudb TI (2004). The burden of Road Traffic Injuries in Developing Countries: The 1st National Injury Survey of Pakistan. *Journal of the Royal Institute of Public Health.* 118: 211–217.

Gianutsos R, Campbell A, Beattie A, Mandriota F (1992). The driving advisement system: a computer-augmented quasi-simulation of the cognitive prerequisites for resumption of driving after brain injury. *Assist Technol*; 4:70–86

Gottwald M (2006). Asylum Claims and Drug Offences. *Int. Journ. of Refugee Law* 18 (1) 81-117

Hagberg M, Wegman DH (1987). Prevalence Rates and Odds Ratios of Shoulder-neck Diseases in Different Occupational Groups. *British Journal of Medicine* 44: 602-10

Hakala PT, Saarni LA, Punamaki R, Wallenius MA, Nygard C and Rimpela AH (2012).Musculoskeletal Symptoms and Computer Use among Finnish Adolescents –Pain Intensity and Inconvenience to Everyday Life: a Cross-sectional Study *BMC Musculoskeletal Disorders* 13:41. Accessed 3-3-13.

Hakkanen M, Viikari-Juntura and Martikainene R (2001).Incidence of Musculoskeletal Disorders among Newly Employed Manufacturing Workers. *Scandinavian Journal of Work, Environment and Health* 127:381-387

Hau R, Csongvay S, Bartlett J (2000). Driving Reaction Time after right knee arthroscopy. Knee Surg Sports *Traumatol Arthrosc*; 889-892.

Hoffman K, Primack A, Keusch, G and Hrynkow S (2005). Addressing the Growing Burden of Trauma and Injury in Low-and Middle-income Countries. *American Journal of Public Health* 95 (1) 13–17.

Hooftman WE, Van der Beek AJ, Bongers PM, Van Michelen W (2005). Gender Differences in Self-reported Physical and Psychological Exposure in Jobs with Both Female and Male Workers. *Journal of Occupational Environment Medicine* 47 (3) 244-52

Hulshof CT, Verbeek JH, Braam ITJ, Bovenzi M, van Dijk FJH (2006). Evaluation of an Occupational Health Intervention Programme on Whole-body Vibration in Forklift Truck Drivers: A Controlled Trial. *Occupational Environment Medicine* 63: 461–468.

Israel DG (1992). Determining Sample Size. University of Florida Extension Services Fact Sheet PEOD-6 1-5.

Karwowski W, Marras WS (2003). eds. Occupational Ergonomics: Principles of Work Design. Boca Raton, FL, USA CRC Press

Kortor JN, Yinusa W, Ugbeye ME (2010). Lower Limb Injuries Arising From Motorcycle Crashes. *Nigerian Journal of Medicine*19 (4) 475-478.

Krause N, Ragland DR, Greiner BA, Fisher JM, Holman BL, Selvin S (1997). Physical workload and ergonomic factors associated with prevalence of back and neck pain in urban transit operators. *Spine*22: 2117–2126.

Kristin M, MaryFran R S (2009). Assessment of Physical Functioning: A Conceptual Model Encompassing Environmental Factors and Individual Compensation Strategies. *Phys Ther*. 89(7): 705–714.

Kröner-Herwig B, Gaßmann J, Tromsdorf M, Zahrend E (2012). The effects of sex and gender role on responses to pressure pain. *Psychosoc Med.* 9:Doc01

Kurppa K, Viikari-Juntara E, Kusosma E, Hauskonene M and Kivi P (1001).Incidence to Tenosynovitis or Peritendinitis and Epicondylitis in a Meat Processing Factory. *Scandinavian Journal of Work, Environment and Health* 17: 32-37

Legh-Smith J, Wade DT, Hewer RL (1986).Driving after a stroke. *Journ. Royal Soc Med*; 79:200–3.

