AN ERGONOMICS STUDY OF ORTHOTICS AND PROSTHETICS WORKSHOPS IN THE EASTERN CAPE OF SOUTH AFRICA.

BY

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THESIS

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ABSTRACT

Background: The South African healthcare system is under pressure due to inequalities inherited from the Apartheid system of the past, as well as more recent maladministration. These problems are particularly evident in the Eastern Cape province, which is considered the second poorest province in the country. Furthermore, the rehabilitation sector within healthcare is struggling for recognition in both the public and private healthcare sectors. Orthotists and prosthetists (O&Ps) form an important service in the greater rehabilitation sector since they provide an essential service for people living with disabilities, thus enabling them to function independently. Limited literature and anecdotal evidence suggest that O&Ps perform strenuous physical work under sub-optimal environmental conditions. Furthermore, it is hypothesized that the contextual influences of a struggling healthcare system such as lack or resources, poor referral systems, staff shortages and poor working environments may create a lot of challenges for O&Ps that can impact O&P's health and well-being and work performance.

Purpose: The purpose of this study was to assess the systemic challenges and enablers facing orthotists and prosthetists working in the Eastern Cape of South Africa and thus also evaluate the impact on their health and well-being as well as their job performance. Furthermore, this thesis aimed to compare the work system of O&Ps working in the public with that of O&Ps in the private sector.

Methods: A quantitative research method was chosen for this study. Data were collected using a descriptive questionnaire-based approach aimed at identifying the socio-technical interactions in the work systems of O&Ps in the Eastern Cape province of South Africa. This study was approved by the Rhodes University Ethical Standards Committee. The questionnaire was created in Google forms and the link to the online form was sent to Medical O&Ps and Orthopaedic Footwear Technicians using instant messaging (WhatsApp). Two hard copies were also handed out. Data were analysed using StatSoft Statistica Software (version 13.4.0.14 by *TIBCO Software Inc.*). Descriptive, parametric, content and correlation analyses were conducted. Significant findings were identified at $p<0.05$.

Results: The study received 43 respondents working in both the public and private health sectors, of which 53.5% were males and 46.5% females. The mean age of the

respondents was 34.38 years with a coefficient of variation of 19.45%. Majority of respondents (68.9%) worked in the public sector, with the remainder working in the private sector, or sharing their time between both healthcare sectors. Generally, respondents were satisfied with the organizational structure of their workplaces and their work environments. Work demands were identified by respondents from both sectors as an area of concern as tasks performed by O&Ps entailed physical strength, prolonged standing, awkward postures, and repetitive movements. Furthermore, there were some concerns about lighting and noise being unfavourable in some of the workshops. For all the system components, the standard deviations had a low dispersion of less than 1.0 from the mean. The lowest dispersion was 0.63 and the highest dispersion from the mean was 0.99. The analysis using the general linear models option revealed a significant difference between the scores of the work system components ($p=0.03$). The subsequent Tukey post-hoc test revealed a significant difference in the mean rating scores between the “Environment” and “Work demands”, with a p-value of 0.03.

There was discontentment from respondents working in both sectors with their work productivity as the public health sector respondents were 64.52% content; private sector respondents were 68.89% content, and respondents working in both sectors were only 56.67% content. When comparing the responses between O&Ps working in the different sectors, respondents working both sectors were unhappy with the provision of tools, machines, and materials, with 56.25% of the respondents working in the public health sector being less happy than the 61.11% working in the private health sector and the 63.19% working in both the private and public health sectors. Respondents had concerns regarding health and well-being with 60.60% of respondents working in both the public and private health sectors and experiencing more challenges than the 61.05% in the public and 67.24% in the private health sectors, respectively. Correlation analyses revealed very high positive correlations between the system components and the system outcomes.

Conclusion: The biggest issue emerging from this study was work demands as O&Ps work is physically demanding. O&Ps had to do a lot of manual handling, heavy load lifting, endure repetitive and vibration movements, prolonged standing and bending in awkward postures to complete tasks. The results from this study indicate that the private health sector is better equipped in terms of the work environment, machines

than the public healthcare sector. The finding from this study can be used to improve the factors that enable O&Ps' job performance and come up with possible solutions to the challenges O&Ps face in their jobs.

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CHAPTER I - INTRODUCTION

BACKGROUND TO THE STUDY

The South African Healthcare System

The current South African healthcare system is divided into the public and private health sectors. The private sector is mostly funded by medical aids and health insurance and caters for the wealthy minority of South Africa's patients (Johnston & Spurrett, 2011). In contrast, the public healthcare system, which is entirely state funded, is in a poor state. This is because of historical inequalities under the Apartheid system, during which healthcare was racially segregated. Facilities for Black Africans experienced a constant shortage of doctors and healthcare resources, which had serious consequences for the people living in the Bantustans (Singh, 2005) (Brauns & Stanton, 2016). It has also had a pronounced effect on the health of poor South Africans and the health policy and services of the present day (Coovadia, Rachel, Barron, Sanders, & McIntyre, 2009). Public health currently consumes around 11% of the government's total budget, which is higher than the 5% of GDP recommended by the World Health Organization (WHO) and reflects the major burden of diseases management and treatment carried by the public sector in South Africa (Jobson, 2015).

The introduction of democracy a quarter of a century ago resulted in policy changes to enable every citizen access to the health services (section 27 of the Bill of Rights). Despite the South African government's efforts to provide a comprehensive health system that is underpinned by quality, the post-apartheid government inherited a health system with massive inequalities in access to services (Johnston & Spurrett, 2011). Furthermore, the public healthcare system, which now serves about 80 percent of the country's population (almost 54 million people) (Mahlathi & Dlamini, 2015), has suffered from maladministration, corruption, and deteriorating infrastructure (Cloete, 2003). This limits the available resources used in the prevention and treatment of a large range of conditions and diseases, and ultimately affects the quality of care of patients.

The Eastern Cape province of South Africa is the second poorest province in South Africa and has a large rural population. Dispersed settlements, poor infrastructure, and

inaccessibility in some areas, contribute to the complexities of providing healthcare services (EC Vision 2020 Plan, 2017). It was also greatly disadvantaged during the Apartheid era. This means that public healthcare resources in the Eastern Cape are even more stretched than those of the wealthier or less populated provinces. Another challenge is attracting and retaining healthcare professionals to work in deep rural areas, resulting in a shortage of medical service-providers in these areas (Dolea, Stormont, Zurn, Shaw, & Braichet, 2009). Healthcare professionals working in the public healthcare sector of the Eastern Cape are therefore not only faced with challenging working conditions, but also high workloads.

Rehabilitation Services in South Africa

The healthcare system plays an important role in the prevention of disabilities, the equitable provision of health services to people with disabilities, and the provision of health rehabilitation (Sherry, 2015). Rehabilitation professionals, which include occupational therapists, physical therapists, medical orthotists and prosthetists, radiographers, speech therapists and medical technologists, should be essential members of the comprehensive package of healthcare (Bezuidenhout, Buchanan, Diener, & Zsilavecz, 2017). Rehabilitation services aim to restore part or full physical functioning, so that people with disabilities can function independently again, thus allowing them to contribute to the economy of the country and not be a financial burden. Rehabilitation services are therefore crucial and should be integrated in the treatment plan for each individual patient (Lusardi, Jorge, & Nielson, 2007), irrespective of whether the patient is being treated in the private or public health sector.

Unfortunately, even though rehabilitation is included in the definition of comprehensive primary health care, alongside preventive, promotional, curative, and palliative care, it remains poorly understood by healthcare managers and healthcare workers in South Africa (Sherry, 2015). Health planners frequently overlook the needs of people in need of rehabilitation, particularly those with disabilities, or discount them as a minority group to only be considered at some point in the future, once the more pressing issues of HIV and child mortality have been resolved (Sherry, 2015). Without the inclusion of rehabilitation health services at primary and secondary care levels, the disability prevalence in South Africa has greatly increased from 2002 to 2012 (Department of Health, 2015).

