OCCUPATIONAL UPPER LIMB INJURIES AND THEIR OUTCOMES IN A PORT ELIZABETH PRIVATE HOSPITAL: A RETROSPECTIVE STUDY

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of
Master of Medicine

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Declaration

I, Javed Iqbal Khan Niazi, declare that this research report is my own, unaided work. It is being submitted for the Degree of Master of Medicine in the branch of Orthopaedic Surgery at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

…………………………

(Signature of candidate)

Signed on the …24… day of ……March…… 2024 in …Port Elizabeth 6070…

Dedication

I dedicate this work to my late father, Amir Abdullah Khan Niazi. My first example of discipline and dedication. He has shown me, by example, that the greatest resource available to man is his will to succeed at his goal and not the material resources he has available to him. May the Almighty bless his hereafter and accept this work as a means of charity on his behalf.

Presentations and publications arising from the research project

None.

Abstract

Study design: Retrospective descriptive.

Background: Occupational injuries are a common occurrence both in developed and developing countries. Developed countries have managed to reduce these injuries due to improvements in their structure and the implementation of prevention strategies. There are no studies done on the outcomes for the occupational injuries of the upper limb as a whole. A review of the literature shows only the outcomes of occupational injuries of the hand.

Aim: The aim of the study was to determine the epidemiology of occupational injuries of the upper limb and their outcome in a private hospital in Port Elizabeth for the period of 01 April 2013 to 31 December 2020.

Methods: A retrospective study was conducted at a private hospital in Port Elizabeth, South Africa, for a period of seven and a half years starting from 01 April 2013 to 31 December 2020. A total of 334 patients over the age of 18 years were included after their consent was obtained. The data relevant to this study were collected from their files.

Results: The age distribution of participants in this study was 18 – 30 years old (28%), 31 – 40 years old (25%), 41 – 50 years old (27%), and older than 50 years old (20%). Eighty percent were males *versus* twenty percent females. Right-hand dominants were 95.8%, left-hand dominants were 3.6%, and ambidextrous were only 0.6%. The majority of injuries occurred to manual labour workers; however, all groups were involved in these occupational injuries. About 35% of injured workers came from the manufacturing industry and 32% from the service-oriented sector. The workers had presented with different types of injuries including fractures (43.1%), tendon injuries (13.5%), amputations (10.8%), dislocations and rotator cuff tears less than 10 % and other miscellaneous injuries were (18.3%), respectively. These injuries occurred due to fall (34.4%) and crush (34.1%). Crush-type injuries were seen more in male workers from the manufacturing industry and falls were the most common cause for these injuries in females from the service-oriented sector. About 80% of workers continued

with the same job under the same employer, 9% of workers lost their jobs, and 8% of workers continued under the same employer after they were accommodated with an alternative job. Surprisingly, fractures were common findings in 41 – 50-year old workers while amputations mostly occurred in 18 – 30-year old workers. Rotator cuff tears were more prevalent in workers above 50 years of age. Overall, these injuries were common during the weekdays and occurred less frequently over the weekend. The longest average return to work time was required for rotator cuff tears. With regard to the time of day for injury occurrence, two peaks were noted in this study. The first peak was observed around 3 PM and the second peak was noticed in the morning at 10 AM.

Conclusion: Most of the workers were younger than 50 years old and predominantly right hand dominant. Just over 50% of workers belonged to skilled trade occupations and process, plant and machine operators. More than-two thirds of injuries took place in the manufacturing and service-oriented industries. The workers sustained different types of injuries, with fractures being the most common finding while the rotator cuff injuries were the least common with two peaks for these injuries at 10:00 and 15:00 hours. Falls and crushes were the two most common causes of injuries. Almost 90% of workers went back to the same company they were with when they sustained the injury, 80% of whom resumed pre-injury jobs and 8% were given accommodated jobs. A multidisciplinary team approach is required to treat these injuries for better outcomes. A larger multi-centre prospective study is recommended for more accurate outcomes. Occupational health and safety measures must be implemented in the workplace to limit these injuries.

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I take this opportunity to express my gratitude to all the Department faculty members for their help and support. I also thank my parents, Safia Begum and Amir Abdullah Khan Niazi (late), my wife, Dr Aamina A. Ditta, who has given me exceptional support and care.

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Nomenclature

ANOVA	Analysis of Variance
CEO	Chief Executive Officer
CMCJ	Carpometacarpal Joint
CRPS	Complex Regional Pain Syndrome
ED	Emergency Department
EU	European Union
GH	Greenacres Hospital
HREC	Human Research Ethics Committee
IOD	Injury on Duty
ILO	International Labour Organisation
MCPJ	Metacarpophalangeal Joint
MVA	Motor Vehicle Accidents
PIPJ	Proximal Interphalangeal joint
PTO	Power take-off
RTW	Return to work
WHO	World Health Organisation

Chapter 1

1. Introduction and Literature Review

1.1. Introduction

An occupational injury refers to an accident that occurs while an employee is performing their job duties, as assigned by the employer (1). Upper limb injuries in this study are any injuries that occur or affect any part of the upper limb from the shoulder to the fingertips. These injuries can occur due to different mechanisms. A crush injury occurs when a body part is subjected to force or pressure, often occurring when torso, limb/s or other parts of the body are squeezed between two heavy objects. Penetration/cut injuries are those with no deep structure involved (e.g. muscle, tendon, vessel, nerve). An assault injury is the result of an illegal act of causing physical harm to another person. Any body part can get injured, and upper limb occupational injuries add a significant burden of disease. These injuries include abrasions, contusions, lacerations, fractures, dislocations, amputations, tendon, ligament and nerve injuries. The injuries of the upper limb can be serious, and they may require surgical intervention and a long period of rehabilitation before the employee can resume his or her own duties.

Accurate data on the economic burden of occupational injuries and diseases is crucial for policy makers. With this information, nations can better allocate the scarce resources for the safety and health of workers in their country. In 2012, the International Labour Organisation (ILO) reported that 4% of global Gross Domestic Product (GDP) was lost due to work-related injuries and diseases (2). According to the International Labour Organisation’s 2014 report, a staggering 313 million workplace accidents resulting in injuries occurred annually worldwide (3). A recent study conducted by the European Agency for Safety and Health at Work (EU OSHA) revealed that work-related injuries and diseases imposed a significant economic burden, equivalent to 3.9% of global GDP and 3.3% of European GDP in 2017 (2). Leigh estimated the cost of occupational injuries and diseases for the United States of America (USA) to be US$250 billion in 2011, equivalent to 1.8% of the country’s GDP (2). In 2013, the Association of Workers’ Compensation Board of Canada reported that over 241,000 Canadian workers suffered work-related injuries or illnesses that resulted in lost time (3). According to the Health and Safety Executive (HSE), the economic burden of work-related injuries and diseases in the United Kingdom was estimated to be £14 billion in 2006/07, equivalent to 1% of the country's GDP (2). Safe Work Australia, a government agency, estimated the cost of work-related injuries and diseases at $61 billion in 2012 – 13, equivalent to 4.8% of the country's GDP (2). A study conducted in Singapore estimated that the cost of work-related injuries and illnesses amounted to SG$10.45 billion in 2013, equivalent to 3.2% of the country's GDP (2).

The South African population was just above 55.5 million people in 2016. The Eastern Cape, one of the nine provinces of the country, has a population of almost 7 million people (4). With a population of over one million residents, as recorded in the 2011 census, the Nelson Mandela Bay Municipality is the sixth largest municipality in South Africa(4). It consists of Black African (60%), Coloured (24%), Caucasian (14%), Indian (1%) and Other (1%) races. According to the 2016 South African Census, less than 1% of the Eastern Cape population were foreign nationals. Just over 50% of the population were females (i.e. 52% female and 48% male). In this region, a significant majority (68%) of the population fell within the working-age range of 14 – 65 years. A small proportion of adults (15%) had completed secondary education, and an even smaller percentage (2.7%) had achieved higher education (4).

Seaport and automotive manufacturing centres are situated in Nelson Mandela Bay. Manufacturing, finance, community services and transport industries constitute the major economic sectors. These sectors provide most of the employment opportunities in the metropolitan area. The manufacturing sector in the Eastern Cape is mainly driven by the automotive subsector. This subsector accounts for 30% of manufacturing employment. Three large original car manufacturers, Volkswagen, Mercedes Benz and Ford are based in the Eastern Cape Province. The automotive sector is the dominant industry in the region, with the production of motor vehicles and parts being the main driver of economic activity. Additionally, the tyre manufacturing industry is also a significant player, contributing substantially to the economy. Furthermore, the region's economy is also bolstered by the Agri-processing sector, which specialises in transforming raw materials like wool, mohair and hides into value-added products. Moreover, the Eastern Cape province is renowned for its thriving fruit and vegetable canning industry, which adds to the region's economic diversity and strength. In 2011, the unemployment rate was around 36% in Nelson Mandela Bay Municipality (5). However, those who are fortunate to have the opportunity to work are not without risks because of their exposure to injuries at work. These injuries can have a serious impact on the individual physically, psychologically and financially. The employer also suffers a financial burden in terms of loss of productivity until the employee has fully recovered and resumes work. The impact on society results from the cost of treatment covered by the state, which gets paid either to a private hospital or it adds workload to the already burdened state sector which works under severe resource constraints.

1.2. Literature review

"Health and safety at work is not just a sound economic policy; it is a basic human right" (6). To address the major issues of workplace and health at national and global level, solutions and strategies are required. The International Labour Organisation (ILO), World Health Organisation (WHO) and European Union (EU) all produce data, develop guidelines and give expenses for work-related injuries at global and national levels. These injuries can be prevented by workplace health promotion, services, safety and health management. Key factors in changing the workplace culture include workers' involvement, proactive management at all levels and engaging leadership. Economic rationale must be added to the legal and enforcement measures that assist businesses and organisations to avoid short- and long-term disabilities, premature retirement and corporate closures brought on by poor management and unsustainable work life. In developed nations, reporting of these work injuries is somewhat comprehensive; sadly, in underdeveloped countries, reporting is far less common. The lack of standardisation of national systems makes it challenging to compare them internationally.

According to Standard Industrial Classification (7)there are 21 industries as shown in Table 1.1 below:

Table 1.1: Standard Industrial Classification

Number	Name of industry
1	Agriculture, forestry and fishing
2	Mining
3	Manufacturing
4	Electricity
5	Water supply
6	Construction
7	Wholesale and retail trade
8	Transportation and storage
9	Accommodation and food service activities
10	Information and communication
11	Financial and insurance activities
12	Real estate activities
13	Professional, scientific, and technical activities
14	Administrative and support service activities
15	Public administration and defence
16	Education
17	Human health and social work activities
18	Arts, entertainment
19	Other service activities
20	Activities of household as employers
21	Activities of extraterritorial organizations and bodies

In 2021, Debela et al. demonstrated that amongst African workers with occupational injuries,57% were from the manufacturing, construction and mining sectors(8).Subgroup analysis revealed that the prevalence of occupational injuries in each of the industries was as follows: manufacturing sites 62%, construction sites 57% and mining sites 51% of injuries, however, the differences in the prevalences between industries was not statistically significant (8). Almost half of the world's labour force is working in the agricultural industry at a global level, and it is estimated to be about 1.3 billion workers of which 60% of them are in developing countries (9). Mucci et al., in 2020, found in their systematic review that upper limb, especially hand injuries were common in young male farmers during the harvesting season involved in driving tractors and using tools (10). In a 2014 study on the incidence of acute traumatic tendon injuries in the hand and wrist conducted in USA, De Jong et al. discovered that the industries responsible for these injuries were construction, food services and transportation sectors with 44.2%, 14.4% and 12.5% of the cases, respectively (11).

The Standard Occupational Classification 2000(12) divides workers into nine major groups that are further divided into sub-groups. These are:

- Managers and Senior officials (for example Directors and Chief Executives of major organisations)
- Professional Occupations (Civil engineers)
- Associate Professional and Technical Occupations (Nurses, Paramedics)
- Administrative and Secretarial Occupations (General office assistants/Clerks)
- Skilled Trades Occupations (Butchers, Glass and ceramic makers)
- Personal Service Occupations (Undertakers and Mortuary assistants)
- Sales and Customer Service Occupations (Sales and Retail assistants)
- Process, Plant, and Machine Operatives (Assemblers of vehicle and metal goods)
- Elementary Occupations (Cleaners, domestics)

Occupational injuries, both fatal and non-fatal, are significantly under-reported at a global level due to lack of insurance coverage of workers and less than optimal record keeping systems, and they constitute a huge burden on employees, their families and the economy (13). There has been a decreasing trend in occupational injuries in developed countries and it has been postulated that this is due to improvements in their structure and prevention programmes (6). McDougall et al., in 2017, described that occupational therapy practitioners should adopt a preventative approach to lower the rate of work disabilities and provide timely results to workers for returning to the workplace (3).

1.2.1. Risk factors/causes

The impact of risk factors leading to injuries on the overall burden of disease is underappreciated (13). Well-known risk factors for occupational injuries include being too young or too old, male gender, poor workplace conditions, long working hours, nightshift, inadequate sleep, insufficient work experience, lack of systematic occupational training, high level of work stress, poor workplace security, emotional instabilities, use of alcohol and lack of physical exercise (14,15).

Factors related to the workplace, as well as factors outside the workplace, can influence occupational injuries (16). In the area of safety management, Kramer et al. (2020) provided helpful insights into the close relationship between work and family domains (16). Occupational injuries increase with the increase of an employee's or partner's shift hours and if they have more children to look after at home (16). However, the opposite effect was reported to occur with an increase in income, which has been shown to lead to fewer occupational injuries. A similar effect has been reported when working shifts change from regular to irregular schedules (16). This latter arrangement allows the employee to adjust his/her work schedule according to his/her social requirements.

The United Nations currently uses age 60 years and over to designate older workers (United Nations, 2017). The Bureau of Labour Statistics in the United States classifies older workers as those aged 55 years and older (Toosi and Torpey, 2017). In Canada, older workers are defined as 65 years of age or older and their number is rising (Statistics Canada, 2016). In Canada and other industrialised nations, there is a tendency for older workers staying in the workforce for longer. There is increasing concern about the health and safety of older workers. Older workers are more prone to injuries due to factors such as long work hours, fatigue and diminished functional ability. While research indicates that the incidence of work-related injuries among older workers was lower compared to young workers (18 – 24 years in the US defence and construction industry), the aforementioned factors also contributed to more severe and expensive outcomes of these injuries (17).

Upper limb injuries were more common in young workers, while lower limb injuries were more common in older workers. In fact, young workers sustain commonly fingers, hands and wrist injuries due to cuts, lacerations, contusions or puncture wounds while old age workers sustain commonly ankles, feet, toes, knees or multiple injuries. Choi in 2015 suggested that with regular training on ergonomic hazards and physical changes that occur with ageing, injuries can be reduced among older workers (18).