Leino P (1989). Symptoms of stress predict musculoskeletal disorders. *Journal of Epidemiology and Community Health* 43, 293-300

Lis AM, Black KM, Korn H, Nordin M (2007). Association between sitting and Occupational Low back pain. *European Spine Journal* 6: 283-298

Long MH, Johnston V, Bogossian F (2012). Work related upper quadrant musculoskeletal disorders in midwives, nurses and physicians: A systematic review of risk factors and functional consequences. *Appl Ergon.*43 (3):455-67. Accessed 8-3-13

Low J and Reed A (1996) eds. Basic Biomechanics Explained. Oxford, Butternort Heinermann

Makale M, Heliovaara M, Sievers K, Impivaara O, Knekt P, Aromaa A (1991). Prevalence, Determinants and Consequences of Chronic Neck pain in Finland. *American Journal of Epidemiology* 134 (11): 1356-1367

Mansfield NJ (2005). Human Response to Vibration, (1st Ed).London: CRC Press.

Massaccesi M, Pagnotta A, Soccetti A, Masali M, Masiero C, Greco F (2003). Investigation of Work-Related Disorders in Truck Drivers using RULA Method. *Applied Ergonomics*34: 303-307.

Mazer B, Shrier I, Feldman DE, Swaine B, Majnemer A, Kennedy E, Chilingaryan G (2010). Clinical Management of Musculoskeletal Injuries in Active Children and Youth. *Clinical Journal of Sport Medicine:* 20(4) 249-255.

McMillan T, Greenwood R (1991). Rehabilitation programmes for the brain injured adult (discussion paper). London: Department of Health. *Appl Occup Environ Hyg*.18 (1):57-64.

Melvin M (2012). The British Columbia Driver Fitness Handbook for Medical Professionals.www.pssg.gov.bc.ca/osmv/medical-fitness. Accessed 11-2-13.

Merlino LA, Rosecrance JC, Anton D, Cook TM (2003). An epidemiological study on Work Related Musculoskeletal Disorders among Apprentice Construction Workers.www.ncbi.nlm.nih. gov/pmc/articles/PMC3263153.

Miller J and Joy E (2007). Foot and Ankle Injuries in Dance. *Clinical Sports Medicine* 19: 351-368

Mogaka EO, Ng'ang'a Z, Oundo J, Omolo J, Luman E (2011). Factors associated with severity of road traffic injuries, Thika, Kenya. *Pan Afr Med* J. 20 8-10.

Moutaery KA and Akhdar F (2004). Implications of Road Accidents in Saudi Arabia. *The Pan Arab Journal of Neurosurgery,* 2 (2) 7-8.

National Institute of Occupational Safety and Health (1997). Musculoskeletal Disorders and Workplace Factors: A Critical Review of Epidemiological Evidence for Work-related Musculoskeletal Disorders of the Neck, Upper Extremities and the Low back. US Department of Health and Human Services (DHHS).*Centre for Diseases Control and Prevention, NIOSH, Publication* No 97-141

National Road Traffic Regulations (2004). Federal Republic of Nigeria Official Gazette No.79, (91) B192.Federal Government Press, Lagos, Nigeria.

Nilsson T (2002). Neurological Diagnosis: Aspects of Bedside and Electro-diagnostic Examinations in Relation to Hand-arm Vibration Syndrome. *International Archives of Occupational Environmental Health*. 75: 55-67

Obremskey T, Brown O, Driver R, Dirschl D (2007). Comparison of Sf-36 and Short Musculoskeletal Functional Assessment in Recovery from Fixation of Unstable Ankle Fractures. *Orthopaedics* 30 (2) 102-7

Odenheimer GL, Beaudet M, Jette AM, Albert MS, Grande L, Minaker KL (2004). Performance-based driving evaluation of the elderly driver: safety, reliability and validity. *J Gerontol*.49:M153–M159.

Ohakwe J, Iwueze IS and Chikezie DC (2011). Analysis of Road Traffic Accidents in Nigeria: A Case Study of Obinze/Nekede/Iheagwa Road in Imo State, South-eastern, Nigeria. *Asian Journal of Applied Sciences,* 4: 166-175.

Oluwasanmi AJ (1993). Road Accident Trends in Nigeria. *Journal of Accident Analysis and Prevention* 25 (4):485-7

O'Neill B and Mohan D (2002). Reducing Motor Vehicle Crash Deaths and Injuries in Newly Motorizing Countries. BMJ 324:1142-1145

Owoeye IO (1998). Science of the Human Back and Causes of Back Pain. Journal of the *Nigerian Medical Rehabilitation Therapist* 3 (6): 1-8

Palmer KT, Griffin MJ, Bendell H (2000). Prevalence and Pattern of Occupational Exposure to Whole-body vibration in Great Britain. Findings from a National Survey. *Occupational Environmental Medicine*57: 229-236

Palmer KT, Synddall H, Cooper C, Coggon D (2002). Smoking and Musculoskeletal Disorders: Findings from a British National Survey. *Annals of the Rheumatic Disease* 62: 33-36

Peden M, Scurfield R, Sleet D, Mohan D, Hyder AA, Jarawan E and Mathers C (2005). *World Report on Road Traffic Injury Prevention.* Geneva. World Health Organization and World Bank.