Sherry (2016) noted that rehabilitation remains excluded and poorly understood in the public healthcare sector, as access to such rehabilitation services is limited in both poorly and well-resourced provinces, with human resources for the provision of these services being subject to challenges, especially in the public sector. Medical and nursing staff are unlikely to refer all patients needing rehabilitation due to a lack of knowledge and exposure to these professions at an undergraduate level as well as rehabilitation specialists' omission in the key guidelines of patient care and treatments and service packages in workplaces (Bezuidenhout, Buchanan, Diener, & Zsilavecz, 2017). An example of the exclusion and poor understanding of rehabilitation therapists by other healthcare workers in public sector is that rehabilitation therapists were dismissed by hospital management, nurses and doctors who refused to attend a seminar that was prepared by therapists in Madwaleni Hospital (Ned, Cloete, & Mji, 2017). This seminar would have introduced them to rehabilitation services, developed a referral system and determined how all health professionals could work together as team instead of as individual silos (Ned, Cloete, & Mji, 2017). This incident indicated a disregard for collaborative practice, undermined the interdisciplinary approach and continuum of care, and highlighted challenges relating to professional superiority versus mutual respect and poor utilization of already limited resources (Ned, Cloete, & Mji, 2017).

Despite rehabilitation services being an important aspect of a holistic treatment approach and effective healthcare, the constraints experienced in the public healthcare sector results in rehabilitation professionals in the Eastern Cape being seemingly undervalued, under-resourced and having to deal with great challenges that may impact their own health, well-being, and work performance. Furthermore, undervaluing rehabilitation services in the public healthcare sector hinders patient referral and treatment (Ned, Cloete, & Mji, 2017) and affects resource allocation, funding allocation and infrastructure development.

Medical Orthotists and Prosthetists (also known as MOPs or O&Ps) integrate health and engineering within their profession. They provide comprehensive rehabilitation to patients by retraining physical and functional abilities, assisting with psychological and emotional adjustments, and ensuring social and community integration (ISPO/WHO, 2005). Orthotic and Prosthetic services are based on the social model of disability and have their own focus on the equalization of opportunities and on social and economic

integration of persons with disabilities (Fredericks & Visagie, 2013). Rehabilitation, particularly when related to orthotics and prosthetics, lends itself well to interdisciplinary teams because the total care of patients with complex disorders requires a wide range of knowledge and skill (Lusardi, Jorge, & Nielson, 2007).

Unfortunately, people with disabilities who live in resource-poor areas experience challenges in accessing health care services and more specifically rehabilitative health care services (Nixon, et al., 2001). There is a shortage of O&Ps in South Africa, in general (Mduzana, Tiwari, Lieketseng, & Chikte, 2020), therefore reducing the number of people benefitting from such services. Without access to orthotics and prosthetics services, people with disabilities are often confined to their homes and are thus excluded from participating in society and locked into poverty and isolation (Khasnabis, 2015).

Ergonomics in Orthotics and Prosthetics

O&Ps are involved in patient care, as well as the manufacturing or production of the required orthotic and prosthetic devices. They are therefore not only exposed to the typical risks encountered through patient handling and interactions (e.g., clinical assessment and examination of patients), but also those encountered during the fabrication process of orthoses and prostheses (Anderson, Stuckey, & Oakman, 2016). Ergonomic hazards in O&P workshops have not been well explored, despite some evidence from clinicians suggesting that they are exposed to a range of hazards, particularly manual handling hazards previously linked to the development of work-related musculoskeletal disorders (WMSDs) (Anderson, Stuckey, & Oakman, 2016). Furthermore, the lack of O&Ps available to serve the population in need of such services increases the workload of those O&Ps available (Anderson, Stuckey, & Oakman, 2016), particularly in the South African public sector. Personal experiences in the O&P profession include being over-worked, exposed to poor working conditions, having a lack of resources and poor management support.

As a result of all the challenges faced by O&Ps, it is important to assess the health and well-being of the O&P professionals in their work environments, and how their workplaces and working conditions can be improved to ensure a safe working environment and increase productivity while being economically viable. Ergonomics is the discipline concerned with “the understanding of interactions among humans and

other elements of a system" (International Ergonomics Association – http://www.iea.cc). Optimal interactions between the worker, machines, tasks, and the environment can improve the safety of the employees, while at the same time performing their tasks to meet production needs (Bridger, 2003). The benefits of ergonomics include, amongst others, decreases in incidence and severity of musculoskeletal disorders, decreases in lost and restricted workdays due to injuries; decrease in absenteeism, workers' compensation, and health care costs; increases in productivity and quality; and improvement in employee morale (Carson, 1994). For O&Ps to perform work effectively and efficiently, they require a safe and suitable physical environment, healthy working conditions, acceptable workload, and greater organizational support that allows them to serve patients and provide them with satisfactory services and devices (Fernandez & Goodman, 1995). Understanding the interactions of system components in O&P workshops could provide insight on the challenges and enablers faced by these healthcare professionals. Such knowledge could be used in the development of guidelines on how the work system of O&Ps can be improved so that it enhances health and well-being as well as work performance.

STATEMENT OF THE PROBLEM AND PURPOSE OF THE STUDY

Healthcare in South Africa is facing many challenges because of past inequalities and the more recent maladministration. Providing healthcare services to the people of the Eastern Cape province of South Africa is particularly challenging, due to a poor population and remote rural areas. Although rehabilitation services are known to be an important aspect of a holistic treatment approach and effective healthcare system, the constraints experienced in the healthcare system in general, and particularly in the Eastern Cape, means that rehabilitation professionals are under-valued, under-resourced and deal with great challenges that impact their health and well-being and work performance. A literature search on ergonomics studies on the O&P profession resulted in a limited number of references. Studies by Anderson, Stuckey, & Oakman, (2016); Nodooshan, Booshehri, Daneshmandi, & Choobinesh, (2016); Anderson, Stuckey, Poole, & Oakman, (2017); and Anderson, Stuckey, & Oakman, (2021) all highlight the physical stressors and resulting musculoskeletal disorders experienced by O&P's, but no studies have focussed on the challenges and enablers of an O&P's

work system. Understanding the interactions of these components of the O&P work system and the contextual challenges facing O&Ps working in the Eastern Cape Province of South Africa will allow for the development of recommendations to improve the health and well-being of O&Ps, while providing service delivery to their patients.

Therefore, the purpose of this study is to assess the systemic challenges and enablers facing orthotists and prosthetists working in workshops in the Eastern Cape of South Africa. The objectives are to:

- identify factors that influence the health and well-being of O&Ps within their jobs
- identify factors that influence job performance of O&Ps in their jobs
- compare the work system of O&Ps working in private and in public healthcare settings.

CHAPTER 2 - LITERATURE REVIEW

HEALTHCARE IN SOUTH AFRICA

Historical Background of the South African Healthcare System

Prior to the advent of democracy in 1994, South Africa's health system was legally characterized by race, gender, and geographic inequities (Singh, 2005) due to Apartheid, a political system which institutionalized racial segregation and resulted in under-resourced healthcare facilities for the non-White South African population (i.e., people not of Caucasian descent). No system could cope with the epidemic of ill-health in the Bantustans (people of colour) and there was a constant shortage of doctors and healthcare resources, which had serious consequences for the people living in the Bantustans (Brauns & Stanton, 2016).

After the introduction of democracy in South Africa in 1994, policy changes were instigated, with South Africa's Constitution guaranteeing access to the health services for every citizen (section 27 of the Bill of Rights) (Constitution of the Republic of South Africa, 1996). The post-apartheid South African government however inherited a healthcare system with huge inequalities in access to good quality services. There are marked differences in rates of disease and mortality between races, which reflect differences in the access to basic household living conditions and other determinants of health (Coovadia et al., 2009). Some key features of the Apartheid system included limited access to healthcare services by women, children, and farm workers; lack of health infrastructure in rural areas; and limited information on health issues (Singh, 2005). The lack of financial resources within the Bantustans was crippling for the black population (Brauns & Stanton, 2016), and health services were essentially doctor-dependent medical services biased towards curing existing diseases rather than preventing diseases (Cullinan, 2006).

Apartheid laws and policies affected all aspects of the citizen's life, including the health sector (Kon & Lackan, 2008). The racism of the Apartheid government was evident in every aspect of health, such as: (1) rigid segregation of health facilities; (2) disproportionate spending on the health of Whites compared to Blacks, which resulted in world-class medical care for Whites, while Blacks were usually referred to congested and dirty facilities; (3) public health policies that disregarded diseases

primarily affecting Black people such as bacterial diarrhoea, hepatitis A, typhoid fever and Schistosomiasis, just to name a few; (4) and the denial of basic sanitation, supply of clean water and other components of public health to rural areas and townships (Brauns & Stanton, 2016). According to the American Association for the Advancement of Science and the Physicians for Human Rights Organization, the South African health care system not only limited access to healthcare for Blacks and often ignored quality-of-care guidelines, but also created an environment in which abuses could occur, such as the refusal of emergency care treatment, falsification of medical records, denial or limitation of Blacks' access to ongoing medical care, and mistreatment of the mentally ill (Kon & Lackan, 2008). In contrast, healthcare for Whites received the bulk of public expenditure, receiving four times more money per capita than their Black South African counterparts, while the Coloured and Indian population received an intermediate share (Brauns & Stanton, 2016).