The migration of workers is a widespread phenomenon documented at a global level. Some of the factors that are at the root of the migration of workers are the shortage of workers due to the ageing population, income inequalities, geopolitical crises, civil wars and climate changes in the high-income countries. Therefore, worries about occupational health and safety of these foreign-born workers are mounting. Migrant workers in any country have a high incidence of occupational injuries, as they are likely to take up odd jobs to please their employers and to make ends meet. According to two studies done in Australia and Spain, foreign workers do not seem to have equal rights to their native counterparts. According to the Australian study, workers who were born outside of Australia had lower rates of recurrent claims and took less time off, but their overall expenses were greater (19).

Race, education and working experience have been looked at in relation to fatal and non-fatal injuries. Fatal injuries have a higher incidence in black workers compared with white workers in the USA. However, there is no association between the non-fatal injuries at work and race. Compared to highly educated individuals, those with low and intermediate levels of education had 2.4 – 2.7 times risks of non-fatal work injuries. Less experienced workers also have a higher chance of non-fatal injuries. Different occupations have a different relationship to these non-fatal injuries. The workers in professional positions are less likely to get non-fatal injuries compared to production sector workers. Moreover, workers who do more strenuous activity are more likely to experience non-fatal injuries (20).

1.2.2. Impact on society and on economy

Occupational injuries cause a financial burden on society, as well as on the economy of every country. The cost increases when patients require surgical intervention when a significant amount of health resources is used. The median cost per injury was found to be 4,508 Australian dollars for non-compensable cases (where treatment was funded by the Australian government tax-funded universal public health insurance scheme) and 5,057 Australian dollars for compensable cases in an Australian study (21). Acute hand and wrist injuries account for about 10 – 30 % of all Emergency Department (ED) visits, and most of these patients who suffer these injuries are young and in their economic productive years (21).

1.2.3 Types of industries/injuries

It has been found that the manufacturing sector has the highest rates of injuries followed by the construction sector. The most frequent kinds of injuries are those that result from being caught-in-machinery, caused by blunt objects, falling from a height and due to penetrating sharp objects. The biggest number of injuries are to the isolated extremities, which are followed by multiple bodily injuries and facial injuries(1). Ozkan et al.'s study revealed that isolated upper extremity injuries accounted for 56.6% of all injuries with the manufacturing sector accounting for 76% of those cases (1).

Work-related injuries range from simple bruises, which may not require medical care to very serious injuries leading to loss of body parts. These injuries can cause permanent impairments, lost income, chronic pain and ongoing medical expenses, all of which can diminish one's quality of life. Certain industries have greater rates of occupational injuries because of the inherently dangerous nature of work needs. Although their injury incidence is lower than the state average, construction workers in Alaska have been shown to have a higher number of injuries. Law enforcement personnel were the next common occupational injury victims behind firefighters. Among all occupations, contusions, strains, sprains or lacerations were the most frequent types of injuries (22). The injury rates among American electric power industry workers had decreased between 1995 and 2013, according to research done in 2017 by Volberg et al. (23). These workers were expected to perform physically demanding maintenance and repair tasks, work long shifts, work in emergency situations and drive. In this industry, sprains and strains were the most frequent types of injuries. However, the other types of injuries, from most common to least common, were contusion, scratches, fracture dislocation, hearing loss, bite, respiratory, dermatitis and electrocution (23). Employees working on the electrical cables, doing mechanical jobs or working on machines and female workers going out for meter readings made up the high-risk group for these injuries(23).

The mining industry is one of the riskiest industries to work in because workers must operate heavy machinery such as excavators, large bulldozers, transportation trucks, roof bolter machines, powered and non-powered hand tools. They also work in an environment which is noisy, poorly ventilated and poorly illuminated making them susceptible to falling rocks. Another study conducted in the USA examined the incidence and severity of wrist, hand and finger injuries among mining industry workers. The results showed that while the number of incidents of these injuries decreased between 2007 and 2017, severity of the injuries increased over time(24). Sixty nine percent of miners reported having injuries. Additionally, those who suffered finger injuries missed more workdays (66%) (24).

High-pressure injection guns are used at an industrial level, such as in the painting, cleaning, lubricating and mass vaccination of animals. Paint, grease, water, oil, air and solvents are commonly the implicated materials. A pressure of 100 psi is required to break the skin, but with these high-pressure guns, the pressure can reach up to 2,000 to 12,000 psi. The presentation of these injuries can be unimportant at the time of the incident, which delays referring these injuries to hand surgeons, and the resulting outcomes of these injuries are very poor and can lead to amputation of the fingers. Severe hand injuries occur due to accidental injection of foreign material with the use of pressure guns under high pressure, these injuries are not very common, and most injuries occur to manual workers at work and male workers are at high risk. Hart et al. in the USA in 2006 reported in their study that 82% of these injuries belonged to work-related incidents. As guns were held in dominant hands, injuries occurred in the non-dominant hand and digital amputation was required within five months from the time of the injury (25).

Hand injuries from high pressure injection of molten metal are uncommon. The injured patient will have a small entry wound but the extent of deep thermal damage to the tissues is quite significant which can lead to finger amputation. One study included a case report in which a 39-year-old right-handed metal worker was unintentionally injected molten metal mixture (80% copper, 9% aluminium, 7% manganese and 4% nickel) in his right hand. Although the patient received immediate surgical exploration; antibiotics cover and relook debridement after a few days, ultimately, he underwent a second ray amputation of the hand due to thermal injuries to his flexor tendons and digital nerves and vessels, which became necrotic (26).

1.2.4 Agents of injuries/Mechanism of injuries

Falls are also common mechanisms of injuries in almost every business activity. These include, amongst others, falling from a ladder, falling downstairs or falling from a scaffolding. In one of the retrospective studies in the USA published in 2020, it was found that older patients (> 65 years old) sustained more severe injuries and their outcome was worse after falling from a ladder (height 9 feet) in comparison to their younger counterparts (18 – 45 years old) who fell from ladder height (12.3 feet). The systolic blood pressure readings, length of hospital stay and injury severity scores following ladder falls were all greater in older workers (> 65 years of age) (27).

Hand and upper extremity injuries are caused by powered instruments including chainsaws, electric saws and hand grinders. Simple lacerations to tendon injuries, fractures and even amputations are among the problems that might occur. Non-occupational users sustain more severe injuries compared to occupational users due to a lack of proper training and experience in using these powered tools. Other possible reasons for these injuries are fatigue and failure to comply with safety precautions (28).

The agricultural sector is also responsible for a number of hand and upper limb injuries in any country. In India, it was found that 43 out of 45 farmers who sustained injuries had hand tools involved in the accident as compared to accidents with other farming tools. In the agricultural industry, shovels, pickaxes, weeding forks, spades, plain edge sickles and serrated-edge sickles are the most frequently used hand tools. The age group (18 – 30 years) reported the least number of injuries, whereas age group (31 – 45 years) experienced the most injuries. These injuries were reported during land preparation, weeding and harvesting of crops. It has been found that lack of ergonomic considerations in the design of hand tools and equipment, lack of expertise, lack of knowledge of safety measures and negligence on the part of farmers, as well as adverse environment, are the contributing factors (29). Numerous prior epidemiological studies have identified potential risk factors for occupational injuries.

There are many tools, machines and materials which can cause occupational injuries. Fortunately, most of these can be prevented by implementing proper protective measures. One tool is the angle grinder, which is a powerful versatile tool that is readily available in hardware stores and accessible to the public. This strong instrument is useful for cutting, shaving and polishing various hard surfaces including stone, concrete and metal. It is used by workers as well as by retired people in the hobby context. It can be responsible for severe injuries to the face and upper limbs as well as trunks in any population group, but particularly in retired people who love to use it for their hobbies when they fail to follow the instructions provided in the user's manual. There are numerous factors, which can contribute to the injuries caused by the angle grinder. In their prospective study of angle grinder injuries to the hands and forearms conducted in Turkey in 2018, Sozbilen et al. discovered that age of the operator and smoking habits were significant factors in the high number of injuries that occurred between 15:00 and 18:00. The resulting impairment was crippling, the injuries were severe and challenging to treat. For this powerful instrument, care should be taken, and instruction given (28).

1.2.5 Local experience

According to a 2017 study on the aetiology of acute hand injuries in South Africa, the majority of the hand injuries were caused by powered tools, powered machines and handling building materials. Most of the injured workers were young low-income males who had multiple dependents with low educational levels and with very little training, working with no protective gloves. The index, middle and ring fingers were commonly injured, and the injuries sustained were lacerations, crush injuries, fractures, tendon injuries, nerve injuries and amputations (30).

1.2.6 Interventions and prognosis/return to work

Hand injuries not only require proper initial diagnosis and treatment, but post-operative therapy also proves very beneficial in achieving good functional outcomes. A therapist using “engagement in occupation as a therapeutic agent of change” is referred to as providing an occupation-based intervention (31). Retrospective research by Millrose et al. was conducted on patients who sustained hand injuries at work. Their study covered finger and wrist injuries, which had the highest proportion (71%) of return to work and very good functional results. Good subjective and objective outcomes were obtained by the patients who had a poor initial outcome from finger and wrist occupational injuries after undergoing a 3 – 5 week specialised hand rehabilitation programme (31).

Return to work (RTW) is a complex process and is not only dependent on the physical readiness of the injured worker. Returning to work following occupational hand injuries is also correlated with several other factors. Severity of the impairment determines how long the healing process takes and how long rehabilitation takes before going back to work. Furthermore, workers who have lower pre-injury income will have a longer time to RTW (32).

1.2.7 Complications

Following upper limb injuries at work, numerous complications arise. These include wound complications (wound breakdown), infection (surgical site infection, osteomyelitis), venous thromboembolism, rhabdomyolysis, myoglobinuria (crush injury, ischemia-reperfusion, extremity compartment syndrome), non-union, heterotopic ossification and joint contracture (33). Complex regional pain syndrome and Dupuytren’s contracture are two complications that are described below, The limbs are affected by a chronic neurological disorder known as complex regional pain syndrome. In addition to sensory, autonomic, motor and trophic dysfunction, patients report severe pain. It is usually caused by the surgical intervention or traumatic injury. There are two types of this condition. Type 1 CRPS occurs without known nerve injury and type 2 CRPS is the result of specific nerve damage. Certain procedures are associated with CRPS. Dupuytren's contracture release, carpal tunnel release, shoulder and distal radius operations are a few examples of procedures linked to CRPS. Complex regional pain syndrome is a well-known complication in upper limb injuries. A multi-disciplinary team including a psychologist is used with medical management to achieve optimal results. Research indicates that the upper limb is more affected by complex regional pain syndrome than the lower limb (34). In a prospective cohort study, Savas et al. determined that the patients with a crushing injury and those who experienced a pain score greater than 5 in the first 72 hours after surgery, were more likely to develop CRPS after surgical management of acute hand injuries.

The age and sex of the workers, educational level, injuries to the dominant hand, and manual as well as non-manual work status were not associated with the development of CRPS. Because of swelling, joint stiffness, tendon adhesions, muscle atrophy, delayed return to work and poor health-related quality of life, it makes recovery more difficult (35).

Duputyren's contracture is commonly seen in white middle-aged males, and it presents with a fibro-proliferative disorder of the hand, and it has a strong genetic predisposition. It has been found that injuries to the hand and wrist can trigger the formation of Duputyren like contracture. It presents with single fibromatous band, usually affects one hand and is less severe and its treatment is conservative with a low chance of recurrence (36). The risk factors for contracture in occupational hand injuries were investigated and it was found that their occurrence was higher among hard manual labourers and those with previous hand injuries (37).

1.2.8 Study relevance

On review of the literature, most studies looked at occupational injuries to the hand rather than the upper limb. This is also the case with the study done in South Africa. For this reason, occupation-related injuries of the whole upper limb were selected as the focus of the study. It might be the first study on occupational injuries of the upper limb in the country.

This study was done in Port Elizabeth which is a major city in the Eastern Cape Province, and it has three private hospitals with their own EDs and orthopaedic services. Two public hospitals offer emergency services, however, only one of them is classified as a tertiary hospital, which offers surgical care for orthopaedic injuries. The primary investigator (PI)'s practice is situated in Greenacres Hospital (GH) in Port Elizabeth. Netcare GH is a 340-bed hospital with a 24-hour ED situated in the centre of the city. The bulk of the practice regards servicing injury on duty cases. On average, approximately 17 new injuries on duty (IOD) cases are seen every month.

Chapter 2

2. Methodology

2.1. Study aims and objectives

The aim of the study was to determine the epidemiology of occupational injuries of the upper limbs and their outcome in patients treated by a single orthopaedic surgeon in a private hospital of Port Elizabeth metropole.

The objectives of the study were to:

- determine the relationship between age and sex, type of occupation and industry of the patients, and the injuries sustained.
- describe the relationship between hand dominance, day and time of the week, and the injuries sustained.
- document the injuries and their effects on the employees as well as to determine the outcome; and
- document the interval between the injury date and the date of resumption of duties.

2.2. Methods

This was a retrospective study of occupational upper limb injuries of workers managed by a single orthopaedic surgeon (PI) that had completed the rehabilitation programmes at Netcare Greenacres Hospital from 01 April 2013 to 31 December 2020. Files of all patients treated for upper limb occupational injuries in the period starting from 01 April 2013 until 31 December 2020 were obtained from the principal investigator's records. Each patient included in the study was ascribed a unique study number to safeguard the anonymity of participants. The files obtained were reviewed by the investigator, and the relevant data was transcribed from each patient's file onto the data collection sheet (see Appendix A). This data collection sheet was safely stored and only the primary investigator had access to it. The PI contacted the participants to obtain the consent for the study and at the same time, data was collected on their hand dominance, occupational status and the date that they resumed work. The PI obtained consent to approach the employee's human resource office for details regarding sick leave and resumption of work that the participant may not remember well.

The study was conducted after acquiring ethics approval from the Human Research Ethics Committee (HREC) (Medical), University of the Witwatersrand (Ethics Ref No: **M220851**). Before the commencement of data collection, permission to conduct the study was obtained from the Chief Executive Officer (CEO) as well as the Department's HOD at Greenacres Hospital (GH) (see Appendix B). Written informed consent was obtained from each participant before using their medical records for the study (see Appendix C). Consent was mainly in writing and in cases where the participant could not come to sign, a telephonic consent was obtained from the participant, and it was recorded and stored in a safe place. All the data collected from the medical records were completely decoded and anonymised to ensure participant confidentiality and other ethical guidelines set out by the committee were stringently followed. R version 4.2.0 (R core Team, 2022, statistical software was used by the biostatistician for the statistical analysis (38).

2.2.1. Patient inclusion criteria

- Patients aged 18 years and older who have sustained occupational injuries to their upper limbs.
- Patients seen at GH practice who were treated by the PI and who attended the rehabilitation programme.
- Patients who consented to participate in the study.

2.2.2. Patient exclusion criterion:

- Patients with incomplete medical records.

Chapter 3

3. Results

3.1. Study participants

There were 334 participants in this study. The participants were further divided into four age groups. Of them 28 % were between the ages of 18 and 30 years; 25% were between the ages of 31 and 40 years; 27% were between the ages of 41 and 50 years, and the remaining 20% were older than 50 years (see Figure 3.1).