Petridou E and Moustaki M (2000). Human Factors in the Causation of Road Traffic Crashes. *European Journal of Epidemiology* 16; 819-826

Ponzer S, Skoog A and Bergstrom G (2003). The Short Musculoskeletal Function Assessment Questionnaire (SMFA)- Cross-cultural adaptation, validity, reliability and responsiveness of the Swedish SMFA. *Acta Orthop Scand*. 74 (6)756-763

Pope MH, Andersson GBJ, Frymoyer JW, Chaffin DB (Eds.) (1991). Mosby-Year Book, Inc, St Louis, MO,

Pope MH, Wilder DG, Magnusson M (1998). Possible Mechanisms of Lower Back Pain due to Whole Body Vibration. *Journal of Sound and Vibration* 215: 687-698.

Porter JM, Gyi DE (2002). The prevalence of Musculoskeletal troubles among car drivers. *Occupational Medicine* 52: 4-12.

Punnett L, Gold J, Katz JN, Wegman DH (2004). Ergonomic stressors and Upper Extremity Musculoskeletal Disorders in Automotive Manufacturing. *Occupational Environment*61: 668-674.

Punnett L, Herbert R (2000). Work-Related Musculoskeletal Disorder: Is there a gender difference and if so, what does it mean? Women Health 38 (6) 474–492.

Punnett L and Wegman D (2004).Work-related Musculoskeletal Disorders: The Epidemiologic Evidence and the Debate.*Journal of Electromyography and Kinesiology* 14 (1) 13-23.

Ratzon N, Schejter-Margalit T (2006). Time to Return to Work and Surgeon's Recommendations after Carpal Tunnel Release. *Occup Med.* (Lond); 56:46–50.

Rehn B, Bergdahl IA, Erom C, Jarvholm B, Lundstrom R, Nilsson T, Sundelin G (2002). Musculoskeletal Symptoms among Drivers of All-terrain Vehicles. *Journal of Sound and Vibration:* 263 (1) 21-29.

Salik Y, Özcan A (2004). Work-Related Musculoskeletal Disorders: A survey of physical therapists in Izmir-Turkey. *BioMed Central Musculoskeletal Disorders*5: 27.

Shute RH, Woodhouse JM (1990). Visual Fitness to Drive after Stroke or Head Injury. *Opthalmic Physiol Opt.*10:327–332.

Silverstein BA, Fine LJ, Armstrong TJ (1987). Occupational Factors and Carpal Tunnel Syndrome. *Am J. Ind Med* 11: 343-358

Sinaki M, Morki B (2000). Low Back Pain and Disorders of the Lumbar Spine. *Physical Medicine and Rehabilitation* 5: 835-893

Skakibara H and Yamada S (1995).Vibration Syndrome and Autonomic Nervous System. *Central European Journal of Public Health* 3:11-14

Smith CK, Weiss EI, Lehkuhi L (1996) eds. Bronstrom's Clinical Kinesiology 5th Ed. Philadelphia, Davies FA Company.

Soucie JM, Wang C, Forsyth A, Funk S, Denney M, Roach KE, Boone D, and the Hemophilia Treatment Center Network (2010). Range of Motion Measurements: Reference Values and a Database for Comparison Studies. *Haemophilia;* e-pub November 11, 2010.

Stetson M, Silverstein B, Keyserling M, Wolfe R and Albers J (1993). Median Sensory Distal Amplitude and Latency: Comparisons Between Non-exposed Managerial /Professional Employees and Industrial Workers. *American Journal of Industrial Medicine* 24: 175-89.

Szeto PY, Lam P (2007). Work-Related Musculoskeletal Disorders in Urban Bus Drivers of Hong-Kong. *Journal of Occupational Rehabilitation* 17: 181-198.