South Africa has a substantial burden of disease, not only from HIV and AIDS, but also from preventable conditions arising from poor sanitation, nutrition, and other conditions of poverty, as well as a growing burden of non-communicable disease affected by lifestyle (Johnston & Spurrett, 2011). Johnston and Spurrett (2011) state that healthcare outcomes are poor in South Africa because of its history, prevalence of poverty, lack of basic infrastructure, exposure to interpersonal violence and lifestyle issues such as alcohol and tobacco abuse. The new democratic South African government has tried to remedy the situation of the past by building more health facilities to address primary and preventive healthcare, especially in the Eastern Cape province of South Africa (Maphumulo & Bhengu, 2019). The Eastern Cape is considered the second poorest province in the country as it was greatly disadvantaged during the Apartheid era. The mainly rural nature of the Eastern Cape, with dispersed settlements, poor infrastructure, and inaccessibility in some areas, also contributes to the complexities of providing healthcare services (EC Vision 2020 Plan, 2017). In rural areas clinics have been built to ensure access to primary healthcare for all citizen of this country. Even so, the primary healthcare system comes with challenges of its own, since access to healthcare, i.e., the opportunity to obtain and appropriately use quality health services (McIntyre & Ataguba, 2014), remains poor. Clinics are usually still too far from many residents in deep rural areas. There is a lack of ambulances, and some areas still have no access to roads for ambulances to access the areas. The right of

access to healthcare remains unrealized for many members of the rural Eastern Cape, where the need is great and the nearest clinic may be a 2.5 hour walk away (for a healthy person) and includes crossing a river and climbing significant hills (Frost, Jenkins, & Emmink, 2017). In addition, there are still issues of attracting and retaining healthcare professionals to work in such deep rural areas. It is evident that the history of South Africa has resulted in a pronounced effect on the health of its people and the health policy and services of the present day (Coovadia, Rachel, Barron, Sanders, & McIntyre, 2009).

The South African health system has come a long way since 1994, the year of the start of democracy. The building blocks are now in place to provide a comprehensive health system that is underpinned by quality, a skilled workforce and appropriate infrastructure (Jobson, 2015). Policies were created to ensure equality in terms of access to quality healthcare for all citizen of South Africa. Despite these, notable features of the fragmented historical health services in South Africa remain, both within the public health sector and between the public and private sectors. What this means is that after twenty-four years since the beginnings of Democracy in South Africa, the country is still grappling with the effects of Apartheid and the challenges of transforming health institutions and promoting equity in development (Coovadia, Rachel, Barron, Sanders, & McIntyre, 2009).

Structure of the Healthcare System in South Africa

Currently, the healthcare system of South Africa is divided into the public health sector, private health sector and the non–governmental organizations (NGOs). People in South Africa can access either the private or the public sector depending on their ability to pay for the private sector services (Mahlathi & Dlamini, 2015). The public health sector is completely state-funded and serves about 80 percent of the country's population of an estimated total number of 54 956 900 people (Mahlathi & Dlamini, 2015). The public health sector receives its funding solely from the National Treasury, and public sector health facilities in South Africa are managed by the provincial Departments of Health (Jobson, 2015). The provincial departments are the direct employers of the health workforce, while the National Ministry of Health is responsible for the country's overall healthcare policy development and coordination (Mahlathi & Dlamini, 2015). Institutions in the public sector have however suffered from poor

management, “misconceived under-funding” and deteriorating infrastructure, which ultimately affect the quality of care of patients (Maphumulo & Bhengu, 2019). Public health consumes around 11% of the government’s total budget and is allocated mostly to nine provincial departments (Jobson, 2015), while the remainder of the funds go towards the National Department of Health. This allocation of the government’s budget towards healthcare is higher than the 5% of GDP recommended by the World Health Organization (WHO) and reflects the major burden of disease management and treatment carried by the public sector in South Africa (Jobson, 2015).

The public health services are divided into primary, secondary, and tertiary services through health facilities that are located in and managed by the provincial Departments of Health; each offering different levels of services (Cullinan, 2006); (Mahlathi & Dlamini, 2015). These facilities are the local clinics which constitute the primary health service providers, district hospitals which make up the secondary health service providers and academic hospitals which are the tertiary health service providers. Hospitals are primarily for individuals who need in-patient care, although all have outpatient departments and causality emergency care (Cullinan, 2006). Even so, O&P workshops are only located in tertiary hospitals. In contrast to the public healthcare sector, the private health sector serves those individuals who can afford to pay for healthcare services and medical aid insurance, and offers state-of-the-art services, equipment, and machinery for the treatment of its patients. The private sector serves its customers well, but at prices that result in only a small minority of the population being able to afford adequate coverage (Johnston & Spurrett, 2011).

After the end of Apartheid, the national government inherited 14 health administrations of the Bantustans and consolidated them into one national health department and nine provincial health departments (Coovadia, Rachel, Barron, Sanders, & McIntyre, 2009). Constitutionally, health is a concurrent function of both national and provincial spheres of government, with the national bodies being largely responsible for setting policies and provinces largely responsible for implementing these policies (Cullinan, 2006).

Ensuring adequate infrastructure is important in the bid to provide access to inclusive healthcare in the country. Post-apartheid, much of the country’s infrastructure was old and run down, particularly in rural areas, townships, and the former Bantustans. Since then, 18 new hospitals have been built and a further 190 upgraded, and today there

are 388 public hospitals in the country: 149 in urban areas and 239 in rural areas (Jobson, 2015). Of the 388 public hospitals, 64 percent are district hospitals, with secondary and specialized hospitals making up 16 percent each and provincial and national hospitals comprising less than 4 percent of all hospitals in the public sector (Cullinan, 2006).

To use resources more efficiently, government has introduced a hierarchy of health services where patients using the public health system are now only able to access higher levels of care once they have been accessed and referred upwards by health workers at lower levels, and the exception to this is a medical emergency (Cullinan, 2006). The first point of entry for South Africans to health services is now at primary level through local clinics and community health centres (Cullinan, 2006). This means that when people need health services, their first point for healthcare access are the local clinics, which render their services for free. Primary healthcare services are run by nurses, although doctors regularly visit the clinics and, if more specialised care is needed, the patient will then be referred to secondary level facilities (i.e., hospitals) by the clinic staff (Cullinan, 2006). If the condition of the patient requires further care and treatment that cannot be provided at primary level, the patient would then be transferred to a district hospital, i.e., the secondary healthcare facility.

At a tertiary level are the advanced academic hospitals, where patients receive more technologically advanced and sophisticated treatments, and these academic hospitals also serve as training institutions for healthcare providers (Jobson, 2015). Provincial tertiary hospitals receive patients from Regional Hospitals and provide sub-specialist support to patients at a ‘level 3’ care. This requires the expertise of clinicians working as sub-specialists or rarer specialties like neurosurgery, plastic surgery, and cardiothoracic surgery (Cullinan, 2006).

Primary healthcare re-engineering offers a vehicle for making healthcare more accessible to people with disabilities, preventing disability through early intervention, and making rehabilitation services available and accessible to all (Jobson, 2015). Health systems should now look to the universal design of facilities and activities, the incorporation of disability considerations into all health programs, and the resourcing of rehabilitation services, particularly at primary health care level, as a matter of urgency (Morris, et al., 2019). This means that prevention of health problems is divided

into primary, secondary, and tertiary prevention. Recent studies (Behm & Gray, 2012; Lusardi, Jorge, & Nielson, 2007; Ned, Cloete, & Mji, 2017) argue that all members of the rehabilitation team should be included as primary healthcare givers and fall within primary prevention to improve prognosis of patients and prevent further disabilities. Rehabilitation is currently not viewed in the same light as medical and curative services, but rather as a speciality service (McCool, et al., 2009), thus its place in the South African healthcare systems, and its capacity to positively influence the country's economy is poorly acknowledged (Morris, et al., 2019).

Challenges facing the Healthcare System in South Africa

Even with the high expenditure towards the overall health of the country, South African health outcomes still compare very poorly to those of countries which have a similar national income and health expenditure (Johnston & Spurrett, 2011). Healthcare provided at present in South Africa is incompatible with the following basic principles of the Constitution of the WHO: (i) "Health is a state of complete physical, mental and social well-being and not the absence of disease or infirmity", and (ii) "The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition" (World Health Organisation, 1978). This infers that South Africa's healthcare outcomes are so poor compared to peer countries that South Africa has a high rate of infant mortality and maternal mortality. The poor healthcare outcomes could be the result of poor management of resources and the shortage of professionals in the health sector (Johnston & Spurrett, 2011). Furthermore, Coovadia et al. (2009) state that since 1994, the health sector in South Africa has been affected by a legacy of maladministration of staff and poor skills of many health personnel, which has compromised the ability to deliver key programmes, notably for HIV, tuberculosis, child health, mental health, and maternal health.