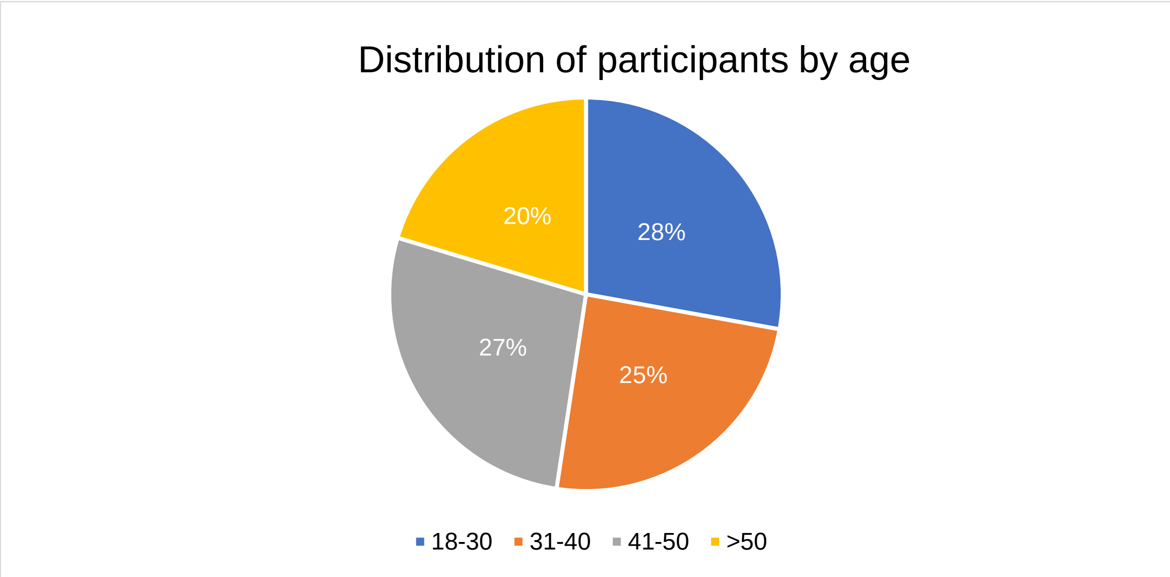

Figure 3.1: Pie chart of age

There was a total of 334 participants in the study; 80 percent of whom were male and 20 percent were female.

Of the 334 study participants, the majority (95.8%) were right hand dominant, with fewer than 5% being left-handed, and less than 1% displayed ambidexterity (see Figure 3.2).

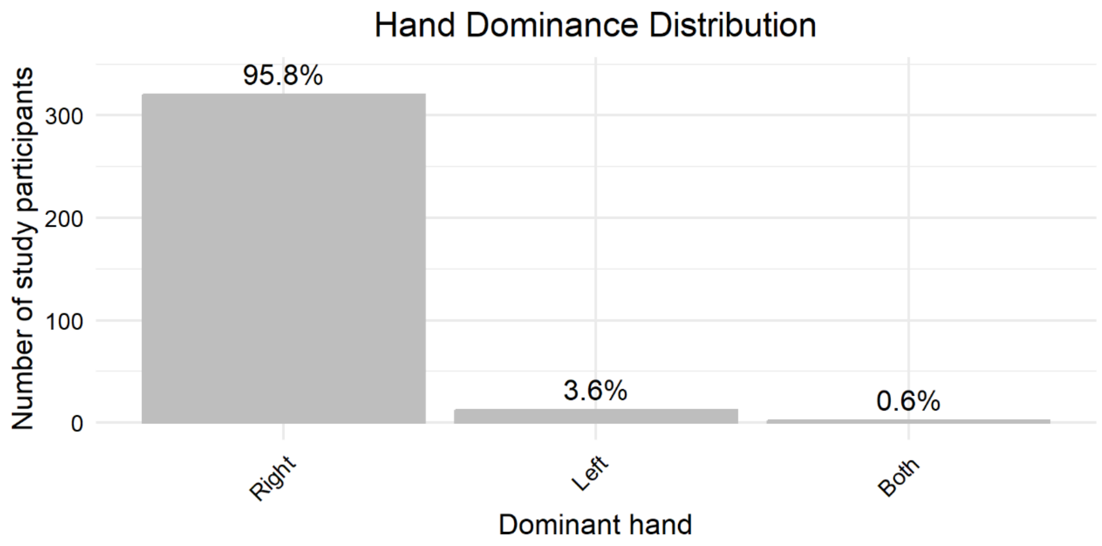

Figure 3.2: Bar chart of hand dominance

The workforce was divided into the following job categories: A breakdown of the workforce by occupation revealed that 27.2% were skilled trade workers, 23.1% were process, plant and machine operators, 18.6% were elementary workers, 11.4% were managerial and senior officials, 9% were associate professional and technical occupations, 5.4% were administrative and secretarial occupations, 2.4% were sales and customer service occupations, 1.8% were professional occupations and 1.2% were personal service occupations. Stated differently, 68.9% of the participants, or more than two thirds worked in skilled trade occupations, as process, plant and machine operators, or in elementary occupations (see Figure 3.3).

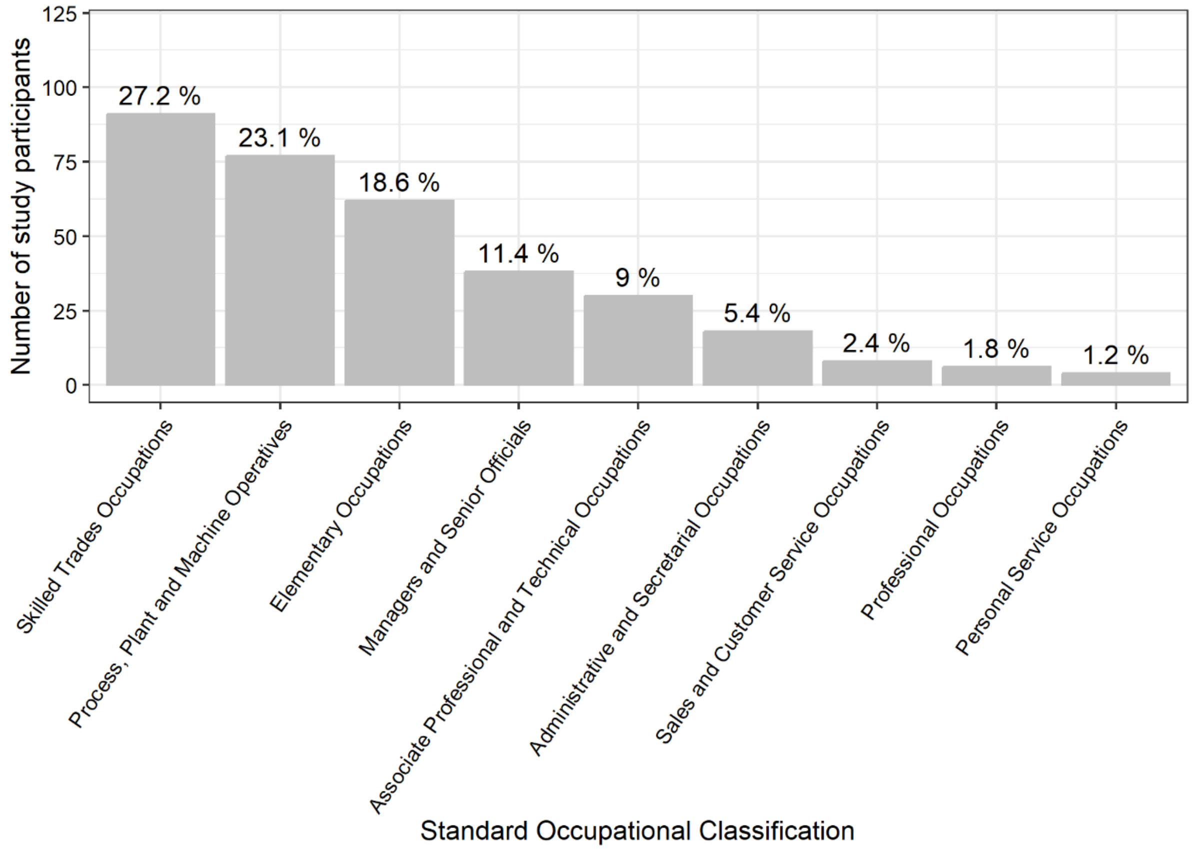

Figure 3.3: Bar chart of occupation type

A visual representation of the distribution of study participants across various trade and industry sectors was presented. Notably, the data reveals that around 35% of the participants were affiliated with the manufacturing industry. Additionally, roughly one-third of the participants belonged to service-oriented sectors encompassing education, finance, food, healthcare, social work and law enforcement. The remaining participants were distributed across retail, construction, agriculture/fisheries and transportation, with each of these sectors contributing less than 10% of the total (see Figure 3.4).

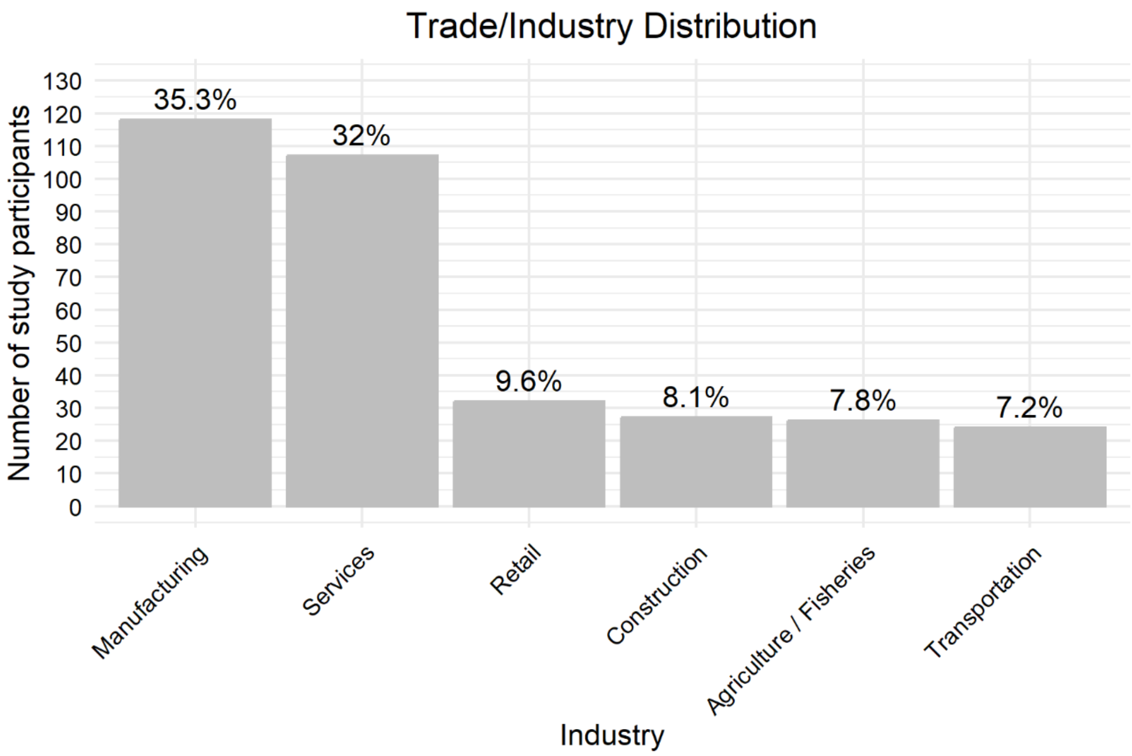

Figure 3.4: Bar chart of industry

With over 40% of the reported injuries being fractures, data from the study showed that these injuries constituted the majority. Tendon injuries represented a smaller proportion, accounting for less than 15% of cases. Amputations of a part of the upper limb made up just <11% of the injuries, while dislocations and rotator cuff tears each made up less than 10% of the total injuries (see Figure 3.5).

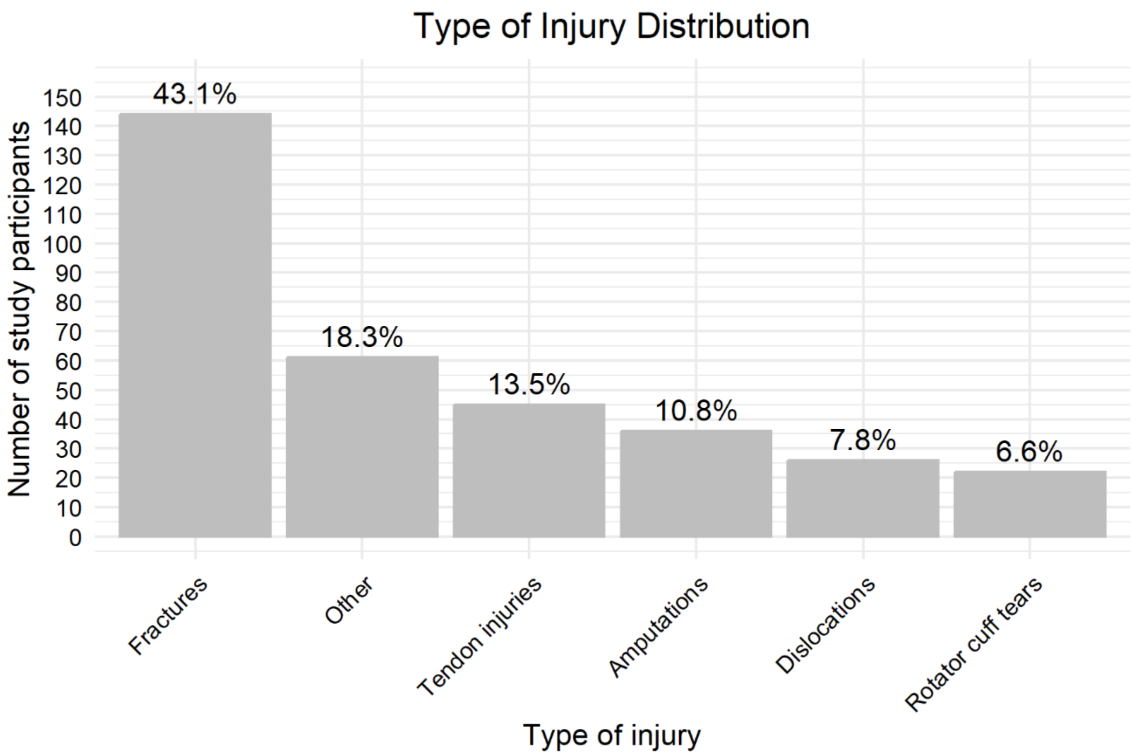

Figure 3.5: Bar chart of type of injury

The distribution of study participants based on the causes of their injuries was illustrated. Notably, roughly one-third (34.4%) of the study participants suffered injuries resulting from falls, while another third (34.1%) experienced injuries due to crushing incidents. Penetration and cuts accounted for 16.5% of the total injuries, with lifting and motor vehicle accidents contributing less than 10%, and trauma due to assault at the workplace caused by assailants (intentional injuries caused by the assailants) made up less than 2% of the overall causes of injuries (see Figure 3.6).