Takala J. (2008). Work-Related Musculoskeletal Disorders: Prevention Report. European Agency for Safety and Health at Work. London.

Taylor JF (1995).ed. *Medical Aspects of Fitness to Drive. A Guide for Medical Practitioners*. The Medical Commission on Accident Prevention.London.

Teutsch SM, Churchill RE (2000).Evaluating Public Health Surveillance. *PMC Articles.* National Centre 176-193 www.ncbi.nlm.nih.gov/pmc/artcles/pmc1941289.

Tinubu BM, Mbada CE, Oyeyemi AL, Fabunmi AA (2010). Work Related Musculoskeletal Disorders Among Nurses in Ibadan, South-West Nigeria: A Cross Sectional Survey. *BMC Musculoskeletal Disorders* 11:12 doi: 10.1186/1471-2474-11-12.

Van der Windt D, Thomas E, Pope D, De Minter A, Macfarlane G, Bouter L and Silman A (2000). Occupational Risk Factors for Shoulder Pain: A Systemic Review. *Occupational and Environmental Medicine* 57: 433-442.

Verster JC and Mets MAJ (2009). Psychoactive Medication and Traffic Safety. *Int J Environ Res Public Health*6 (3): 1041–105.

Viitari-Juntura E, Rauas S and Martikamen R (1996). Validity of Self Repeated Physical Work Load in Epidemiological Studies on Musculoskeletal Disorders. *Scandinavian Journal of Work Environmental Health* 22: 251-259

Waller JA (1980). Physician's Role in Highway Safety-Functional Impairment in Driving.*N Y State J Med;* 80:1987–1991.

Westgaard RH (2000). Work-related Musculoskeletal Complaints: Some Ergonomic Challenges Upon the Start of a New Century. *Applied Ergonomics* 31: 569-80.

Westgaard RH, Jansen T (1992). Individual and Work-related Factors Associated with Symptoms of Musculoskeletal Complaints: A quantitative Registration System. *British Journal of Industrial Medicine* 49:147-153

Westropp NM, Gill TK, Taylor AW, Bohannon RW and Hill CL (2011). Hand Grip Strength: Age and gender stratified normative data in a population-based study. *BMC Research Notes* 2011, 4: 127.

Wijnhoven HA, de Vet HC, Picavet HS (2006). Prevalence of musculoskeletal disorders is systematically higher in women than in men. *Clin J Pain*. 22 (8): 717-24.

World Confederation for Physical Therapy (2011). Policy Statement: Direct Access and Patient/Client Self-referral to Physical Therapy. London, UK: WCPT; 2011. (Accessed 22-9-11).

World Health Organization (1985). Identification and Control of Work-related Musculoskeletal Disease; Technical Report Series. WHO Geneva. No 714.

World Health Organization (2009). Global Status Report on Road Safety. Geneva, Switzerland: World Health Organization; 2009. Available at http://www.who.int/violence_injury_ prevention/road_safety status/ 2009/en. Accessed 28-4-2011.

World Health Organisation (2011). World Report on Road Traffic Injury Prevention: Summary. WHO, Geneva, Switzerland. Available at http://www.who.

World Health Organization (2013a). Global Status Report on Road Safety. Geneva, Switzerland: World Health Organization; 2013. Available at www.who.int/entity/ violence_injury_ prevention/road_safetystatus/2013/en/ - 30k.

World Health Organization (2013b) Pedestrian Handbook Report. Geneva, WHO, Geneva, Switzerland. Available at http://www.who.Com.

Yale SH, Hansotia P, Knapp D, Ehrfurth J (2003). Neurologic Conditions: Assessing Medical Fitness to Drive. *Clin Med Res*.1(3): 177–188.

Zomeren Van and Minderhoud Brouwer (1987). Acquired Brain Damage and Driving: A Review. *Arch Phys Med Rehabil*68:697-705.

APPENDIX 1

RETURN TO DRIVING QUESTIONNAIRE – PATIENT MODEL (RTD-PM)

Dear Respondent,

My name is Okafor Udoka, C. I am currently undertaking this research work titled Return to Driving after Musculoskeletal Disorders: Developing a Nigerian Musculoskeletal Disability Index as part of my Thesis -a requirement leading to the award of a Ph.D in the School of Postgraduate Studies, University of Lagos.