The public health sector shortcomings are well documented (Maphumulo & Bhengu, 2019), and in the past few years these have been acknowledged by the government. The public health sector faces several challenges, one being that the output of doctors from medical schools before 2005 increased at a rate that was estimated to still be inadequate to supply the needs of the country. South Africa hence still faces shortages of human resources, especially within the public sector and in rural areas, and this

shortage poses a challenge to the implementation of many health policies, including the National Health Insurance (NHI) and undermines equity (Doherty & Singh, 2016).

The scarcity of human resources, especially in rural areas and at lower levels of the health system, have presented one constraint to policy implementation. For many South Africans, particularly those in rural areas, district hospitals are the only hospitals they can ever get admitted to (Cullinan, 2006) as more specialist services are unaffordable. Regional hospitals are often the most overburdened of all levels of hospitals, bearing the brunt of the many inadequacies in the district hospitals and several regional hospitals. For example, the Eastern Cape is unable to perform basic operations such as caesarean sections because of staff shortages and such operations are then referred to regional hospitals, which are only supposed to deal with more complicated health problems (Cullinan, 2006). Currently, Mthatha Regional Hospital is the referral hospital for over 20 district hospitals and alongside it lies the R500-miliion Nelson Mandela Academic Hospital (a tertiary hospital) which was built to relieve Mthatha Regional Hospital and to provide specialist care. However, it is unable to function properly as it too is severely understaffed and cannot attract the necessary specialists to the town as it lacks decent housing and schools (Cullinan, 2006). The supply and retention of adequately skilled health professionals across the country's public health facilities is a key concern for the National Ministry of Health (Mahlathi & Dlamini, 2015). This has led to developments of new policies that permit health workers to work both in the public and private sector under certain rules and regulations, namely the Remunerative Work outside Public Service Policy. The government has built more clinics and hospitals to improve health care access. Even so, the country still lacks personnel to work at these clinics and hospitals. More policies have been put in place to retain health care professionals and reduce emigration to foreign countries and to the private sector.

Another key constraint to policy implementation is that at all levels of the health system there has been inadequate stewardship, leadership, and management, and it is this lack of stewardship and leadership that has been evident in the highly variable quality of care delivered within the public sector (Coovadia, Rachel, Barron, Sanders, & McIntyre, 2009). The same authors state that poor stewardship at the policy level, weak management and unsupportive supervision at the implementation level are major obstacles to improving the health system in South Africa. Poor management at

every level of the health department and a lack of proper guidelines for the different levels of government are exacerbating problems in health facilities and hamper the development of an efficient and effective public health service (Cullinan, 2006). There is also widespread theft of medicine, linen and other stock. For example, two Eastern Cape provincial pharmaceutical depots have failed to submit proper records for the past nine years, making is easy for drugs to be misallocated and neither the provincial health department, nor depot managers can account for transactions involving purchase of medicines in the province over this time period (Cullinan, 2006). Despite the promulgation of a plethora of progressive health policies developed since 1994, the South African public health system reflects several obstacles regarding implementation (Ned, Cloete, & Mji, 2017). The role of the Ministry of Health in providing overall guidance on activities that contribute to improving levels of health in South Africa has generally been characterised by good policies, but without equivalent emphasis on the implementation, monitoring, and assessment of these policies throughout the system (Coovadia, Rachel, Barron, Sanders, & McIntyre, 2009). What all this emphasizes is the failure of South Africa to establish a strong healthcare system at all levels and to develop and manage human resource capacity adequately, particularly at district levels (Ned, Cloete, & Mji, 2017).

There is increasing demand on healthcare delivery organizations, and this is happening in every country as people are now living longer thanks to advances in understanding of the causes of diseases, and consequent improvements in a diagnostic techniques and treatments (Clinical Global Impression (CGI), 2014). Two global issues are emerging in healthcare as healthcare professionals face the complexities of current patient care: the need for specialized health professionals and the need for collaboration amongst healthcare professionals (Lusardi, Jorge, & Nielson, 2007). Challenges to patient-centred care include a lack of adequate resources, increased administration work due to fear of litigation and unprofessional behaviour of health workers (Jardien-Baboo, van Rooyen, & Rickes, 2016). There is considerable variation in the availability of hospital beds and health professional across provinces; and unsurprisingly, the starkest differences are seen in the distribution of doctors, particularly specialists (McIntyre & Ataguba, 2014). The poor working conditions and poor pay of local health workers needs to be addressed, as does the urgent need to train more health professionals (Cullinan, 2006). Many of the

public hospitals within the Eastern Cape are in a state of crisis, with much of the public healthcare infrastructure in poor condition and non-operational because of underfunding, mismanagement, and neglect (Jardien-Baboo, van Rooyen, & Rickes, 2016). Poor hygiene and poor infection control are challenges faced by the healthcare system in South Africa; an example of this would be the 26 babies that died in 2005 while being kept in the intensive care unit at Mahatma Gandhi Hospital in Durban as a result of klebsiella, a bacterium caused by poor hygiene (Cullinan, 2006). The lack of integration of services due to fragmentation of system operations and poor policy coordination in healthcare has exacerbated verticalization (vertical programs are disease or health issue specific programs, such as AIDS or malaria, which are driven by outside planners and donors, and are not sustainable if funding dries up or is reallocated to other priorities (Caloyerans, Hangsheng, Exum, Broderick, & Mattke, 2014)). It has also encouraged a 'solo' mentality and 'bypassing' of existing policies and procedures thereby causing poor health system performance in South Africa (Malakoane, Heuns, Chikobvu, Kigozi, & Kruger, 2020).

Rehabilitation Services in South African Healthcare

According to the World Report on Disability, there are more than 1000 million people living with disability worldwide, constituting about 15 percent of the global population. Of this number, between 110 million and 190 million adults experience significant difficulties in functioning and it is estimated that 93 million children live with a moderate or severe disability (Khasnabis, 2015). An estimated 7 percent of all South Africans have a disability, and this figure is expected to increase as people live longer, because of better treatment options for chronic illnesses (Bezuidenhout, Buchanan, Diener, & Zsilavecz, 2017). This means that the prevalence of disability is rising because of an aging population and the global increase in chronic disease conditions (Khasnabis, 2015).

The process of creating a health system that is responsive to both the disability and rehabilitation needs of people with physical, sensory, psycho-social and learning impairments is inevitably compromised by mediating differences in opinions for the identification of focus areas for service provision and resource allocation (Ned, Cloete, & Mji, 2017). Downsizing in healthcare, reorganization from traditional functional structures to patient-focused structures, and the use of total quality management

approaches that reward group participation over individual efforts have contributed to the increased emphasis on interdisciplinary team care (Lusardi, Jorge, & Nielson, 2007).

The rehabilitation team is a group of healthcare providers from different specialities who come together and work towards a common goal for the holistic care and rehabilitation of the patient (Behm & Gray, 2012). The professionals most often represented on the team include an orthopaedic or vascular surgeon, a neurologist, the patient's primary physician, a medical orthotist and prosthetist, nurses, a physical therapist, an occupational therapist, a dietitian, a social worker, a vocational counsellor, and most importantly, the patient (Lusardi, Jorge, & Nielson, 2007). (Momsen, Rasmussen, Nielsen, & Iversen, 2012). The outcomes from interdisciplinary team care could be experienced at three levels (healthcare professionals, patients, and healthcare organizations) and these outcomes have an impact on staff satisfaction, quality of care, control of costs, well-being, and staff retention (Nancarrow, et al., 2013).

People with disabilities who live in resource poor countries generally experience difficulties in accessing health care services, and more specifically rehabilitative health care services (Nixon, et al., 2001). This results in constrained access to rehabilitation services and disadvantages the disabled population of South Africa. Globally, in 2015 only 1 in 10 persons of the disabled population in need of rehabilitation had access to prosthetic and orthotic devices, with the problem of accessing such devices being more acute in low- and middle-income countries (Khasnabis, 2015). Without access to prosthetics and orthotics services, people are often confined to their homes and are thus excluded from participating in society and are locked into poverty and isolation (Khasnabis, 2015). Rehabilitation, particularly when related to orthotics and prosthetics, lends itself well to interdisciplinary teams because the total care of patients with complex disorders requires a wide range of knowledge and skill (Lusardi, Jorge, & Nielson, 2007).