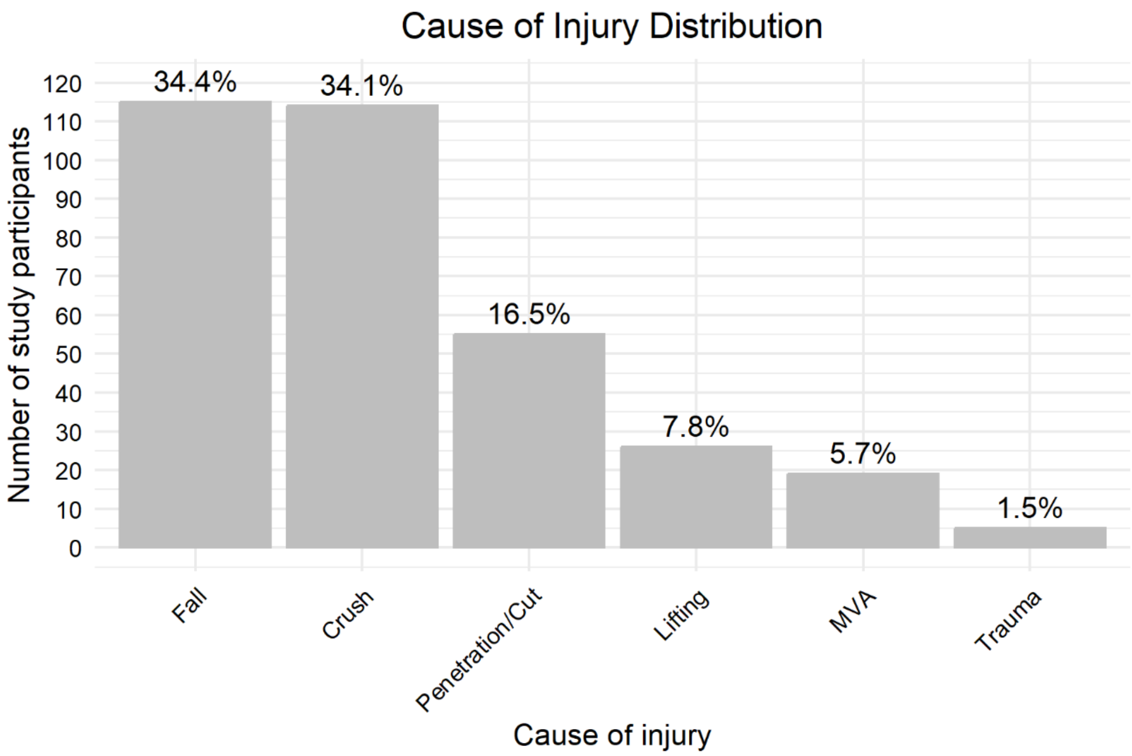

Figure 3.6: Bar chart of cause of injury

A summary of the outcomes following injuries among study participants was written. Remarkably, a significant majority, accounting for 80%, continued with their employment within the same company and in the same role even after sustaining an injury. In contrast, 9% of the participants lost their jobs after they had sustained amputations of fingertips of one or more fingers, fractures of clavicle, radius, and ulna, metacarpal, thumb or trans-radial amputation, dislocations of shoulder joint with and without any fractures, flexor and extensor tendon injuries of fingers and rotator cuff tears while 8% were accommodated by their employer for a different position within the same company. Only a small fraction, less than 2%, chose to leave their current company to pursue the same role in another organisation, and less than 1% transitioned to a different job at a different company (see Figure 3.7).

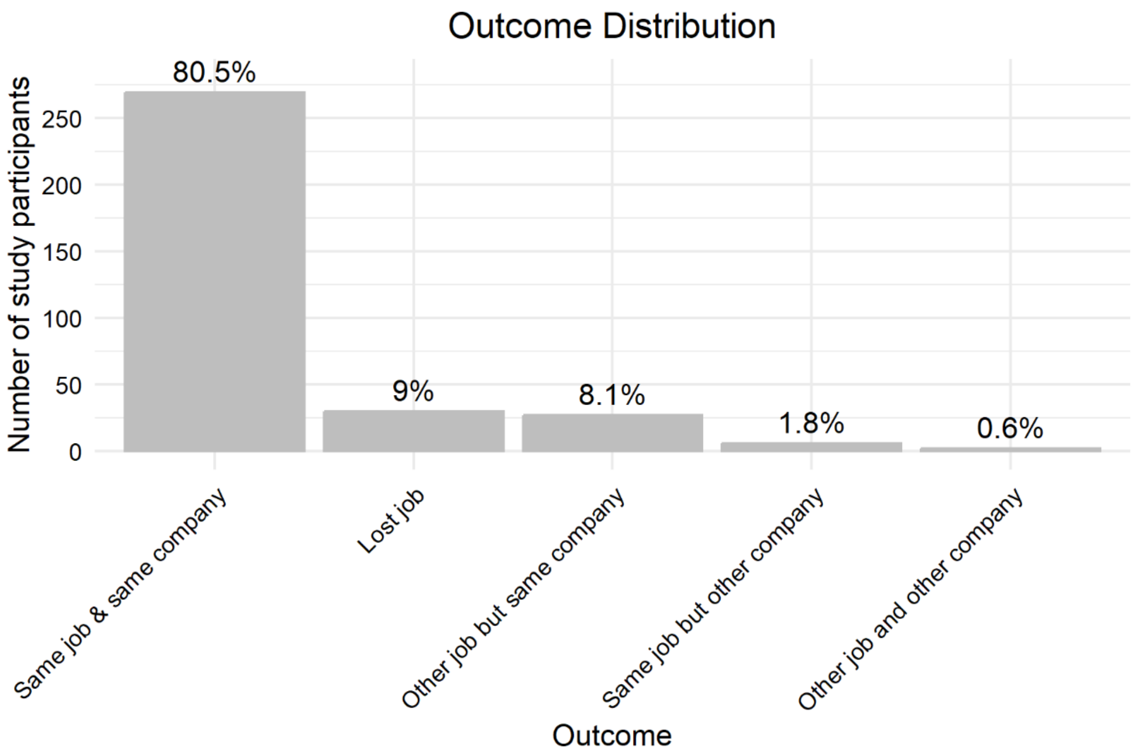

Figure 3.7: Bar chart of outcome

3.2. Type of Injury *versus* demographic factors

Fractures were the most common injuries amongst workers while the rotator cuff tears were the least common injuries. In this research, a total of 146 fractures of the upper limb were found. Fractures in the region of the hand were the highest (44.5%). The region of the forearm has the next highest occurrence of fractures involving the radius/ulna (38.3%). Humerus bone fractures also occurred (10.2%), and the least number of fractures were in the shoulder region (6.8%). These results demonstrate that compared to the proximal part of the same limb, fractures were more common in the distal part of upper limb. The breakdown of these fractures is shown in Table 3.1 below.

Table 3.1: Breakdown of number of fractures by site

Fracture site	Numbers
Phalanx	36
Distal Radius	33
Metacarpal	20
Radial head & neck	12
Scaphoid	9
Proximal humerus	9
Radius/Ulna shaft	8
Clavicle	5
Distal humerus	5
Olecranon	3
Scapula	3
Coracoid process	2
Humerus shaft	1

In this study, 48 amputations/disarticulations of upper limb were found. Amputations through P3 (distal phalanx) were very common, some patients required disarticulations at distal interphalangeal joint (DIPJ), followed by amputations through P1 (proximal phalanx) and metacarpophalangeal joint (MCPJ) disarticulations. Proximal interphalangeal joint (PIPJ) disarticulations were not common, but some patients required amputations through P2 (middle phalanx). The percentage of employees who sustained amputations/disarticulations was 10.8%. One patient underwent disarticulation at the wrist joint, another patient had a high below-elbow amputation, and a third one had a high above-elbow amputation. The last/third patient also had concurrent dislocation of shoulder joint, midshaft humerus fracture with radial nerve injury of the opposite upper limb.

A total of 48 disarticulations and amputations occurred, and their breakdown is shown in Table 3.2 below.

Table 3.2: Breakdown of amputations

Disarticulation/Amputation	Numbers
Distal interphalangeal joint (DIPJ)disarticulation/Amputation through P3	34 (70.8%)
Metacarpophalangeal joint (MCPJ)disarticulation/Amputation through P1	7 (14.58%)
Proximal interphalangeal joint (PIPJ)disarticulation/Amputation through P2	4 (8.3%)
Wrist disarticulation	1 (2%)
High below-elbow amputation	1 (2%)
High above-elbow amputation	1 (2%)

A total number of 44 tendon injuries were seen during the time of the study. There were combinations of both flexor and extensor tendons with phalangeal fractures, more than one finger had tendons injuries as well as digital nerves were severed in some cases. The breakdown of the tendon injuries is presented in Table 3.3 below.

Table 3.3: Breakdown of tendon injuries

Tendon Injury	Numbers
Extensor tendons Zone I and Zone III	27 (61%)
Flexor tendons Zone II	12 (27%)
Long head biceps	3 (6.8%)
Distal biceps	2 (4.5%)

In this study 26 patients sustained dislocations at different regions. The breakdown of dislocations is presented Table 3.4 below.

Table 3.4: Breakdown of dislocations

Dislocation level	Numbers
Glenuhumeral joint	10 (38%)
Elbow joint	4 (15%)
Metacarpophalangeal joint(MCPJ)	4 (15%)
Acromioclavicular joint	3 (11.5%)
Lunate dislocation(volar)	1 (3.8%)
Carpometacarpal joint(CMCJ)	1 (3.8%)
Proximal interphalangeal joint(PIPJ)	1 (3.8%)

There were 22 rotator cuff tears included in this study. These injuries were caused by fall (59%), lifting (18%), use of excessive force (9%), pulling (4.5%), hit by a falling object (4.5%) and assault (4.5%). The diagnosis was confirmed with an ultrasound examination performed by a radiologist. In 72% of cases, full thickness tears of supraspinatus tendon were observed. In 18% of cases, full thickness tears of subscapularis tendon were detected, whereas 13.6% of the cases had partial thickness tears of supraspinatus tendon.

The remaining injuries of the upper limb have been classified as “Other injuries”. In total 58 patients sustained these injuries in this category and the breakdown is shown in Table 3.5 below.

Table 3.5: Breakdown of other types of injuries

Type of injury	Numbers
Contusions (hand)	24
Nailbed injury	11
Scapholunate ligament injury	6
Collateral ligament injury (thumb)	4
Compartment syndrome forearm	3
Radial nerve injury associated with humeral shaft fracture	2
Injury of long thoracic nerve (winging of scapula)	1
Compression neuropathy of median nerve at hand level	1
Foreign bodies (fingers)	3

Foreign body in hand (injected prima paint)	1
Traumatic olecranon bursitis	2

The diagram below shows the total number of injuries in different regions of the upper limb for this research.

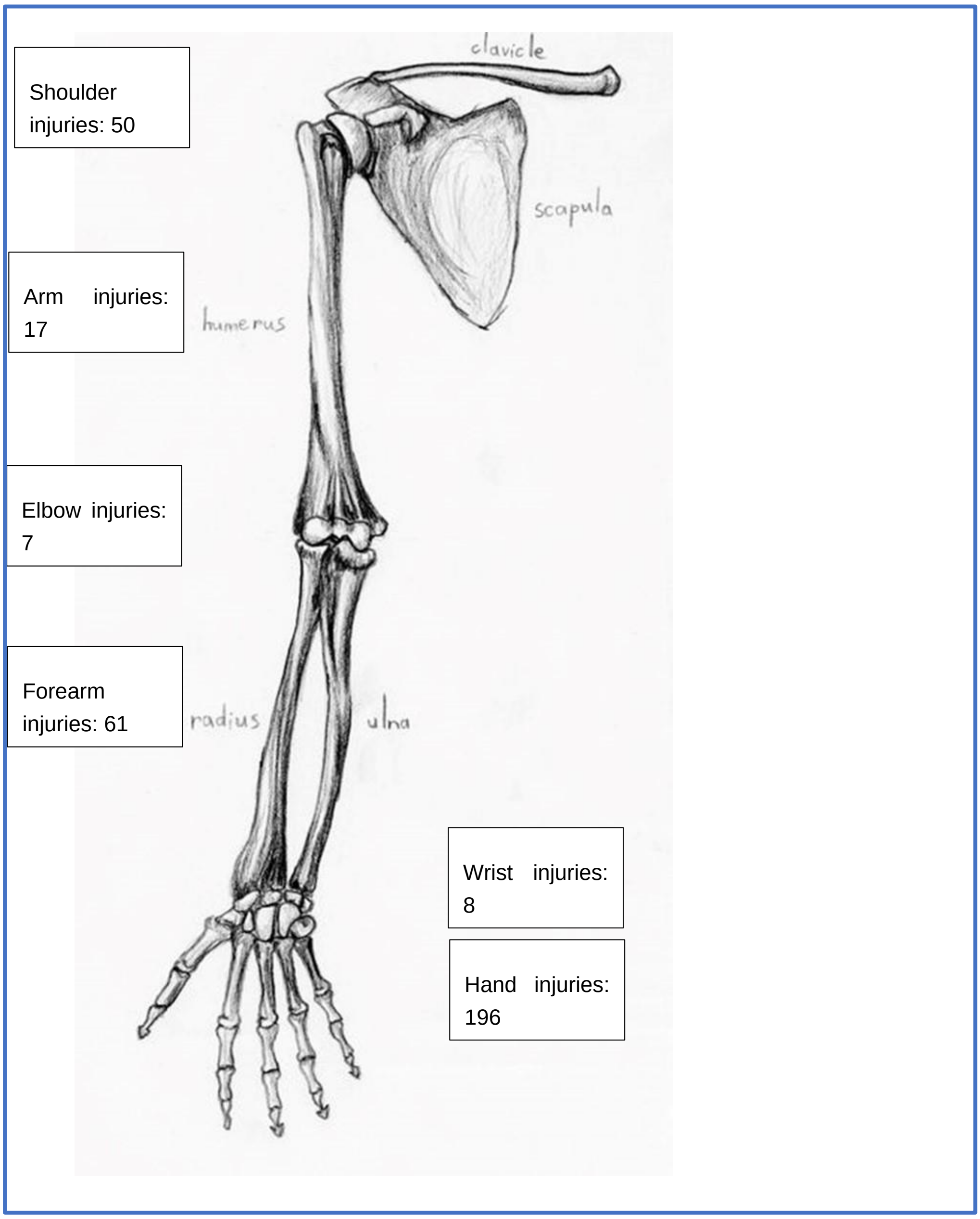

Figure 3.8: Pictorial representation of injury frequency by region of upper limb

Source: https://www.deviantart.com/zexia/art/Bones-of-the-upper-limb-89845279 (39)

A statistically significant correlation between age and type of injury was found using Fischer's exact test (p-value = 0.0025). The relationship between age and the type of injuries has been discussed (see Figure 3.9). Individuals aged 18 – 30 years were more likely to have amputations than fractures, the fractures were most common in the 41 to 50 age group (see Figure 3.9). Tendon injuries were more common among skilled workers in the manufacturing industry, the hand region was most affected, with extensor and flexor tendon injuries being more common. The extensor tendon injuries were more than double those of flexor tendon injuries in the employees. Tendon injuries were most frequent in individuals aged 31 to 40 years. On the other hand, individuals aged over 50 years were frequently affected by rotator cuff tears and dislocations.