This study seeks to bring to focus the multi-factorial determinants of when and how individuals who stopped driving as a result of musculoskeletal disorders including musculoskeletal-related surgeries and amputations could resume driving activity without causing a menace to other road users or contribute to crash risk. It is hoped that the outcome of the study will give direction to solving many societal safety questions leading to improved road and public safety in Nigeria.

Your cooperation and consent is hereby solicited by this document. Kindly complete this questionnaire which comprises sections A-D with average completion time of 10 minutes only. Please note that participation is voluntary. Also respondent's identity is NOT required. Further, be assured all information supplied in this questionnaire will be treated with utmost confidentiality and used only for the purpose of this research.

OKAFOR U.A.C (PT) MSc

…………………………………………..**Researcher**

CONSENT FORM

I wish to confirm my consent and participation in this study as introduced above. I also understand that the information supplied by me is confidential and is for the purpose of the research only.

……………………………….**Respondent** (Signature/Date)

PATIENT SURVEY (RTD-PM)

SECTION A: SOCIO-DEMOGRAPHIC DATA

1. AGE: ……… 2. SEX: M ☐ F ☐ 3. HEIGHT (m): …………

4. WEIGHT (kg): ………… 5. BLOOD PRESSURE (mmHg): …………………

6. OCCUPATION:.................………..........7.EDUCATIONAL BACKGROUND: TERTIARY ☐ SECONDARY ☐ PRIMARY ☐ INFORMAL ☐

8. MARITAL STATUS: SINGLE ☐ MARRIED ☐ SEPARATED ☐ DIVORCED ☐ WIDOWED ☐

9. AVERAGE MONTHLY INCOME: (A) <₦25, 000 (B) ₦26,000 - ₦50,000 (C) ₦ 51,000 - ₦75,000 (D) ₦76,000 - ₦100,000 (E) >₦100,000

10. DO YOU SUFFER FROM: EPILEPSY YES ☐ NO ☐
DIABETES YES ☐ NO ☐

SECTION B: NATURE OF MUSCULOSKELETAL INJURY

11. How did you sustain your disorder/injury/surgery?
    - Road traffic accident ☐
    - Domestic accident/fall ☐
    - Industrial accident ☐
    - Degenerative/Osteoarthritis ☐
    - Others (please specify)………………………………………………

12. If by road accident, what type? (if applicable)
    - Motor vehicle ☐
    - Motor cycle ☐
    - Tricycle ☐
    - Others (please specify)………………………………………

13. When the injury occurred, were you the driver or a passenger?
    Driver ☐ Passenger ☐ Date of injury: M/ Year…………..

14. What nature of disorder/injury did you sustain?
    - Bone injury/fracture ☐ Soft tissue/Disc injury ☐
    - Spinal injury ☐ Degenerative/Osteoarthritis ☐
    - Head injury ☐ Others (please specify)……………..........................

15. What part of the body is your disorder /injury/surgery?

Lower limb (leg) ☐ Back/spine ☐ Head ☐

Upper limb (hand) ☐ I do not know ☐ Others…………………………

16. On the scale below, indicate your pain level when you had the disorder/injury

No pain ↓ Mild ↓ Moderate ↓ Severe ↓

17. What type of treatment did you receive after your condition? (You may tick more than one): Surgery/drugs ☐ Drugs only ☐ Physiotherapy/drugs ☐ Traditional Medicine ☐ Others (please specify) ………………