Despite this, health policy implementers frequently overlook the needs of people with disabilities, or discount them as a minority group to be considered at some point in the future, once the pressing issues of HIV and child mortality have been resolved (Sherry, 2015). According to Nixon et al. (2001) rehabilitation is vital in terms of human rights,

health outcomes and quality of life and needs to be integrated into HIV plans. As the experience of disability intersects with primary health conditions such as HIV and AIDS, and non-communicable diseases, there is reason to believe that the effectiveness of other programs may be curtailed, unless disability is considered in health system design (Sherry, 2016).. Rehabilitation professionals should be regarded as essential members of the comprehensive package of care as the omission of rehabilitation significantly influences the patient's ability to access multi-disciplinary services (Bezuidenhout, Buchanan, Diener, & Zsilavecz, 2017); (Lusardi, Jorge, & Nielson, 2007). However, with the omission of rehabilitation health services at primary and secondary care levels, the disability prevalence in South Africa has greatly increased (Sherry, 2016).

The importance of rehabilitation services and the role played by rehabilitation professionals is vastly undervalued in the South African public healthcare sector. The introduction of rehabilitation professionals at district hospital and primary healthcare level is largely a recent occurrence, and staff retention (therapists and doctors) within the public health sector is poor. Therefore, there is an endless cycle of educating health staff about the needs of people with disabilities and rehabilitation services (Bezuidenhout, Buchanan, Diener, & Zsilavecz, 2017). Effective team functioning begins during the education of each individual health professional (Lusardi, Jorge, & Nielson, 2007). Furthermore, there are issues of the ever-changing policies that not even rehabilitation managers understand (Nixon, et al., 2001). The biggest challenge is that none of these policies developed a service package for rehabilitation services, and Sherry (2015) noted that rehabilitation remains excluded and poorly understood in the public healthcare sector. Based on anecdotal evidence, rehabilitation members are often located outside the main building of the hospital, with debilitating building structures, lack of equipment and tools and poor access for patients who struggle to ambulate or mobilize. It is therefore reasonable to postulate that rehabilitation professionals experience the same, if not greater, challenges as other healthcare workers in the public South African healthcare system.

Orthotics and Prosthetics

Orthotics and prosthetics are established disciplines in the field of health science and are often practiced together as they have a lot of commonalities and both follow the

same steps of service delivery (Khasnabis, 2015). Medical orthotists and prosthetists practice in a variety of settings, like hospitals, rehabilitation centres, education institutions and research institutions (Lusardi, Jorge, & Nielson, 2007). Orthotics is a speciality within the field of healthcare technology concerned with the design, manufacture, and application of orthoses (Khasnabis, 2015). Orthoses are externally applied devices used to modify the structural and functional characteristics of the neuromuscular and skeletal systems (Khasnabis, 2015). Prosthetics is a specialty within the field of healthcare technology concerned with the design, manufacture, and application of prostheses (Khasnabis, 2015), which are artificial devices that are used both externally and internally for replacing or restoring certain body parts and help regain the lost functionality of the body part that is either missing or malfunctioning (Thurston, 2008).

The emergence of orthotics and prosthetics as a health profession followed a course like that of the profession of physical therapy (Lusardi, Jorge, & Nielson, 2007). Developing these professions is closely related to the three significant events in world history: World War I, World War II, and the onset and spread of poliomyelitis in the 1950s (Lusardi, Jorge, & Nielson, 2007). Until World War II, the practice of prosthetics depended on the skill of individual craftsmen such as blacksmiths, armour makers, artisans, and even the individuals with amputations themselves who fashioned makeshift replacements limbs from materials at hand (Lusardi, Jorge, & Nielson, 2007). Prosthetics not only serve the purpose of functionality, i.e. making movement easier for people who had lost an extremity (Thurston, 2008), they also serve to create a sense of “wholeness” (Norton, 2007).

Seeing the need for quality orthotic services, the WHO published guidelines for training personnel in developing countries for prosthetic and orthotic services in 2005 (World Health Organization, 2005). With rapid advances in technology and healthcare, the roles of the prosthetist and orthotist have expanded from a technology focus to a more inclusive focus on being a member of the rehabilitation team (Lusardi, Jorge, & Nielson, 2007). Current educational requirements reflect these changes in orthotic and prosthetic practice as entry into the profession now requires the completion of a bachelor’s degree from an accredited institution of higher education (World Health Organization, 2005). The World Report on Disability outlined that worldwide existing training facilities for prosthetic and orthotic professionals and other providers of

essential rehabilitation services are deeply inadequate in relation to the need; therefore, more professionals need to be trained, but training alone would not solve the problem - equal focus is needed to develop the service provision (Khasnabis, 2015).

The ‘industrial’ environment of orthotic and prosthetic workshops suggests it is more appropriate to compare risks in the O&P work environment with that of other manufacturing work environments, rather than to traditional clinical settings (Anderson et al., 2017). In these workshops, most activities are carried out by manpower and the tasks are labour intensive (Nodooshan et al., 2016). Manual material activities (e.g., heavy load lifting, lowering, and carrying), awkward and static working postures are very common and ergonomic aspects of working conditions are seldom considered (Nodooshan et al., 2016).

ERGONOMICS AND SOCIO-TECHNICAL SYSTEMS THEORY

The objective in ergonomics is to apply scientific knowledge about human capabilities and limitations and other characteristics to the design of machines, tools, workplaces, and physical environments, to enhance usability, productivity, health, safety, and minimise human errors via design (Hendrick & Kleiner, 2001). Since modern ergonomics contributes to the design and evaluation of work systems and products (Bridger, 2003), incorporating a macroergonomics approach, or work system design perspective can be beneficial to individual, group and organizational effectiveness (Robertson, 2000).

Macroergonomics is a sub discipline of human factors / ergonomics that emphasizes a broad system view of design and fitting the organization to the person or persons within the organization (Carayon, et al., 2013). Macroergonomics is an important approach to enhancing healthcare quality and patient and employee safety (Carayon, et al., 2013; Fray, Waterson, & Munro, 2015). Therefore, macroergonomics deals with the overall work system design. Macroergonomics is a holistic work system design methodology, and its foundations are said to be in sociotechnical theory and general systems theory (Hendrick, 2008). There are different types of macroergonomic methods being developed, with the sociotechnical systems theory being one of them. Organizational design and management factors are best understood in a sociotechnical work system context (Hendrick & Kleiner, 2001).

According to Sommerville & Baxter (2010), the term ‘socio-technical systems’ was originally coined by Emery and Trist in 1960 to describe systems that involve complex interactions between humans, machines, and the environmental aspects of the work system; nowadays, these interactions are true of most enterprise systems. Sociotechnical theory is based upon general systems theory which sees systems as composed of autonomous yet interdependent parts that mutually interact as part of a purposeful whole (Whitworth, 2009). Socio-technical systems theory defines systems as a collection of messy, complex, problem-solving components (Dwyer, 2011). It states that effective work sites have joint optimisation of their social and technological systems, and that work groups should have sufficient autonomy to control key variables in the work process (Kleiner, Hettinger, DeJoy, Huang, & Love, 2015) . Socio-technical theory was developed to address organizational work-related social and technical issues simultaneously and is based on the concept that performance of a system can be improved if social and technical aspects of a system are treated together during the design process (Clegg, 2000). A sociotechnical system is the synergistic combination of humans, machines, environments, work activities and organizational structures and processes that comprise a given enterprise (Carayon, et al., 2015). The concept indicates that there should be three key considerations for an organizational design. Technical system design considerations focus on the optimised use of equipment, machinery, processes, procedures, physical work settings and arrangements, types of production technology and flexibility etc. (Hussain, et al., 2014). Furthermore, social design considerations include workers’ attitudes, behavioural styles, organisational culture, degree of communication openness, organisational power structure, reward system, values, etc. (Hussain, et al., 2014). Sociotechnical systems theory has, at its core, the notion that the design and performance of new systems can be improved, and indeed can only work satisfactory, if the ‘social’ and ‘technical’ components are brought together and treated as interdependent aspects of a work system (Clegg, 2000). The coordination between the human and technical activities can only be successful and meaningful if one system is supportive of the other, owing to the interdependence of all systems, since a change in one system inevitably affects the other systems (Eason, 2008; Gorejena, Mavetera, & Velempi, 2016). Improvements in sociotechnical design principles and practice should contribute to enhanced levels of performance, where this can be interpreted to include operational measures such as effectiveness and productivity,

along with psychological indicators concerned with well-being and attitudes (Clegg, 2000). When he formulated his principles of sociotechnical system design, Cherns (1976 & 1987) included ‘minimal critical specification’ by which he meant that designers should leave as much flexibility as possible so that people can make adjustments to match the system to what they needed in their work situation (Eason, 2008).