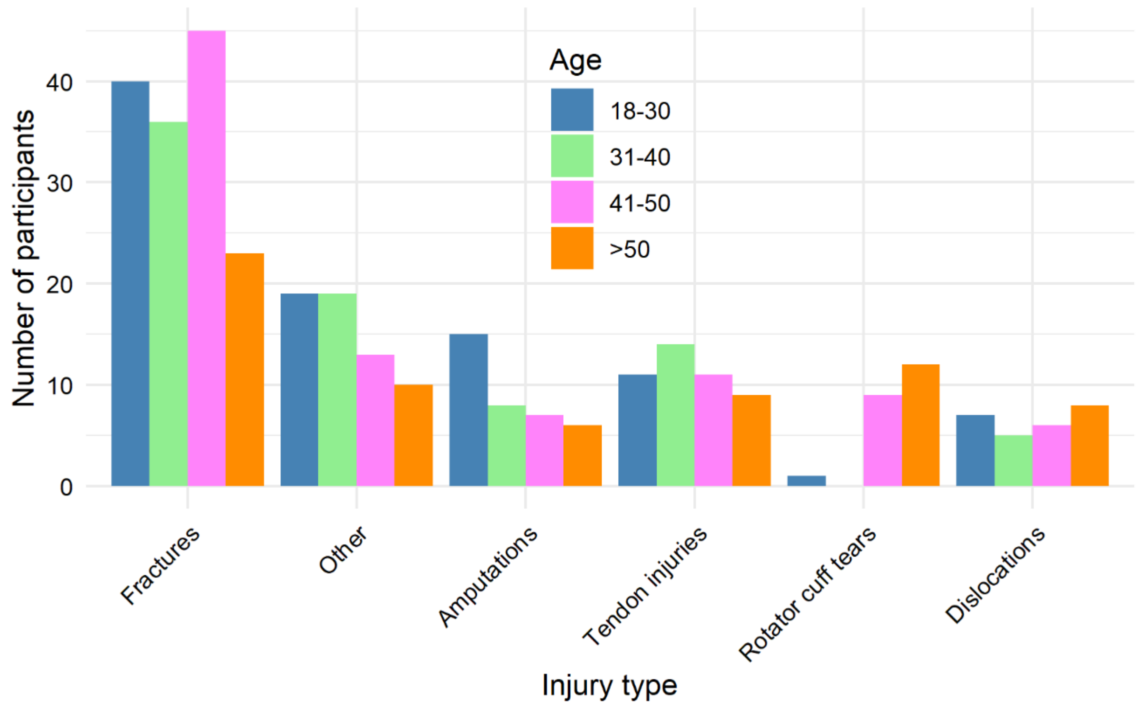

Figure 3.9: Bar chart of type of injury versus age

The association between gender and the type of injury was also investigated using a Pearson' Chi-squared test; however, results did not support statistical analysis (p-value = 0.7176). Fisher's exact tests were also used to investigate the relationship between injury type and other variables, such as hand dominance, type of occupation and industry. According to the results of these tests, there was no statistically significant correlation found between hand dominance and injury type (*p*-value = 0.3407), occupation type and injury type (*p*-value = 0.3923), or industry and injury type (*p*-value = 0.1444).

3.3. Type of injury *versus* day of the week

The distribution of different types of injuries across the days of the week are summarised in Figure 3.10. Amputations occurred every day of the week, with Thursday having the most cases (10 cases) and Sunday having the fewest (1 case). The number of dislocations varied across the week, with the highest count on Thursday (6 cases) and Monday (7 cases) and the lowest on Saturday (2 cases). The data revealed that fractures were quite common, with the highest counts on Friday (29 cases) and Thursday (28 cases), while the lowest numbers were seen on Sunday (10 cases). Rotator cuff tears occurred in varying numbers, with the highest count on Friday (8 cases) and the lowest on Saturday and Sunday (0 cases). Tendon injuries also varied over the course of the week, peaking on Monday (14 cases) and falling on Sunday (1 case). Other injuries, which included various types of injuries not specified in the other categories, were relatively consistent, with the lowest counts on Sunday (4 cases) and Thursday (5 cases) and the highest counts on Friday (12 cases) (see Figure 3.10).

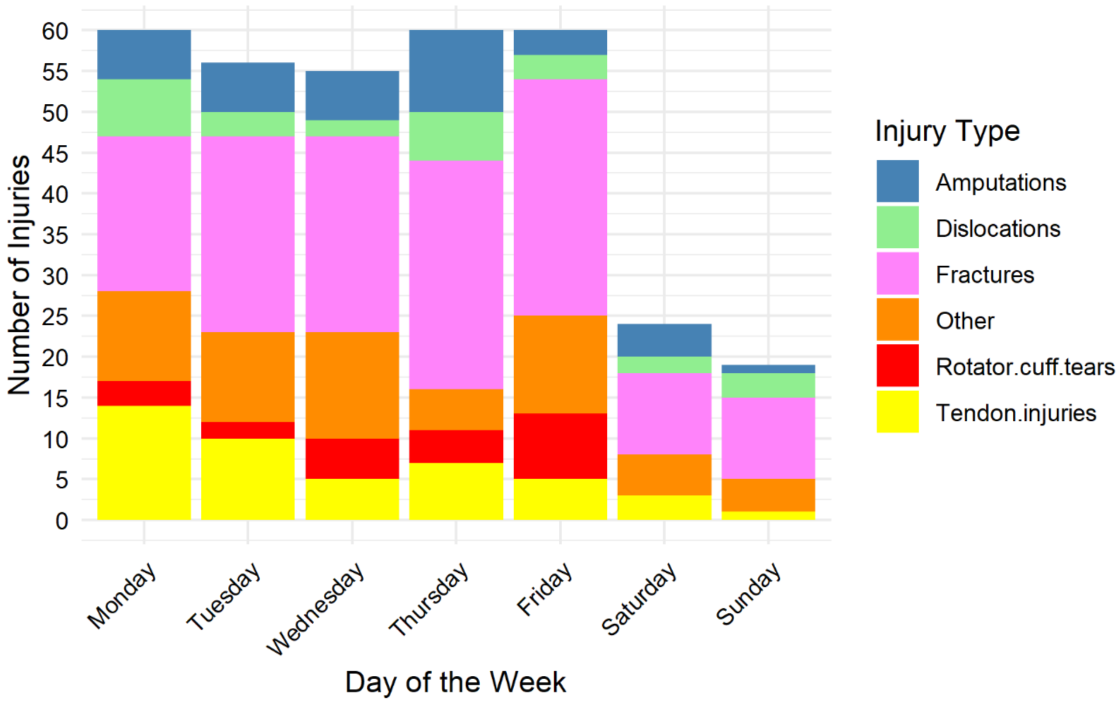

Figure 3.10: Distribution of injuries across the week

Overall, the highest total number of injuries was observed on Monday, Thursday and Friday, the number of injuries was 60 in each of the three days. Sunday had the fewest injuries, with 19 cases. A Student's t-test was conducted, and the results indicated that the difference in the average number of injuries between weekdays and weekends was statistically significant (*p*-value = 0.0181), with more injuries occurring during the weekday.

3.4. Effects of Injuries on employees

Fisher's exact tests were conducted to assess the association between the outcome (job loss, change of job, etc.) and injury (type and cause). According to the findings, there was no statistically significant correlation found between the type of injury and the outcome (*p*-value = 0.4698), or between the outcome and the cause of injury (*p*-value = 0.446).

The association between the cause of injury and age (p-value = 0.1844), and hand dominance (p-value = 0.1853) was not statistically significant, according to an analysis of the relationship between cause of injury and demographic factors.

However, there was statistically significant correlation (p-value = 0.0035) between gender and cause of injury. As seen in Figure 3.11, falls were the leading cause of injuries among females, while falls or crushes were the most common causes among males.

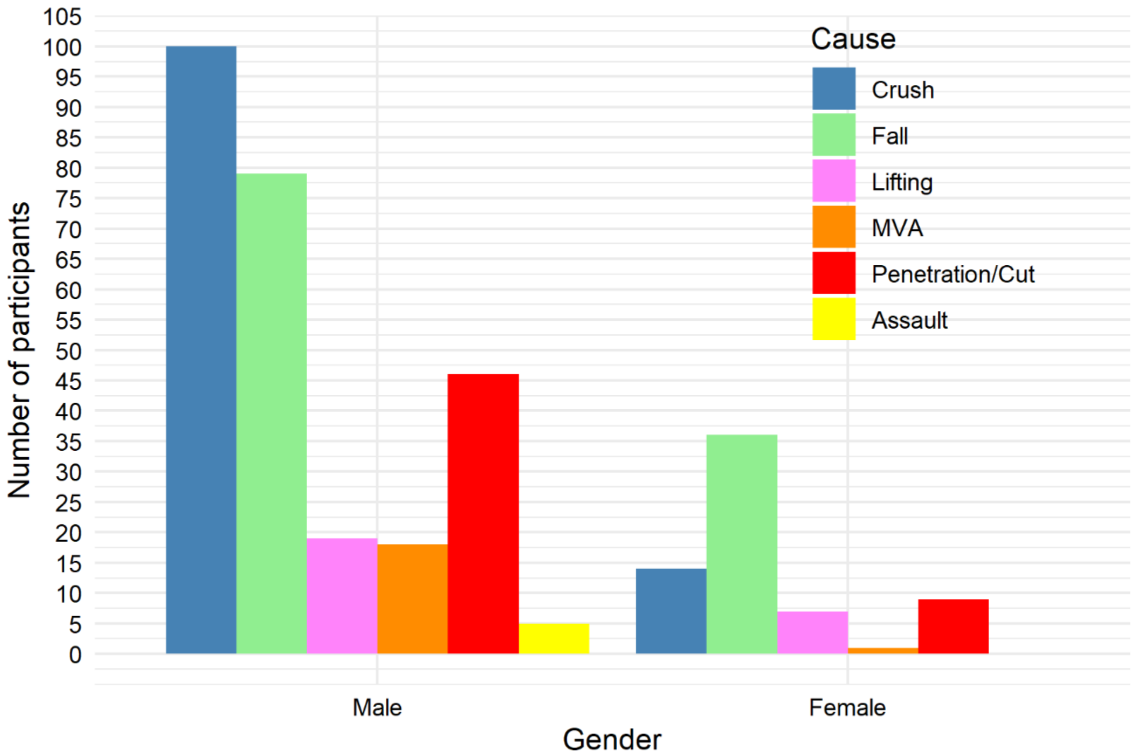

Figure 3.11: Bar chart of cause of injury versus gender

Additionally, there was statistically significant correlation (p-value = 0.0001) between the type of occupation and the injury cause. Figure 3.12 demonstrates that workers in the skilled trades as well as process, plant and machine operators routinely report higher number of injuries especially from crush, falls and assaults resulting in trauma from sharp objects or gunshots from assailants. This suggests that individuals in these occupations are more susceptible to injuries, possibly due to the physical nature of their work involving machinery and manual labour.

Elementary occupations, for example general workers, cleaners, mohair sorters, pickers, packers, scourers and waitresses, also exhibit notable injury numbers, especially in crush, fall and an assault. This implies that individuals in elementary occupations face significant risks, potentially related to the physical demands and hazards associated with their work.

Managers and Senior Officials generally have lower injury numbers compared to trades and operatives, but they still experience risks, particularly in fall, crush and assault. This may be associated with the diverse nature of their roles and the environments in which they operate. Sales and Customer Service Occupations, Administrative and Secretarial Occupations, Professional Occupations and Personal Service Occupations generally demonstrate lower numbers of injuries, suggesting that individuals in these occupations are less prone to workplace injuries, at least based on the causes listed in the table.

In terms of specific causes, patterns emerge. Lifting and Penetration/Cut exhibit varying numbers across occupations, with Skilled Trades, Process, Plant, and Machine Operatives, and Elementary Occupations often showing higher figures, reflecting the physical demands of their work. Motor Vehicle Accidents (MVA)-related injuries are relatively low across all categories, with slightly higher numbers in Skilled Trades and Process, Plant, and Machine Operatives, possibly due to the use of machinery or vehicles in these occupations. In summary, the data highlights that the higher prevalence of injuries particularly related to crushes, falls and an assault, were seen in certain occupational sectors such as skilled trades and process, plant, and machine operatives.

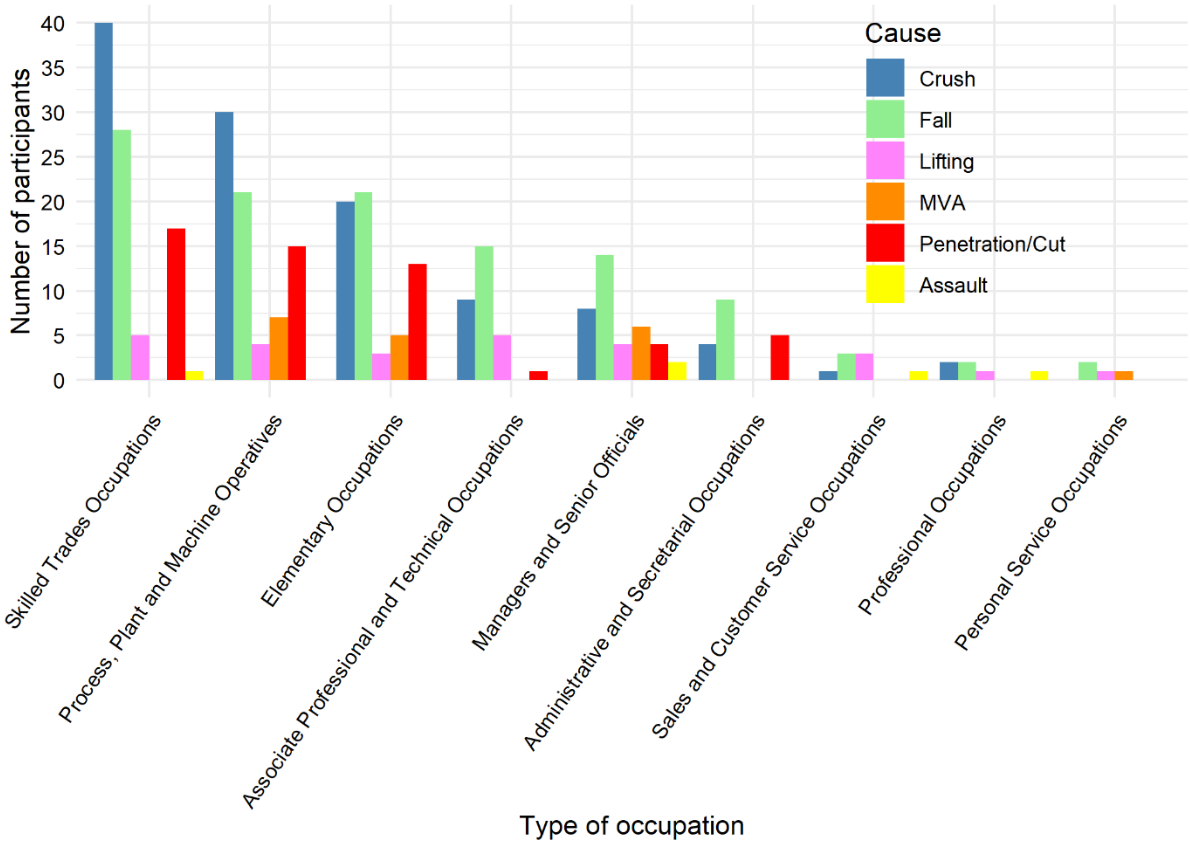

Figure 3.12: Bar chart of cause of injury versus type of occupation

There was also a statistically significant association between the cause of injury and the type of industry (*p*-value = 0.0005). Figure 3.13 illustrates that the manufacturing industries had caused most occupational injuries in this research. Crushing was the most frequent mechanism of injury within the manufacturing industries. Falling was the most common mechanism of injury amongst all other industries.