18. Do you have a valid driver's license? Yes ☐ No ☐

SECTION C: BURDEN OF STOPPED DRIVING AFTER MUSCULOSKELETAL DISORDER

19. Have you returned to driving after your disorder/injury/surgery? Yes ☐ No ☐

20. Why have you not returned to driving (You may tick more than one)

I feel it is too early to resume driving ☐

I feel my present pain/discomfort cannot permit me yet ☐

I feel my healthcare practitioner will not approve ☐

Family members/friends warned me not to drive yet ☐

I am afraid due to the memory of the incident ☐

Others (please specify)……………………………………

21. Is inability to drive a difficulty to you? Yes ☐ No ☐

22. How do/did you cope with transportation due to your inability to drive? (You may tick more than one)

I depend/ed on support from family members/friends ☐

I depend/ed on public transportation ☐

I have/had no means, so I stay at home all through ☐

I had to hire a driver ☐

As a professional driver, it has taken me out of job ☐

Others (please specify)………………………………………

23. Does/did inability to drive cause you financial difficulty? Yes ☐ No ☐

24. In what type of community setting do/did you normally drive?

City ☐ Suburban ☐ Rural ☐

25. Did/would you ask your health practitioner when you can return to driving?

Yes ☐ No ☐

SECTION D: RETURN TO DRIVING AFTER INJURY

26. When did you resume driving? Month/Year……………………………..........

27. Were you asked by your healthcare practitioner to resume? Yes ☐ No ☐

28. Did you just feel you could drive, so you resumed yourself? Yes ☐ No ☐

29. Did your healthcare practitioner oppose your returning? Yes ☐ No ☐

30. Were you still on strong pain killers/drugs when you resumed driving?

Yes ☐ No ☐

31. Did your healthcare practitioner offer full dosage information to you regarding the strong analgesics/pain killers he prescribed to you? Yes ☐ No ☐

32. Will you still drive even when your healthcare practitioner explained possible side-effect of strong drugs on driving safety? Yes ☐ No ☐

33. Did you receive physiotherapy treatment after your injury/surgery? Yes ☐ No ☐

34. Were you still on physiotherapy when you resumed driving? Yes ☐ No ☐

35. Did your healthcare practitioner recommend that you go for a driving evaluation/ re-test before returning to driving? Yes ☐ No ☐

36. If yes to 35, who carried out the driving evaluation?

FRSC personnel only ☐

FRSC and Vehicle Inspection Office ☐

FRSC- approved driving school ☐

Others (please specify)…………………………………………

37. Was the driving evaluation done ON or OFF the road?

ON the road (practical) ☐

OFF the road (theory) ☐

Both ON and OFF the road ☐

38. Did you apply for a special driver's license (class J) or a handicap parking permit as a result of your disorder/injury/surgery? Yes ☐ No ☐

39. Before you returned to driving, did your vehicle require any special modification?

Yes ☐ No ☐

40. Since returning, have you been involved in any road crash? Yes ☐ No ☐

41. Would you attribute your accident to your disorder/injury? Yes ☐ No ☐

42. Who should decide on patient's return to driving after musculoskeletal disorder/injury/surgery?

(a) Physiotherapist Yes ☐ No ☐

(b) Orthopaedic Surgeon Yes ☐ No ☐

© Occupational Therapist Yes ☐ No ☐

(d) Road Safety Personnel Yes ☐ No ☐

(e) Patient himself Yes ☐ No ☐

(f) Collaboration between practitioners and regulators Yes ☐ No ☐

43. What is the best treatment approach for early return to driving after musculoskeletal disorders/Injury/surgery?

Surgery/Drugs Yes ☐ No ☐

Drugs only Yes ☐ No ☐

Physiotherapy/Drugs Yes ☐ No ☐

Traditional Medicine Yes ☐ No ☐

Others (please specify)…………………………………………………………

APPENDIX I1

RETURN TO DRIVING QUESTIONNAIRE- PRACTITIONER MODEL (RTD-PRM)

Dear Respondent,

My name is Okafor Udoka, C. I am currently undertaking this research work titled Return to Driving after Musculoskeletal Disorders: Developing a Nigerian Musculoskeletal Disability Index as part of my Thesis -a requirement leading to the award of a Ph.D in the School of Postgraduate Studies, University of Lagos.

This study seeks to bring to focus the multi factorial determinants of when and how individuals who stopped driving as a result of musculoskeletal disorders including musculoskeletal-related surgeries and amputations could resume driving activity without causing a menace to other road users or contribute to crash risk. It is hoped that the outcome of the study will give direction to solving many societal safety questions leading to improved road and public safety in Nigeria.

Your cooperation and consent is hereby solicited by this document. Kindly complete this questionnaire which comprises sections A-D with average completion time of 7 minutes only. Please note that participation is voluntary. Also respondent's identity is NOT required. Further, be assured all information supplied in this questionnaire will be treated with utmost confidentiality and used only for the purpose of this research.
Thank you.

OKAFOR U.A.C (PT) MSc

…………………………………Researcher

CONSENT FORM

I wish to confirm my consent and participation in this study as introduced above. I also understand that the information supplied by me is confidential and is for the purpose of the research only.