Another important area to focus on is to achieve organisational design inclusivity by understanding, highlighting, and promoting design practices that can minimise the effects of individual differences and variations (Nadler, 1998). Individual differences matter in the workplace due to varying levels of physical, physiological, and cognitive capabilities; differences in the level of skill, experience, cultural background, and attitude towards work (Sharma & Devi, 2011). This means that special considerations are made to achieve organisational design optimization by valuing differences at an individual level and proactively integrating these within the system design process so that the adverse effects of diversity can be minimized (Hussain, et al., 2014).

Fundamentally, sociotechnical approaches to workplace safety emphasise the critical importance of design across the sociotechnical continuum (Kleiner, Hettinger, DeJoy, Huang, & Love, 2015). The design of sociotechnical systems should aim to enhance quality of working life and improve system performance (Carayon, et al., 2015). Given the dramatic growth in complexity of everyday work systems, sociotechnical systems thinking can perhaps most usefully be thought of as providing a set of constructs, objectives, and methods to assist vital efforts towards joint optimisation of system components and interrelationships (Kleiner et al., 2015).

The Systems Engineering Initiative for Patient Safety (SEIPS) model

A work system involves the following components: (1) two or more persons, interacting with some form of (2) technology (hardware and/or software, procedure), (3) an internal work environment (both physical and cultural), (4) external environment (with nested sub-environments) and (5) an organisational design and management subsystems (Kleiner, Hettinger, DeJoy, Huang, & Love, 2015). Organisation of work and job design are the key areas where effective contribution of socio-technical design approach has been recognised (Baxter & Sommerville, 2011).

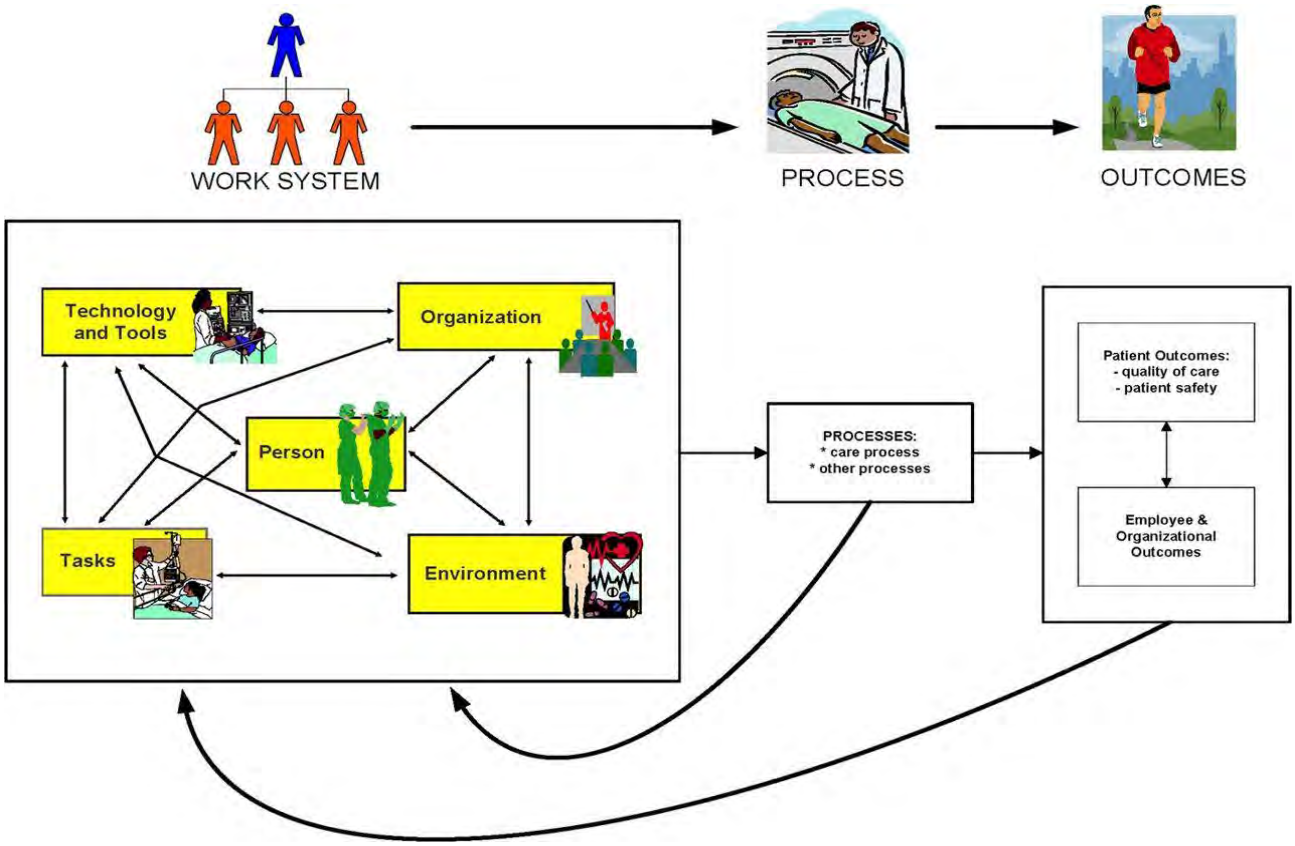

Figure 1: The SEIPS Model of Work System and Patient Safety (Carayon, et al., 2006)

The SEIPS model depicted in Figure 1 is a dynamic model where work systems may adapt in response to different patient care processes and outcomes (Carayon, et al., 2014). The SEIPS model was developed by Carayon and collegues specifically to address patient safety and other organizational, employee, and patient outcomes for healthcare work systems (Steege & Dykstra, 2016). The model outlines five components for the work system structure: person, organization, task, environment, and tools and technology; and in its subsequent SEIPS 2.0 version, the ability of the system to adapt and respond to the effects of external forces on the work system (Carayon et al. (2006); Holden et al. (2013)). According to the work system model, a person (such as a care provider, or another employee of a healthcare institution such as an Orthotists and Prosthetist) performs a range of tasks using various tools and technologies (like the computer numerical control technology), within a certain physical environment (the workshop and consultation rooms) and under specific organizational conditions (Carayon, et al., 2014). The SEIPS model emphasizes the relationships between components of the system and the importance of considering the entire system when evaluating healthcare processes and outcomes (Steege & Dykstra, 2016). The structure of an organization (or, more generally, the work system) affects

how effectively care is provided (the process); and the means of caring for and managing the patient (the process) affects how safe the patient is (outcome) (Carayon, et al., 2006).

Work System of Orthotics and Prosthetics

The need for ergonomics in healthcare in the United Kingdoms has been recognised since the inception of the profession and discipline; however, development and growth have been slow (Hignett, Carayon, Buckle, & Catchpole, 2013). The situation is assumed to be worse in South Africa, as very little research has been published on healthcare and ergonomics. Healthcare is directly or indirectly associated with the provision of health facilities to individuals (Hamid et al., 2018).

Healthcare workers face a wide range of hazards on the job, including slips, trips and falls, exposure to noise and chemicals such as glutaraldehyde, ethylene oxide and drugs; and biological hazards comprise needle stick injuries, exposure, and susceptibility to infections such as tuberculosis, hepatitis and HIV/AIDS occurring through direct and indirect body contact (Hamid et al., 2018). Occupational exposure hazard outcomes include musculoskeletal (MSD) hazards - associated with animate and inanimate load handling and static postures; environmental hazards in the workplace such as fire, security, lighting, temperature; equipment-related hazards such as poor usability, lack of maintenance, lack of electrical and protective equipment such as PPE; and stress and burnout due to high work demands and organisational changes (Hignett, Carayon, Buckle, & Catchpole, 2013).