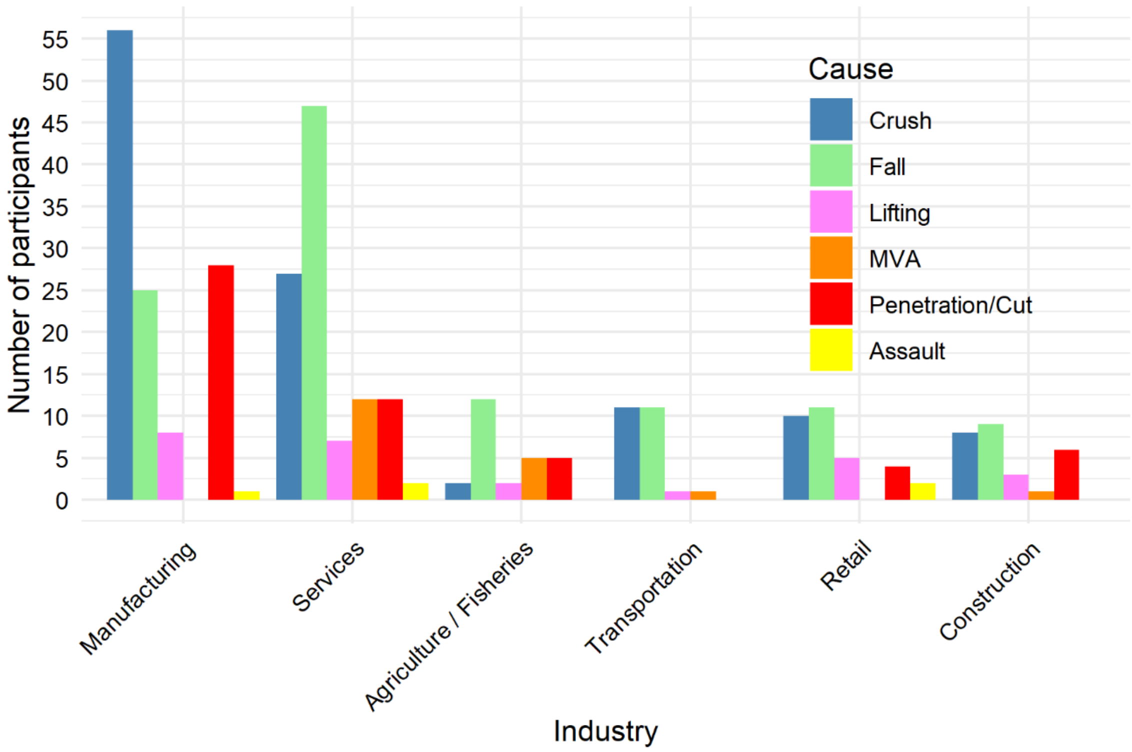

Figure 3.13: Bar chart of cause of injury versus industry

The statistical analysis showed that there was no significant association between the outcome and any of the demographic factors. This was evident in the *p*-values obtained from Fisher's exact tests: 0.2984 (age), 0.3988 (gender), 0.097 (type of occupation), 0.4488 (hand dominance), and 0.4433 (industry).

3.5. Analysis of time to return to work

Descriptive statistics about the time interval (in days) between the injury and the individual's return to work have been shown in Table 3.6. As shown in Table 3.6 below, the minimum duration was 1 day, and the maximum was 180 days. The mean value indicates that, on average, it took approximately 37 days to return to work after an injury.

Table 3.6: Descriptive statistics for time to return to work

	Duration (days)
Mean	37.19
Minimum	1.00
Maximum	180.00

To evaluate the correlation between time to return to work and other factors, Kruskal-Wallis tests were performed. The results indicate that the industry and amount of time it took to return to work were statistically significantly correlated (*p*-value = 0.0018). However, the difference in time to return to work among the age groups was not statistically significant (*p*-value = 0.2108). Similarly, the association between time to return to work and factors such as hand dominance (*p*-value = 0.7645) and type of occupation (*p*-value = 0.6354) was not statistically significant, neither was the association between time to return to work and gender (*p*-value = 0.1767).

Agriculture / Fisheries and Construction have the lengthiest average recovery times averaging 50.7 and 42.4 days, respectively (see Table 3.7). Multiple fractures of forearm associated with compartment syndrome, extensor tendon injuries of fingers and rotator cuff tears were common injuries for workers in the agriculture/fisheries industry. One of the workers in the same industry suffered trans-humeral amputation of the arm on one side and segmental fracture of humerus associated with radial nerve injury and dislocation of glenohumeral joint of the opposite side. In the construction industry, workers sustained different types of injuries (44%), ranging from scaphoid fractures, zone II flexor tendon injuries of the hand and amputations of fingers at distal phalanges and metacarpal fractures.

Services, with an average duration of 38.9 days, Transportation, with an average duration of 37.9 days and manufacturing with an average duration of 34.4 days, followed in terms of recovery times. In contrast, Retail has the shortest average "time to return to work" at 25.8 days. These findings indicate significant differences in how injuries affect employees across these sectors, with Agriculture/Fisheries and

Construction showing lengthier recovery periods, while Retail represents a quicker return to work on average.

Table 3.7: Time to return to work by industry

Industry	Mean (days)	Minimum (days)	Maximum (days)
Agriculture / Fisheries	50.7	3	155
Construction	42.4	2	120
Services	38.9	1	180
Transportation	37.9	1	120
Manufacturing	34.4	1	120
Retail	25.8	1	91

The time to return to work_was influenced by the type of injury (*p*-value <0.001). The time to return to work for each kind of injury is compiled in Table 3.8.

Table 3.8: Time to return to work by injury type

Injury type	Mean (days)	Minimum (days)	Maximum (days)
Rotator cuff tears	59.3	28	120
Dislocations	44.2	14	98
Amputations	37.1	14	120
Tendon injuries	37.1	1	155
Fractures	35.3	1	120
Other	30.8	1	180

Table 3.8 shows that rotator cuff tears resulted in the longest average return to work time, with an average of 59.3 days. The range in recovery times for this injury type varied from 28 days to 120 days. This suggests that individuals with rotator cuff tears tended to have a relatively extended period of recovery, with considerable variation in their return to work duration. Dislocations of large joints, mainly shoulder joint and very few cases of elbow joint as well as volar dislocation of lunate had a mean return to work time of 44.2 days, falling below that of rotator cuff tears. The range for dislocations extended from 14 to 98 days, indicating moderate variability in recovery times. This suggests that, on average, individuals with dislocations recovered more quickly compared to those with rotator cuff tears. Finger joint dislocations can take up to six months for complete recovery while shoulder joint recovery takes place in eight weeks.

Both amputations and tendon injuries shared the same mean return to work time of 37.1 days. Despite their similar averages, they exhibited variability in their recovery times. Amputations had a recovery time range of 14 to 120 days, while tendon injuries showed a broader range, extending from 1 to 155 days. This suggests that while these two injury types had comparable average recovery times, individuals with tendon injuries can face more diverse experiences in their return-to-work process. There were three patients who had sustained proximal traumatic amputations.

The first case involved a 40-year-old male municipal worker who was driving a truck. He had a BMI of 37.55 kg/m^2, and he was travelling on a tarred road with dry conditions with clear visibility and dry conditions when he lost control of the truck and it fell onto one side, severely crushing his left hand in the process. He was right hand dominant. He presented with a mangled left hand which was not salvageable and left wrist disarticulation was performed on the same day of injury. He had received occupational therapy and psychological treatment as well. He returned to work after completing the rehabilitation programme. He was accommodated with another job but continued working for the same employer.

The second case was a young 18-year-old male who was a general worker in Biltong Delight (food industry). He was pushing the meat through the mincer machine and his dominant right hand was caught inside the machine and sustained high below-elbow amputation. He had received occupational therapy, and it took him 57 days to return to the same company on light duty. He left the job as soon as he was compensated from the compensation fund.

The third case was a 45-year-old male general farm worker in the farming industry employed as a tractor driver. The power take-off (PTO) shaft grabbed the sleeve of his overall and winched his arm. He sustained complete left trans-humeral amputation (high above-elbow amputation). In addition, he suffered a right midshaft humerus fracture with radial nerve fallout and anterior dislocation of shoulder joint. He had multiple left-sided ribs fracture with hemopneumothorax. He was also a right-hand dominant patient. The radial nerve was explored while the shoulder was reduced, and the right humerus fracture was openly reduced and internally fixed. It took him almost

12 months to complete his rehabilitation and surprisingly he went back to the same industry and kept his same job. He made a full recovery in his right arm.

With recovery period ranging from 1 to 120 days, fractures had an average return to work of 35.3 days. This data indicates that, on average, individuals with fractures tend to return to work more quickly than those with rotator cuff tears, although their recovery times can still vary substantially.

In summary, the analysis of the data underscores the considerable variation in return-to-work times among different types of injuries. While some injuries, such as rotator cuff tears, often result in lengthier recovery periods on average, there is a range of experiences within each injury category. The cause of the injury also influenced the time it took to return to work after sustaining an injury (*p*-value = 0.0150). An analysis of time to return to work for each cause of injury is presented in Table 3.9.

Table 3.9: Time to return to work by cause of injury

Cause of injury	Mean (days)	Minimum (days)	Maximum (days)
MVA	53.7	14	180
Lifting	43.6	1	120
Fall	39.9	1	120
Penetration/Cut	35.6	1	155
Crush	31.5	1	120
Assault	26.6	14	32

According to the findings in Table 3.9, it took an average of 53.7 days for people who were injured in motor vehicle accidents (MVAs) to return to their jobs. These workers suffered from severe upper limb injuries, including mangled extremities that necessitated wrist disarticulation, along with related injuries to other body parts. This shows that a person's capacity to return to work as soon as possible is often significantly affected by motor vehicle accident injuries.

The average time to return to work for lifting-related injuries is 43.6 days. Although this is less time than for MVA injuries, it is still quite a long time. Within this category, there is a notable variation in recovery times, ranging from 1 to 120 days, with some patients being able to return to work rather quickly and others needing to take longer time off.

The most frequent injuries in the shoulder region included anterior shoulder dislocation leading to anterior instability, rotator cuff tears, traction injury of the long thoracic nerve causing winging of scapula, and rupture of the long head of the biceps tendon. In the elbow region, there have been reports of the distal biceps and triceps tendon rupturing at its distal insertion site. The hand region saw scapholunate dislocation, finger ligament injuries, and extensor tendon injuries.

Injuries caused by falls had a mean return to work time of 39.9 days, which is slightly shorter than lifting injuries. The range in this category is also quite broad, with some individuals returning in as little as 1 day, while others required up to 120 days to recover and resume work. Penetration or cut-related injuries had a mean return-to-work time of 35.6 days. While this category has a slightly shorter average recovery period compared to falls, the range of 1 to 155 days indicates considerable variation, with some individuals experiencing significantly longer recovery times.

Individuals who sustained injuries due to crushing events had a mean return-to-work time of 31.5 days. The range of recovery times in this category, from 1 to 120 days, suggests that while the mean is shorter, there are still cases where individuals faced prolonged absences from work. In contrast to the other categories, assault-related injuries had the shortest mean return to work time, at 26.6 days. Also, the range for this category is the narrowest, with recovery times ranging from 14 to 32 days. This indicates that trauma injuries as a result of assault generally result in a more consistent recovery timeline.

In summary, the data highlights that the cause of injury significantly affects the time that it takes for individuals to return to work. Injuries resulting from motor vehicle accidents and lifting tend to have the longest recovery periods, while assault-related injuries lead to shorter and more consistent return-to-work times.

The time to return to work and the outcome had a statistically significant correlation (p-value = 0.0082). The individuals who changed jobs but stayed with same company took longest to return to work, an average of 54.6 days, with a minimum of 18 days and maximum of 180 days (see Table 3.10).

Table 3.10: Time to return to work by outcome

Cause of injury	**Mean (days)**	**Minimum (days)**	**Maximum (days)**
Other job but same company	54.6	18	180
Lost job	38.5	2	97
Same job & same company	35.7	1	120
Same job but other company	27.3	10	44
Other job and other company	9	1	17

On the other hand, those who 'lost job' due to their injuries took an average of 38.5 days to return to work, with a minimum of 2 days and a maximum of 97 days (see Table 3.10). It was found that 44% of workers who had lost their job sustained amputations of fingers at the distal phalanx levels (P3). These workers took a long time to return to work. Some of the workers had sustained serious injuries such as high below elbow amputation and multiple fractures of forearm with compartment syndrome. Some employees experienced Human Resources (HR) problems because of the circumstance, and their contracts were terminated. To find out why these workers had lost their jobs, the HR departments of these employees were contacted. Out of the 334 workers in this study, 30 (9%) had lost their jobs. Seven of the workers were seasonal, seven had resigned, four had been fired, four had absconded, two had been laid off, and one had their employment terminated, according to information obtained from HR. For three workers, HR provided no response at all, and for two workers, it withheld information or provided no explanation. While the average return time is shorter compared to the first group, it still indicates a significant impact on individuals' ability to return to work.

Individuals who were able to keep the "Same job and same company" following their injuries had a slightly shorter recovery period compared to the previous two groups, with an average of 35.7 days, a minimum of 1 day, and a maximum of 120 days (see

Table 3.10). This suggests that those who had shorter return to work time were more likely to continue in their pre-injury job and company.

For those who had the opportunity to continue with the “same job but different company”, the data shows an average return time of 27.3 days, with a minimum of 10 days and a maximum of 44 days (see Table 3.10). It might be because they were offered a better remuneration package and had lower expectations from their new employer because they were starting a new job but already had the necessary skills.