…………………………………Respondent (Signature/Date)**.**

PRACTITIONER SURVEY (RTD-PRM)

SECTION A: SOCIO-DEMOGRAPHIC DATA

1. **Sex**: M ☐ F ☐
2. **Professional group:** Physiotherapist ☐ Orthopaedic Surgeon/Senior Registrar ☐ Occupational Therapist ☐ Others ....
3. **Years of practice experience** 2-5 ☐ 6-10 ☐ 11-15 ☐ 16-above ☐
4. **Work setting**: Teaching Hospital ☐ Orthopaedic/Specialist Hospital ☐ Federal Medical Centre ☐ General Hospital ☐

SECTION B: PREDICTORS OF RETURN TO DRIVING

5. Do you determine when your patients return to driving after musculoskeletal disorders, injury or surgery including amputation? Yes ☐ No ☐
6. What factors would you consider very important in deciding the return to driving for a patient after musculoskeletal disorder/surgery?

   Minimal drug dependence ☐ Range of joint motion ☐

   Pain Severity ☐ Appreciable muscular coordination ☐

   Patient's Age Patient's job demands ☐

   Nature of injury/surgery ☐ Patient's emotional stability ☐

   Others (please specify)……………………………………
7. When do you advise your patients that they can return to driving?

   At the point of hospital discharge ☐

   When patient expresses readiness to return ☐

   When there is clinical evidence that disorder/surgery has resolved ☐

   Others (please specify)………………………............................
8. In your opinion, who should determine a patient's return to driving following musculoskeletal disorders/injury/surgery (you may tick more than one)

   Physiotherapist ☐ Physician ☐ Orthopaedic Surgeon ☐

   Occupational Therapist ☐ Others (Please specify)……………………………..

SECTION C: EFFECT OF STRONG ANALGESICS ON DRIVING

9. Do you prescribe strong analgesics for your patients recovering from musculoskeletal disorder/injury/surgery? Yes ☐ No ☐

10. Do you think the side effect of such strong analgesics/pain killers constitute crash risk which may affect driving safety? Yes ☐ No ☐

11. Do you give full dosage information to your patients on such medication? Yes ☐ No ☐

12. Do you warn your patients on possible side effects of strong drugs on driving performance and safety? Yes ☐ No ☐

13. Do you think that improved regulation and enforcement will improve road safety and minimize road crashes in Nigeria? Yes ☐ No ☐

14. Are you familiar with traffic laws in Nigeria? Yes ☐ No ☐

15. Would you support/recommend a Nigerian driving law mandating healthcare practitioners to restrict or to report medically/physically unfit drivers? Yes ☐ No ☐

16. Do you know of any Nigerian driving law offering legal immunity/protection to a reporting healthcare practitioner? Yes ☐ No ☐

SECTION D: RETURN TO DRIVING MODEL

17. Are you aware of return to driving policy/ re-test model in any country? Yes ☐ No ☐
    Which country? ……………….........which health condition?………………........

18. Are you aware of any return to driving policy/re-test model in Niger Yes ☐ No ☐

19. What model of return would you recommend/practice?
    Healthcare practitioner alone to certify patient fit to resume driving ☐
    Practitioner's certification to be followed by driving retest by the regulators ☐
    Suggest other model (s):1……………………………………………..
    2.……………………………………………………………………….

20. In your practice, would you consult/involve other healthcare practitioners in taking clinical decisions concerning patient's return to driving? Yes ☐ No ☐

21. Who would you consult/involve before deciding? (You may tick more than one)
    Physiotherapist ☐ Orthopaedic Surgeon/Registrar ☐
    Physician ☐ Occupational Therapist ☐
    Other professionals (please specify)………………................

22. Would you support a strict return model that recommends driving re-test before returning to driving following all musculoskeletal disorder/surgery?

    Yes, I support a driving retest for all musculoskeletal disorders/surgery ☐

    Yes, but only for patients who did not drive for at least six months due to injury ☐

    No, the healthcare practitioner's clinical judgment is sufficient ☐

    Other recommended model/ policy (please specify)..

23. Do you think that a strict policy is necessary to avoid discrimination against some patients, such as elderly patients? Yes ☐ No ☐

24. Will you be concerned about being sued if a patient is involved in an accident after you had approved his return to driving? Yes ☐ No ☐

25. Will you be willing to recommend and practice return to driving in Nigeria in view of such medico-legal issues that may arise? Yes ☐ No ☐

THANK YOU!