In comparison to other allied healthcare professionals, O&Ps are exposed to a combination of clinical and manufacturing environments, which expose them to a range of hazards during the fabrication of orthoses and prostheses (Anderson, Stuckey, & Oakman, 2016). Many jobs in healthcare involve a wide range of physical actions that are performed under sub-optimal conditions and could place workers at risk for accidents and injuries (Jagannath & Adalarasu, 2012). The common jobs within healthcare comprise of pushing, pulling, reaching, bending, stretching, lifting, lowering, sitting, and standing, walking, and carrying (Jagannath & Adalarasu, 2012). O&Ps face high ergonomic risks (the likelihood of negative outcomes occurring) and therefore have greater potential for the development of musculoskeletal problems along with other work associated injuries (Hamid et al., 2018). This stressful situation can be

aggravated by physical discomforts in the workplace as healthcare workers are at high potential risk of physical strain that can lead to musculoskeletal disorders (MSD) (Jagannath & Adalarasu, 2012). In general, healthcare workers are at high potential risk of physical strain that can lead to musculoskeletal disorders (MSD) (Jagannath & Adalarasu, 2012). Physical hazards are mainly attributed to manual handling of patients and excessive workloads such as awkward or static postures during treatment of patients is another cause of stresses and strains (Hamid et al., 2018).

In addition to the physical demands, caring for patients often involves dirty, and cognitively difficult situations in which the patients can be both mentally and emotionally vulnerable (Hignett et al., 2013). Cognitive load can be thought of as the amount of mental activity imposed on working memory, which may come from competing mental tasks, environmental factors, our own psychological or physiological state (e.g., fatigue), as well as from the demands inherent in the task at hand (i.e., intrinsic cognitive load) (Burgess, 2010).

Impaired mental health in nurses and allied health professionals affects several aspects of their work functioning, including cognitive aspects (e.g., staying alert) and causing incidents at work (Ketelaar, et al., 2013). Healthcare professionals who experience higher levels of cognitive load make poorer medical decisions and provide poorer care for all patients, due to lower levels of controlled processing (Burgess, 2010). Numerous studies have shown that fatigue, sleep deprivation, chronic and acute stress, and anxiety significantly deplete working memory and diminish mental processing ability (Burgess, 2010). There also is evidence that physiological and psychological impairments diminish healthcare professionals' performance in healthcare settings. For example, studies of physicians, residents, nurses, and paramedics have found that higher levels of acute and chronic stress, fatigue, psychological distress, depression, and burnout are associated with a greater likelihood of making medical errors and providing suboptimal or poorer patient care.

In summary, at its core, sociotechnical theory has the notion that the design and performance of work systems can be improved, and indeed can only work satisfactory, if the 'social' and 'technical' components are brought together and treated as interdependent aspects of a work system (Clegg, 2000). The human and technical components of an O&P work system, such as the machines, tools, material handling,

and the personnel are all interdependent and the coordination between the human and technical activities can only be meaningful if one system is supportive of the other, owing to the interdependence of all systems, a change in one system affects inevitably the other systems (Gorejana et al., 2016). Improvements in sociotechnical design principles and practice should contribute to enhanced levels of human performance, where this can be taken to include operational measures such as effectiveness and productivity, along with physical and psychological indicators concerned with health and well-being (Clegg, 2000).

CHAPTER 3 - METHODOLOGY

RESEARCH DESIGN

This research explored the systemic challenges and enablers influencing Orthotists and Prosthetists (O&Ps) working in the O&P workshops in the public and private sectors in the Eastern Cape province of South Africa. Given the lack of literature about the work system of O&Ps, a quantitative research approach was adopted as a first step in determining systemic factors influencing O&Ps well-being and performance. Quantitative research can be construed as a research strategy that emphasizes quantification in the collection and analysis of data (Bryman, 2012). This type of research was deemed suitable for this research project as the purpose of this study was to explore the contextual factors of a group of professional O&Ps in the EC. Quantitative research is a way to learn about a particular group of people, known as a sample population (Allen, 2017), and collecting a broad range of data was considered necessary to understand the work system within which O&Ps work and are affected by.

This research study used a descriptive questionnaire-based approach aimed at identifying the socio-technical interactions in the work systems of O&Ps in the Eastern Cape province of South Africa.

STUDY POPULATION

The Eastern Cape province has three public/state-owned and approximately 15 privately-owned O&P workshops, whose employees were all approached to participate in this study. The study population included Medical O&Ps and Orthopaedic Footwear Technicians (OFTs) as both occupations perform clinical and manufacturing work. O&P technicians and assistants were excluded from participation in the study as they do not engage with patients or participate in any clinical activities. It was considered important to incorporate individuals who partake in a combination of clinical and manufacturing work as this gives a clear understanding of the full scope of work activities in the system within which O&Ps are expected to operate.

A convenience sampling method was adopted as a primary recruitment strategy, as well as snowball sampling as a secondary recruitment method. The database of the

Health Professions Council of South Africa (HPCSA) was consulted, together with the database of the South African Orthotic and Prosthetic Association (SAOPA). The HPCSA database publicly lists all healthcare providers in South Africa both within the public or private healthcare sector. However, the HPCSA database may be not always be accurate as healthcare professionals do not necessarily update personal details consistently; for example, when relocating to another province, the current address on the website may not be updated. Alternatively, names and details may not be removed when O&Ps are longer practising within the profession. Therefore, in addition to consulting the HPCSA and SAOPA databases, the provincial Eastern Cape Department of Health (ECDoH) was contacted to request permission to conduct this study and to request the exact number of medical O&Ps and OFTs employed within the public health sector in the Eastern Cape. Unfortunately, the ECDoH was unable to assist with the number of O&Ps employed in the public health sector as their system has no information specific to O&Ps.

For O&Ps practicing in the private sector, the SAOPA database was consulted. Only those individuals listed as currently practicing in the Eastern Cape were selected for the study. Information extracted from the various databases included the name, place of work and contact details, such as a telephone number or email address. This information was merely used to contact suitable candidates to inform them about the study and ask whether they wanted to participate. Each private O&P workshop was contacted, and permission requested from the owner or manager to conduct research on their staff. If permission was granted, the researcher requested the employer to kindly supply additional contact numbers and emails of relevant staff members who were eligible to participate in the study but may not be appearing on the databases.

In addition to extracting information of O&Ps from various databases and contacting O&P workshops, a secondary recruitment strategy was employed, namely the snowball sampling method. Snowballing is not a purely random sampling method but a type of convenience sampling method and is usually done where potential participants/ subjects are difficult to find (Bryman, 2012). In this study, participants were asked to recommend other potential participants. Some O&Ps who had agreed to participate in the study also referred their colleagues by requesting permission to share their contact details with the researcher.

MATERIALS AND TOOLS

A self-developed questionnaire was used as the instrument of data collection for the study and was estimated to take participants 30-35 minutes to complete. The use of a self-developed questionnaire was necessary because there are no questionnaires specific to O&Ps' work systems and the researcher needed a questionnaire that only queried the information relevant to the objectives of this study. A self-designed questionnaire interrogating the work system was needed as alternative surveys, such as the COPSOQ does not interrogate factors such as the physical work environment, or aspects such as tools, machines, and materials, which were considered important in this particular work system. The questionnaire was structured according to the components of the SEIPS model by Carayon et al. (2006). The questionnaire consisted of closed-ended questions written in English with two open-ended questions at the end. The questionnaire, which is attached as Appendix A, consisted of two sections:

Section I: This part of the questionnaire contained biographical questions regarding personal information, professional information, and educational background as these could influence work performance and health and well-being.

Section II: This section interrogated the work of the O&Ps by looking at their work demands and work conditions to identify the factors that influence or affect O&Ps in within their jobs. Participants answered questions on the socio-technical systems components, such as organizational set-up, environmental exposure, work demands, and tools, machines and materials used. Organizational set-up questions were asked to understand the management structure, and work relationships of O&Ps with their managers and colleagues as they must work together to achieve the common goals of the workshops that they work in. Environmental exposure questions investigated the well-being of O&Ps in their workshops by looking at the physical design and layout of the workshops as well as exposure to dust, heat, light, and noise. Work demand questions were focused on identifying perceived physical and cognitive demands, and questions about tools, machines and equipment were asked as these are important for O&Ps to complete their work efficiently and effectively. It was also necessary to investigate the self-reported health and well-being of O&Ps as well as work output. The overall health of each employee is fundamental to the productivity, effectiveness, and efficiency to achieve the

common goals of the workshop. In O&P workshops, the goal of work is to manufacture devices and deliver to them patients. It is important to know how much work is accomplished over a certain period to be able to note areas of success and improvements required.