Finally, the "Other job and other company" category stands out with the shortest average return time of just 9 days, along with a minimum of 1 day and a maximum of 17 days (see Table 3.10). As one patient was operated for compound metacarpal fractures of index and middle fingers about 10 months ago by another surgeon in a different town, so his injuries were already completely healed, and a second patient underwent surgical repair of collateral ligament injury of thumb, and he took slightly longer.

The workers who were aged between 18 and 30 years took an average of 35.62 days to return to work after an injury, while those aged 31 to 40 years took an average of 35.26 days. In comparison, individuals in the age group of 41 to 50 years required an average of 37.41 days, while those aged over 50 years had an average return time of 41.38 days (see Table 3.11).

Table 3.11: Averages for time to return to work

Variable		Average duration (days)	ANOVA p-value
Age (years)	>50	41.38	0.5019
	41-50	37.41	
	18-30	35.62	
	31-40	35.26	
Gender	Male	38.60	0.0584
	Female	31.60	
Dominant hand	Both	45.00	0.9198
	Left	36.92	
	Right	37.15	
Type of occupation	Elementary Occupations	41.39	0.5200
	Skilled Trades Occupations	39.08	
	Sales and Customer Service Occupations	38.50	
	Associate Professional and Technical Occupations	37.67	
	Process, Plant and Machine Operatives	36.65	
	Managers and Senior Officials	34.32	
	Professional Occupations	30.33	
	Personal Service Occupations	28.00	
	Administrative and Secretarial Occupations	24.56	
Industry	Agriculture / Fisheries	50.65	0.0161
	Construction	42.41	
	Services	38.93	
	Manufacturing	34.41	
	Retail and Transportation	30.98	
Type of injury	Rotator cuff tears	59.27	0.0009
	Dislocations	44.15	
	Tendon injuries	37.09	
	Amputations	37.06	
	Fractures	35.33	
	Other	30.82	
Cause of injury	MVA	53.74	0.0072
	Lifting	43.58	
	Fall	39.88	
	Penetration and cut	35.60	
	Crush	31.50	
	Trauma	26.60	
Outcome	Other job but same company	54.63	0.0042
	Lost job	38.53	
	Same job same company	35.72	
	Same job but other company	27.33	
	Other job and other company	9.00	

When looking at gender, male workers' average return to work time was 38 days *versus* females at 31 days. The workers who had elementary occupations took 41.39 days while workers from administrative and secretarial occupations took 24.56 days to return to work. Agricultural/fisheries industries workers had the longest time to return at 50 days on average *versus* the retail and transportation industries workers which were at the shortest at 30 days on average. Rotator cuff injuries took almost 60 days to return to work when compared with the other injuries which took 30 days on average. Workers who were involved in an MVA took 52 days on average in comparison with trauma patients who only took 26 days to return to work. The workers who changed their job and employer, took only 9 days to return to work while those who changed their job but remained with the same employer, took 54 days to return to work (see Table 3.11).

In Table 3.11, every *p*-value corresponds to an Analysis of Variance (ANOVA) test. In particular, the *p*-value for the age variable is higher than the predetermined significance level of 0.05. This indicates that there were no statistically significant differences in average return times among the age groups. In other words, age was not a significant factor affecting the time required to return to work following an injury.

Males took a little longer than females to return to work, which was a discernible difference in their return to work times. A marginal effect of gender on the time it took to return to work is suggested by the associated *p*-value (0.0584), which is rather close to the significance level of 0.05. Gender on the other hand, did not significantly affect the statistical analysis.

The time it took for employees to return to work varied significantly between industries. The associated *p*-value (0.0161) is below the typical significance threshold of 0.05, indicating that industry was a statistically significant factor affecting the time it took for individuals to return to work. The employees from the agriculture/fisheries industries tended to take longer to return to work, compared to the individuals from other industries.

The type of injury was also a statistically significant factor in the time required to return to work following an injury (*p*-value = 0.0009). Those with rotator cuff tears tended to take longer than employees with other types of injuries. Furthermore, the cause of injury was a statistically significant factor of the return to work duration (*p*-value = 0.0072), with motor vehicle accident individuals taking longer.

A peak in injuries occurred in the afternoon around 3 PM, with 46 (14%) of the injuries occurring between 3 and 4 PM. Of the 46 injuries, 13 (28.3%) were fractures, 8 (17.4%) were amputations, 7 (15.2%) were tendon injuries, 4 (8.7%) were dislocations, 3 (6.5%) were rotator cuff tears, and 11 (23.9%) were other injuries (see Figure 3.13).

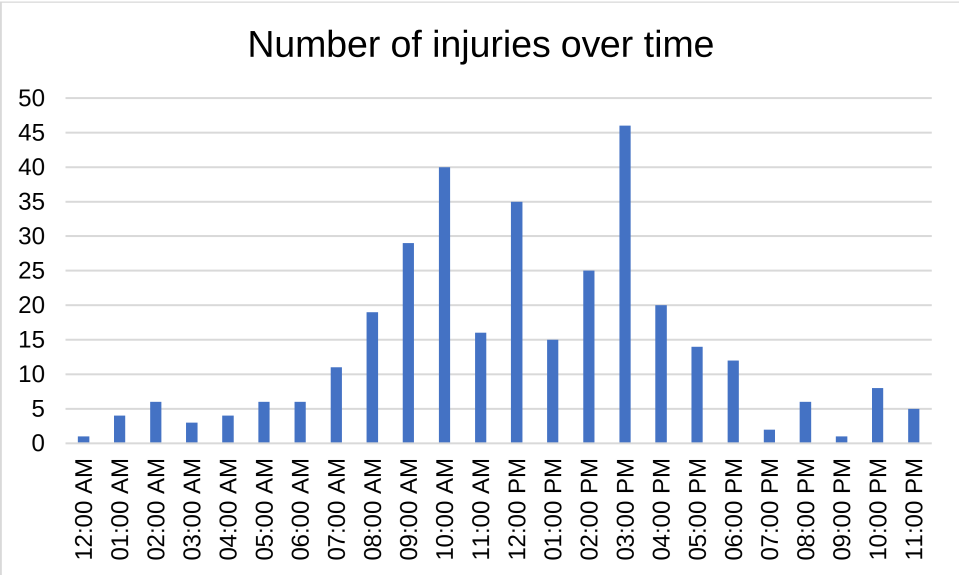

Figure 3.14: Time at which injuries occurred

Another peak occurred in the morning at around 10:00 AM, with 40 (12%) of the injuries occurring between 10:00 AM and 11:00 AM. Of the 40 injuries, 22 (55%) were fractures, 6 (15%) were tendon injuries, 5 (12.5%) amputations, 1 (2.5%) was a rotator cuff tear, and 6 (15%) were other injuries (see Figure 3.13).

Table 3.12 below indicates that the peak in injuries was in the afternoon, with over 45% of the injuries occurring in the afternoon. The second peak was in the morning, with over a third of the injuries occurring in the morning.

Table 3.12: Injuries by segment of the day

		Number of injuries	Percentage
Early morning	12:00 AM to 5:59 AM	24	7.2%
Morning	6:00 AM to 11:59 AM	121	36.2%
Afternoon	12:00 PM to 5:59 PM	155	46.4%
Evening	6:00 PM to 11:59 PM	34	10.2%

Chapter 4

4. Discussion

The results of the study demonstrate a strong correlation between upper limb occupational injuries and factors such as gender, type of occupation, industry, cause of injury, injury type, outcome, demographic factors, time and day of the week, time to return to work and impact on employees (20,30,40–42).

In the study, 27% of workers were over 40 years old, and 20% were over 50 years old (see Figure 3.1). The older patients overall sustained fewer injuries compared with the young workers in this research. The older workers had this advantage over young workers due to having more years of experience and they avoid taking unnecessary risks in pleasing their employers. The study's findings are consistent with numerous international studies (1,30,41,42). Oh et al. observed similar results that workers having more years of employment encounter fewer non-fatal injuries than their counterparts at work (20). The research findings show that fractures and dislocations were more prevalent in 18 – 30 years and 41 – 50 years age groups. Due to their slower reflexes and lower baseline functional status and physiological reserve, older patients were more susceptible to these severe injuries (27). Younger patients hold their hands out during ladder fall injuries and are more prone to have extremity injuries (43).

Primarily, the male population in this research has followed the other studies done both locally and internationally. Male workers are required to earn money for their living and to raise their families. These results are consistent with the study done by Bicer et al., which shows that 88% were male *versus* 12% females and they only looked at the risk factors for acute occupational hand injuries (40). Another study by Stewart et al., shows similar figures for males *versus* females (88.5% male *versus* 11.5% female) (30). A study conducted by Sung-shil et al., also shows 63.1% were male workers *versus* 36.9% female workers, (42). Razik et al., in their study, found that 79.5% were male and 20.5% were female workers, and they included all occupational injuries (41).

In the current study, 96% of participants were right-hand dominant and 3.6% were left-hand dominant and only 0.6% exhibited the ambidextrous traits (see Figure 3.2). Meaningful information on hand dominance and its relation to occupational injuries was not evident, as the percentage of left-handed workers was very low. Urso-Baiarda et al. found that hand dominance had no effect in predicting return to work (44). Hart et al. found that 58% of injuries were seen in non-dominant hands, 41% in the dominant hands, and a single ambidextrous patient injured his right hand (25).

Three distinct occupational groups accounted for 69% of the occupational injury cases in the study. Workers in skilled trades, process, plant and machine operators and elementary occupations were particularly vulnerable to this kind of injuries (see Figure 3.3). Occupation specific training of employees is compulsory for skilled trades and to allow them to operate the machinery and even to do elementary jobs. Remarkably, according to a Stewart et al. study, 80% of the workers had never received training specific to their line of work (30). According to a different study by Bicer et al., 27% of the injured workers worked in skilled trades, process, plant and machine operations and elementary occupations (40).

This research found that 67.3% of the injured workers came from manufacturing and service-oriented industries (see Figure 3.4). The findings are consistent with other studies such as Stewart et al., which reported injuries among machine operators at 34.2%, construction workers at 17.1%, and general manual labourers 11.4%(30).. Bicer et al. found that 48.8% of injuries in workers from skilled trade and retail, 27.9% from elementary occupations and 14% from process, plant, and machine operators(40). In the construction industry, there are more injuries, but overall rates were lower, according to Lucas et al(22). Sung-shil et al. documented 28.8% of injuries in workers from the manufacturing industry (42).

In the current study, more than 40% of all participant workers had sustained fractures (see Figure 3.5). Phalangeal fractures (hand) and radius/ulna fractures (forearm) were common occurrences (80%). The fractures of the arm and around the shoulder girdle were less than 20% (see Table 3.1). Similar findings had been shown in other studies such as Stewart et al., which found 77.1% finger fractures, but they had only focused on hand injuries (30). Melmer et al. found that 13.5% of workers had sustained fractures of the upper extremity (27).

In the current study, 10.78% of the workers had upper extremity amputations (see Figure 3.5). Seventy percent (70%) of cases involved disarticulations at the DIPJ, while most amputations occurred through the distal phalanx (P3) (see Table 3.2). Disarticulations were 14.58% at the MCPJ and only 8.3% at the PIPJ (see Table 3.2). These findings were in keeping with those of other research, including that conducted by Bicer et al. who discovered that 59% of hand injuries caused by guillotine involved traumatic finger amputations (40). In their prospective study, Stewart et al. reported 5.7% mangled extremities and 8.5% amputations of thumbs and fingers (30).

Three patients (0.89%) in the study had mangled extremities when they first appeared (see Table 3.2). The results differed from those of another research study. Two mangled extremity cases (5.7%) and one patient with a wrist joint amputation were reported by Stewart et al. (30). According to Ro et al. there is a rising trend in arm amputations among workers, particularly in those over 50 years (45). Lack of occupational training, the use of protective gear, or distraction at scene, which is a component of human error, could have contributed to these serious injuries.

The findings in the current study on amputations were consistent with other studies. The other studies showed that the lesser experience of workers, lack of proper training and not having/using protective gloves were found to be the contributing factors in causing these injuries. It was discovered that the reason for these injuries was caught-in type injuries (24,30).

In the current study, dislocations of the upper extremity were seen in 7.78% of workers (see Figure 3.5). It was noted that shoulder dislocations (38%) were the most common findings caused due to falls or after lifting objects in workers from various industries (see table 3.4). In contrast to other studies, this study revealed a significantly lower number of dislocations. Lim et al. found that workers in the mining, quarrying, agriculture and forestry industries had 32.2% of their workers experience dislocations as a result of hazardous work environments, as these industries were more susceptible to these injuries (42).

In this study, tendon injuries occurred in 13.74% of workers (see Figure 3.5). Out of these tendon injuries, 61% were extensor tendon injuries of the hand being at zone I (mallet injury) and zone III (injury of central slip causing boutonniere's deformity). Zone II (no man's land) injuries accounted for 27% of hand flexor tendon injuries. The long head of biceps tendon injuries were 6.8%, and the distal biceps tendon injuries were only 4.5%. There were combinations of flexor and extensor tendon injuries of fingers associated with phalanx fractures due to crush type of injuries (see Table 3.3). The findings of this study aligned with those of Sozbilen et al. who discovered that injuries to the dorsal side of hand and fingers were more common (43%) than those to the volar side (39%). In their study, there were less than 10% occupational injuries, and the majority of these injuries were not related to the workplace (28). Despite not identifying the specific type of tendon injuries, Stewart et al. found that 20% of the workers had experienced tendon injuries (30).

The mean age of workers who sustained rotator cuff tears was 52 years, and 6.5% of them had rotator cuff tears (see Figure 3.5), and over 90% of the workers underwent surgical repair. The recovery period for these injuries was two months before they returned to their work. The results of this study were different from other studies such as Kemp et al., who found that occupational workers who had surgical repair of rotator cuff tears, had experienced less post-operative satisfaction, and a smaller proportion of them had returned to their preoperative work. Tear size and number of tendons torn had no discernible impact on the compensation status (46).

In this study, one third of workers (34.4%) had sustained occupational injuries after falling (see Figure 3.6). It was not possible to determine the exact height from which these workers fell, as there was no recording for it in the employer's report. Another one third of workers (34.1%) had sustained crush injuries which occurred due to a falling heavy object, or some other causes (see Figure 3.6). The other causes of occupational injuries were penetration/cut (16.5%), lifting heavy objects (7.8%), motor vehicular accidents (5.7%) or due to an assault in the form of bodily force or gunshot/knife (1.5%) respectively (see Figure 3.6). Stewart et al. found that 85% of workers were injured due to power tools/machines or handling building materials (30). Alessa et al. found that being struck or getting caught in / by parts of a machine was attributed to most loss workdays (84%). Melmer et al. looked at the injuries caused by ladder fall during a 6-year period and these were 100% as they included 178 participants who fell from ladders (27). Razik et al. found that 87.7% of workers sustained occupational injuries of the upper limb due to falls (41). Sozbilen et al. found that angle grinder injuries only occurred to 9.7% of the workers in the occupational sector and this lower number of injuries could be due to occupational training given to the workers (28).