APPENDIX III

RETURN TO DRIVING QUESTIONNAIRE- REGULATOR MODEL (RTD-RM)

Dear Respondent,

My name is Okafor Udoka, C. I am currently undertaking this research work titled Return to Driving after Musculoskeletal Disorders: Developing a Nigerian Musculoskeletal Disability Index as part of my Thesis -a requirement leading to the award of a Ph.D in the School of Postgraduate Studies, University of Lagos.

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Thank you.

OKAFOR U.A.C (PT) MSc

……………………………………Researcher

CONSENT FORM

I wish to confirm my consent and participation in this study as introduced above. I also understand that the information supplied by me is confidential and is for the purpose of the research only.

………………………………Respondent (Signature/Date)

REGULATOR SURVEY (RTD-RM)

SECTION A: SOCIO-DEMOGRAPHIC DATA

1. Sex: M ☐ F ☐
2. Years in FRSC: Between 2-4 ☐ 5-7 ☐ 8-10 ☐ Above 10 ☐
3. Zonal Command……………….……........... 4. Title/ Rank……………………

SECTION B: CRASH RISK PREDICTORS

5. Do you observe drivers recovering from musculoskeletal disorders/orthopaedic injuries who drive with physical impairments? Yes ☐ No ☐
6. Tick the common conditions seen by you while on duty.
   - Drivers with limb amputation ☐
   - Drivers with leg/arm shortening ☐
   - Drivers while on POP/ arm slings ☐
   - Drivers wearing prosthesis/orthotic devices ☐
   - Drivers wearing neck collar/bandages ☐
   - Others (please specify)……………………………………………..
7. Do you suppose that among such drivers, some may drive also while on strong analgesics/pain killers? Yes ☐ No ☐
8. Does driving while under the influence of such strong drugs can constitute crash risk? Yes ☐ No ☐
9. Does the FRSC have a means of detecting drivers under the influence of drugs (such as strong analgesics/pain killers? Yes ☐ No ☐
10. Does the FRSC have any punishment/penalty for drivers under the influence of such drugs? Yes ☐ No ☐

SECTION C: CRASH RISK FOLLOWING RETURN

11. Do you think that pain and reduction in joint motion such as the knee can cause a reduction in reaction speed during driving? Yes ☐ No ☐
12. Do you think that reduction in driving reaction speed constitutes a crash risk in driving? Yes ☐ No ☐
13. Does the FRSC issue special drivers license to physically impaired drivers in Nigeria? Yes ☐No ☐

14. Does handicap parking permit exist in Nigeria? Yes ☐ No ☐

15. Do you observe traffic violations among drivers who are returning to driving after musculoskeletal disorders /injury/surgery? Yes ☐ No ☐

16. Do you observe increased road crashes among drivers who returned to driving after musculoskeletal disorders/ injury/surgery? Yes ☐ No ☐

17. Do you often find such drivers at fault when they are involved in road crashes? Yes ☐ No ☐

SECTION D: RETURN TO DRIVING MODEL

18. Are you aware of any return to driving policy or re-test model applicable to musculoskeletal conditions in any country? Yes ☐ No ☐

19. If Yes to 18, which condition(s)? …………………...........………………........................
....which country(s)?...

20. Does the FRSC have any policy/re-test model for patients with musculoskeletal disorders before they can drive again? Yes ☐ No ☐

21. If yes to 20, please elaborate………………………………………….............................
…………………………………………………………………………………………

22. Is there any Nigerian traffic law requiring the healthcare practitioner to stop or report impaired drivers? Yes ☐ No ☐

23. Is there any Nigerian law requiring the healthcare practitioner to certify patients fit before they can return to driving? Yes ☐ No ☐

24. If No to 20, would you welcome an indigenous return to driving re-test model following musculoskeletal disorders/injury? Yes ☐ No ☐

25. Do you think the healthcare practitioners should evaluate their patients’ ability to return to driving after musculoskeletal disorders/ injury Yes ☐ No ☐

26. Do you think enforcing such a policy/ model will have positive impact on driving safety by reducing road crashes in Nigeria? Yes ☐ No ☐

THANK YOU.