In this study, almost 90% of the workers resumed their duties after sustaining occupational injuries; 80% of the workers resumed their preinjury duties with the same employers and 8% of workers were offered an alternative job and they also continued duties with the same employers after completion of a rehabilitation programme (see Figure 3.7). Manufacturing, administrative/specialists, retail, and construction industries had the options of offering these alternative positions as they wanted to retain their skilled workers. There were less than 2% of workers who could not change their jobs, but they had luckily found a new employer (see Figure 3.7). These workers were either security officers working for a security company, mechanic, technician or general workers in the manufacturing and construction industries. They were fortunate as they had found a new company but were allowed to carry on with their same duties. A small percentage of less than 1% of workers had no options other than changing their jobs as well as employer (see Figure 3.7). There were 9% of workers who had lost their jobs as they were contract workers, had lack of education and skills, were not offered modified jobs, resigned, dismissed, absconded, retrenched or their HR did not give reasons or disclose the information for their employees (see Figure 3.7). There were no studies available which could describe the occupational injuries and their outcomes of workers on returning to either the same employers or need for some modifications in their work positions. Shi et al. discovered that workers were less likely to return to work if impairment was severe and pre-injury income was lower (32).

In this study, the number of occupational injuries were higher during weekdays (58%), and they were significantly less over the weekends (21%) (see Figure 3.10). Interestingly these injuries most commonly occurred on Thursday, Monday and Friday and this pattern helps in suggesting that these workers were either excited as the weekend was approaching or perhaps, they were in a hurry to finish their job (see Figure 3.10). Two peaks for the injuries were seen in the research findings, the first peak being two hours after starting the shift (as workers were settled to their work and busy in the middle of it) and the second peak at 1 – 2 hours before knocking off (maybe hurrying up and pressurised to finish the day's job in expectation of the end of the working day (see Figure 3.14). These results have been found in other studies such as Bicer et al., who showed that most of the hand injuries took place in the second half of the shift duration (40).

There was no statistically significant correlation between age, hand dominance, injury type, or cause and result in the current study. Nonetheless, there was a significant correlation (*p*-value = 0.0035) between gender and cause of injuries. Female workers sustained most injuries after a fall while their male counterparts had crushes and falls as the common cause for injuries (see Figure 3.11). These findings aligned with previous research by Beltran-Sanchez et al., which discovered that despite belonging to the same occupational group, men and women might have quite distinct exposure patterns to work-related risks (43). Razik et al. discovered that falling from a height was the most frequent cause of traumatic occupational injuries, with severe injuries requiring longer stays occurring more frequently in females (41). Volberg et al. also showed that female meter readers had higher injury rates and 19% were injured after falling on the same level (23).

In this study, the workers took approximately an average of 37 days to return to work after an injury (see Table 3.6). This was the overall mean figure for all the workers who returned to work. The age differences had an important effect on their average length of return to work with the employees in the 18 – 30 years age group taking 35.62 days, 31 – 40 years age group taking 35.26 days, 41 – 50 years age group taking 37.41 days, and those older than 50 years taking 41.38 days (see Table 3.11). It was found that age was not a significant factor affecting return to work after an injury. Male workers took slightly longer time than females to return to work, the associated *p*-value (0.0584) was close to the significance level of 0.05 (see Table 3.11).

Workers from the agriculture/fisheries industry took an average of 50.65 days before returning to work (see Table 3.11). The employees who had sustained rotator cuff tears took an average of 51.08 days, motor vehicular accident injuries required an average of 53.74 days, while the injuries caused by lifting took an average of 43.58 days (see Table 3.11). It was found that those workers who moved to a different role but within the same company/under the same employer tended to take longer than others (see Table 3.11). Multiple factors caused delayed return to work to a modified work. These were lower levels of education, financial issues and psychosocial factors. It was shown in other studies that the severity of the injury and lower preinjury income of the worker were the two factors responsible for delayed return to work (32,44). When compared to patients who sustain finger injuries or wrist fractures, Millrose et al. found that patients with CRPS took longer to return to work(31).

4.1 Limitations

Although the number of the population of this study has numbers comparable to those of available studies in the field, two factors may be sources of limitations. The study was conducted in a single orthopaedic surgery in a single private hospital. This might limit the types of patients and types of industries included in the study. Secondly, the study was of a retrospective nature, using patient records covering 7½ years. A more comprehensive study could be conducted, following the patients over a period of time, collecting data as their demographic characteristics and circumstances change.

4.2 Recommendation

For more precise results regarding upper limb occupational injuries, a larger, multi-centre prospective study is advised.

Chapter 5

5. Conclusion

Most of the employees who suffered from occupational injuries were males, right-handed, and under 50 years old. Process, plant, and machine operators and skilled trade occupations accounted for about half of the workers in this research. More than 67% of injuries took place inside the manufacturing industry and service-oriented sector. These workers sustained various types of injuries, fractures being the most common, while rotator cuff tears were the least common. Falling or being crushed were the two common causes of these injuries. More than 88% of workers were able to continue their employment with the same employer, and only 8% of workers were accommodated with an alternative job. About 9% of employees in the study lost their jobs. The peak times of the day when injuries occurred were 10:00 and 15:00 during weekdays. Mutilating and other debilitating injuries can occur at the workplace and can be disastrous to the worker and his dependents such as the three cases that sustained proximal upper limb amputations. A multi-disciplinary team approach is needed in treating these injuries to achieve the best outcomes. Occupational health and safety measures must be implemented in the workplace to limit these injuries.

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Appendices

Appendix A – Ethics Clearance Certificate

UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

R49 Dr JIK Niazi

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M220851

NAME: (Principal Investigator)	Dr JIK Niazi
DEPARTMENT:	School of Clinical Medicine Department of Orthopaedic Surgery Medical School University
PROJECT TITLE:	*Occupational upper limb injuries and their outcomes in a Port Elizabeth private hospital: a retrospective study*
DATE CONSIDERED:	2022/08/26
DECISION:	Approved unconditionally
CONDITIONS:	
NOTE:	If contact information regarding student study participants is required, please contact the Registrar's office - <Nicoleen.Potgieter@wits.ac.za>
SUPERVISOR:	Professor AA Aden and Dr A Younus
APPROVED BY:	CB Penny Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	2022/11/16

This Clearance Certificate is valid for 5 years from the date of approval. An extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office secretariat on the 3rd floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated from the research protocol as approved, I/we undertake to submit details to the Committee. **I agree to submit a yearly progress report**. When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in **August** and therefore reports and re-certification will be due in the month of **August** each year. Unreported changes to the study may invalidate the clearance given by the HREC (Medical).

Signature of Principal Investigator

2023/09/09
Date

Appendix B – Data Collection Sheet and Data Capture Spreadsheet

Study No.

Sex: M F Age at time of injury ------- Dominance: R L Both

Trade/industry: Office Construction Transport Food industry Communication

Police Entertainment Agriculture other: ……

Designated Job: ………….

Date of injury…../……./……. Time of injury……:……. Place of incident……………..

Injury caused by: employee co-worker incidental intentional

Description of incident:………………………………………………………………………………………

Task that the employee was performing: ………………………………………………………………………….

Status of attention/distraction: distracted not distracted

Side of injury: R L both

Injury Diagnosis: ………………………………………………………………………………………………

Treatment…………………………………………………………………………………………

Outcome: same job/same company other job/same company same job/other company other job/other company lost job

Resumption of duty date: ……/……/……..

Serial No.	Dominance	Industry/trade	Date of injury	Time of injury	Place of injury	Description of incident	Task to perform	Attention / distraction	Side of injury	Injury Diagnosis	Outcome:	Resumption of duty date

Appendix C – Letter to Request Permission to Conduct Research at Greenacres Hospital

NETCARE

Netcare Greenacres Hospital

Tel: +27 (0) 41 390 7000
Fax: +27 (0) 41 390 7089
Cnr Cape and Rochelle Roads, Greenacres, South Africa
PO Box 27488, Greenacres, 6057, South Africa
www.netcare.co.za

LETTER CONFIRMING KNOWLEDGE OF NON-TRIAL RESEARCH TO BE CONDUCTED IN THIS NETCARE FACILITY : DR JAVD IQBAL KHAN NIAZI, ORTHOPAEDIDC SURGERY DIVISION, UNIVERSITY OF THE WITWATERSRAND

Dear Dr Niazi

RESEARCH : OCCUPATIONAL UPPER LIMB INJURIES AND THEIR OUTCOMES IN A PORT ELIZABETH PRIVATE HOSPITAL : RETROSPECTIVE STUDY

We hereby confirm knowledge of the above-named research application to be made to the Netcare Research Operations Committee and in principle agree to the research application for Netcare Greenacres Hospital, subject to the following:

1. That the data collection may not commence prior to receipt of FINAL APPROVAL from the Netcare Research Operations Committee.
2. A copy of the research report will be provided to the Netcare Research Operations Committee once it is finally approved by the tertiary institution, or once complete.
3. Netcare has the right to implement any recommendations from the research.
4. That Hospital Management reserves the right to withdraw the approval for research at any time during the process, should the research prove to be detrimental to the subjects / Netcare or should the researcher not comply with the conditions of approval.
5. In terms of your application process, please email this letter, together all your relevant documentation, to Dr Folscher – Netcare Research Project Manager, at research@netcare.co.za

We wish you success in your research.

Yours faithfully

12/07/2022

ANDRE BOTHMA
HOPSITAL GENERAL MANAGER

DATE

Appendix D – Patient Information Sheet and Consent Form

STUDY INFORMATION DOCUMENT

Study title: Occupational upper limb injuries and their outcomes in a Port Elizabeth private hospital: A retrospective study

Greeting/s: Dear reader thank you for your time, which you have spared to read about my research.

Introduction:

I, Dr Javed I K Niazi, am doing research on Occupational upper limb injuries and their outcomes in a Port Elizabeth Private Hospital. Research is a process used in seeking new knowledge. In this study, we want to learn the epidemiology of occupational injuries of the upper limb treated by single orthopaedic surgeon in Greenacres Hospital for the period of 01 April 2013 to 31 December 2020.

Invitation to Participate: I am inviting you to take part in a research study, which will be conducted at Greenacres Hospital in Port Elizabeth.

What is involved in the study? This could include but would not necessarily be limited to such features as:

1 It will be a retrospective descriptive study where only the data will be collected on patients who sustained upper limb injuries at work and they had completed rehabilitation after the treatment was given by the single orthopaedic surgeon (Dr Javed IK Niazi)
2 I will collect data for the period 01 April 2013 to 31 December 2020.

Risks of being involved in the study: There are no risks to the participants who will give consent to add their data for our study.

Benefits of being in the study: There will be no direct benefit to the participant. However, this study will help to describe and suggest any preventive measures that may arise if certain variables are found to be associated with certain injuries, jobs or categories of workers.

The Participant will be given pertinent information on the study while involved in the project and after the results are available.

Participation is completely voluntary and anonymous. Information gathered during the research will be used solely for this study and all efforts will be made to ensure the confidentiality of the participant's personal information. Please note that while your name will be recorded with the data, it will not be used in the report. All identifiable data will be stored securely on a computer with password-restricted access. Please be aware that if you decide to withdraw, you may withdraw from the study at any time and your data will be returned to you or destroyed. You may also decide not to answer any specific question.

Reimbursements for "out of pocket" expenses: This will not be required as my study is a retrospective study.

Confidentiality: Personal information of all the participants will be treated in the strictest confidence and will only be available to the Principal Investigator (PI) and his/her Supervisor, in the case wherein the PI is a postgraduate student. The only exceptions - and all of them are rare - would normally be:

1 personal information may be disclosed if required by law
2 the Human Research Ethics Committees of the University may exceptionally require personal data to respond to a formal complaint, or for a compliance audit
3 the South African Health Products Regulatory Authority (SAHPRA), which is the successor body to the South African Medicines Control Council (SAMCC), might conceivably require access to personal data, if conducting an investigation into a drug trial

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

Anonymity: Patients files will be issued an anonymous number and all the identifiers will be removed

Contact details of researcher/s: Please find my contact details as Dr Javed IK Niazi (Principal investigator) my cell number 083 265 3435 and an e-mail address at drjikniazi@hotmail.com in case participants require further information, or report adverse events.

Contact details of HREC administrator and chair –

This study has been approved by the Human Research Ethics Committee (Medical) of the University of the Witwatersrand, Johannesburg ("Committee"). A principal function of this Committee is to safeguard the rights and dignity of all human subjects who agree to participate in a research project and the integrity of the research.

If you have any concern over the way the study is being conducted, please contact the Chairperson of this Committee who is Professor Clement Penny, who may be contacted on telephone number 011 717 2301, or by e-mail on Clement.Penny@wits.ac.za. The telephone numbers for the Committee secretariat are 011 717 2700/1234 and the e-mail addresses are Zanele.Ndlovu@wits.ac.za and Rhulani.Mukansi@wits.ac.za

Thank you for reading this Study Information Sheet.

Date: February 2022

PARTICIPANT CONSENT SHEET

Occupational upper limb injuries and their outcomes in a Port Elizabeth Private Hospital: a retrospective

1. I have been given a Participant Information Sheet which explains the nature and processes involved in this study, which is attached hereto.
2. I was given time to read it, or had it read to me, in the language I best understand.
3. I was given time to ask any questions I wanted to and found any answers given to me to be reasonable and satisfactory.
4. I believe I fully understand why the study is being conducted and what the intended outcomes will be.
5. I understand that there will be no immediate benefit to me, should I agree to participate, nor will I receive any payment; conversely, participation will not cost me anything but my time.
6. I understand that, even if I initially consent to take part in the study, I may subsequently withdraw at any time and would not be required to give any reasons; if that happened, any data collected about me for the purposes of the study would immediately be destroyed, unless I give consent for it to be retained.
7. I have been given a range of contact details, listed below. If I require further information or become concerned about any aspect of this study, I am free to speak to any of these contacts.

Contact details:
Dr Javed I K Niazi (Principal Investigator) on cell number +27 83 265 3435 or by e-mail at drjikniazi@hotmail.com
Prof A Aden (Supervisor) on cell number +27 82 330 3643, or by e-mail at araden@global.co.za
Dr Aftab Younus (Co-supervisor) on cell number +27 82 687 4974, or by e-mail at aftabyounus@gmail.com
Dr Sisa Pazi PhD (Biostatistician) on his email address: sisa.pazi@gmail.com

Professor CB Penny, Chairperson of the Human Research Ethics Committee (Medical) at the University of Witwatersrand, on telephone no. 011 717 2301, or by e-mail at Clement.Penny@wits.ac.za.

Ms. Z Ndlovu or Mr Rhulani Mkansi, Committee Secretariat, telephone nos.: 011 717 2700/1234, or by e-mail at: Zanele.Ndlovu@wits.ac.za or Rhulani.Mkansi@wits.ac.za

Name of Participant: ____
Date: ____
Place: ____
Signature or mark ____

Witnessed by:

Name of Witness: ______________________________________
Signature: ______________________________________
Date: ______________________________________

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