The questions within the questionnaire were mostly closed questions. This was to enhance ease of answering, comparability of the answers, and to reduce the possibility of variability when analysing the data (Bryman, 2012). Another advantage of using closed questions is that they can be pre-coded, thus turning the processing of data for computer analysis into a simple task (Bryman, 2012). A 6-point Likert scale, ranging from ‘strongly disagree’ to ‘strongly agree’ was therefore used in the closed ended questions in Section 2. A Likert scale is a psychometric scale that has multiple categories from which respondents choose to indicate their opinions, attitudes, or feelings about a particular issue (Nemoto & Beglar, 2014). The highest score was allocated to those who agreed the most and the lowest score to those who strongly disagreed, e.g., ‘strongly agree’ was scored 6, ‘agree’ was scored 5, ‘agree somewhat’ was scored 4, ‘disagree somewhat’ was scored 3, ‘disagree’ was scored 2, and ‘strongly disagree’ was scored 1.

The two last questions in section 2 were open-ended questions that gave the respondents the opportunity to add any further information relevant to the study or share their opinions relating to the study.

Translation of the questionnaire was not necessary as the O&P course is offered in English in all South African universities and assumptions could be made that all participants were well-versed in the English language. The questionnaire was sent to O&Ps in Rwanda and Tanzania training institutions for colleagues to check whether the questionnaire is ambiguous and had valid questions.

Validity and Reliability Analysis

Cronbach’s Alpha is an important concept in the evaluation of assessments and questionnaires. It is mandatory that assessors and researchers should estimate this quantity to add validity and accuracy to the interpretation of their data (Tavakol & Dennick, 2011). The calculation of the correlation will yield a figure, known as a coefficient, that varies between 0 (no correlation and therefore no internal consistency) to 1 (perfect correlation and therefore complete internal consistency) (Bryman, 2012).

Table 1: Observed Cronbach's alpha

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.793	.782	40

According to the use of Cronbach's alpha for validity and reliability, it is important that the observed alpha be greater than or at least equal to 0.7 (Bryman, 2012). Since the observed alpha for the questionnaire used in the current study was 0.782, the measurement instrument was considered valid in terms of what the researcher wanted to achieve. Validity is concerned with the extent to which an instrument measures what it is intended to measure, and reliability is concerned with the ability of an instrument to measure consistently (Bryman, 2012). It should be noted that the reliability of an instrument is closely associated with its validity, but an instrument cannot be valid unless it is reliable (Tavakol & Dennick, 2011). However, the reliability of an instrument does not depend on its validity (Tavakol & Dennick, 2011). In brief, the researcher was confident that the instrument (questionnaire) used was fair and consistent.

ETHICAL CONSIDERATIONS

This study was reviewed and cleared by the Rhodes University Ethical Standards Committee (RUESC) (refer to Appendix B.1 – RUESC clearance, Review Reference: 2020–1032-3299), which is a member of the South African National Health Research Ethics Committee. The application entailed considerations of risks and benefits, issues of voluntary and informed consent (Appendix C – Letter of Information), privacy, anonymity, and confidentiality, as well as feedback. In addition, gatekeeper permission was obtained from the private practices, as well as the Eastern Cape Department of Health (Appendix B.2).

PROCEDURES

Once gatekeeper permission from the Eastern Cape Department of Health for O&Ps employed in the public health sector had been granted, the researcher informed the hospitals' Chief Executive Officers, Heads of Departments and then the staff at the O&P workshops via email and instant messaging (WhatsApp). The researcher had to find alternative means of gathering data due to the COVID-19 pandemic, which

resulted in a national lockdown of the country. Travelling had been restricted and some workplaces were still not fully functional during the period of data collection due to safety precautions within the workplaces. It was therefore decided to create the questionnaire on Google Forms and distribute the link electronically using email and instant messaging (WhatsApp). Interested participants who preferred a paper version of the questionnaire were also accommodated.

When permission was granted in the private sector, the questionnaires were administered to the O&Ps privately using Google forms, sent to the participants using email and instant messaging (WhatsApp).

For both public and private sector O&Ps, the researcher gave a brief written overview of the study (refer to Appendix C) through emails and instant messaging. Before the participants could partake in the study, they were given the opportunity to ask questions. Consent was provided implicitly by filling in the questionnaire and submitting it via Google forms or returning the paper version of the questionnaire to the researcher. Participants could withdraw their participation in the study at any time by not submitting the questionnaire. The questionnaire on Google Forms was open from the 18th of May 2020 and closed on the 31st of July 2020. The last submission was recorded on the 26th of June 2020. After that, no more responses were recorded even though the form was still active.

DATA ANALYSIS

The reliability and consistency of the questionnaire was checked using Cronbach's alpha. The questionnaire responses were first processed by allocating a numerical code to each of the Likert scale responses. The closed–ended questions in this section had responses ranging from 'strongly disagree' to 'strongly agree'. The corresponding values attached to these responses were: 1, 2, 3, 4, 5, and 6, respectively. For most questions, this scoring meant that the smaller values were attached to responses that reflected negatively on the work system, whereas the larger scores were attached to responses that reflected positively on the work system. Once the data had been processed, various methods of data analysis were conducted, namely descriptive analysis, comparative analyses using general linear models, correlation analysis and content data analysis.

A descriptive analysis was necessary to emphasize the importance of the contextual understanding of social behaviour; this means that behaviour, values, etc. must be understood in context (Bryman, 2012). The data variables used to describe the data were percentages of responses, means, standard deviations, and coefficients of variation. These data were displayed in the form of graphs and tables.

A comparative analysis between the public, private and both sectors was conducted using the mean scores for each work component and for each outcome. These were compared to one another to determine whether the one or other component was rated significantly better or worse than the other components, or to determine whether there was a significant difference between the outcomes. The General Linear Models option of comparing the rating scores of the work system components with one another was used, and so were the outcomes on the workers with one another. Statistical details included a 95% confidence interval (p-value of 0.05), and a Tukey post-hoc test was conducted to locate the significant differences.

For the correlation analyses, a Pearson's correlation was used. Correlation is a measure of the strength and direction of the relationship between two variables (Bryman, 2012) such as interval/ratio variables and/or ordinal variables (Schober, Boer, & Schwarte, 2018). Pearson's correlation coefficient measures the statistical relationship, or association, between two continuous variables (Franzese & Luliano, 2019). A positive correlation indicates that the two variables move in the same direction; with a +1.0 correlation when they move in tandem, while a negative correlation coefficient indicates that they move in opposite directions (Schober, Boer, & Schwarte, 2018). A correlation of zero suggests no correlation at all (Franzese & Luliano, 2019). Correlation coefficients were interpreted as per Table 1.

Table 2: Rule of thumb for interpreting the size of a correlation coefficient (Franzese & Luliano, 2019).

Size of Correlation	Interpretation
0.90 to 1.00 (-0.90 to -1.00)	Very high positive (negative) correlation
0.70 to 0.90 (-0.70 to -0.90)	High positive (negative) correlation
0.50 to 0.70 (-0.50 to -0.70)	Moderate positive (negative) correlation
0.30 to 0.50 (-0.30 to -0.50)	Low positive (negative) correlation
0.00 to 0.30 (0.00 to -0.30)	Negligible correlation

The open-ended questions at the end were analysed using content analysis. Current applications of content analysis show three distinct approaches: conventional, directed, or summative. A directed approach was chosen for this study, as analysis starts with a theory or relevant research findings as guidance for initial codes (Hsieh & Shannon, 2005). The researcher used the result of the descriptive analysis to identify common constructions and emerging concepts.

CHAPTER 4 - RESULTS

This chapter presents the results for socio-demographic data, and responses to the questionnaire using descriptive analyses, parametric analyses, correlation analyses and content analysis of the open-ended questions. A comparison of the private versus public sectors are also conducted. The statistical tables can be found in Appendix D.

SOCIO-DEMOGRAPHIC DATA

46 O&Ps responded to the questionnaire – 44 responses were submitted online, while the remaining two were received in paper format. Three online responses were deleted as the respondents were not practicing in EC, nor were they in South Africa (one of the respondents was in Botswana and two were in Namibia). A total of 43 responses were therefore used in the study, 41 of which were responses submitted online remained, and two paper format responses. The response rate of the study was approximately 87.75% (based on an estimated total number of 49 O&Ps in the Eastern Cape province), with 53.5% of respondents being male and 46.5% female. The minimum age of the respondents was 24 years, and the oldest respondent was 53 years old. The average recorded age of the respondents was 34.38 years and the age variation of the respondents calculated using the coefficient of variation (CV) was 19.45%. The race distribution of the respondents was 92.9% Black (African), 4.8% White (Caucasian) and 2.4% Asian. While 95.3% of the respondents felt they were in good health, 4.7% felt they were not in good health. Health issues identified included depression and diabetes mellitus. Also, two (4.7%) of the respondents had a disability, while one (2.3%) preferred not to say whether they had a disability, or not.

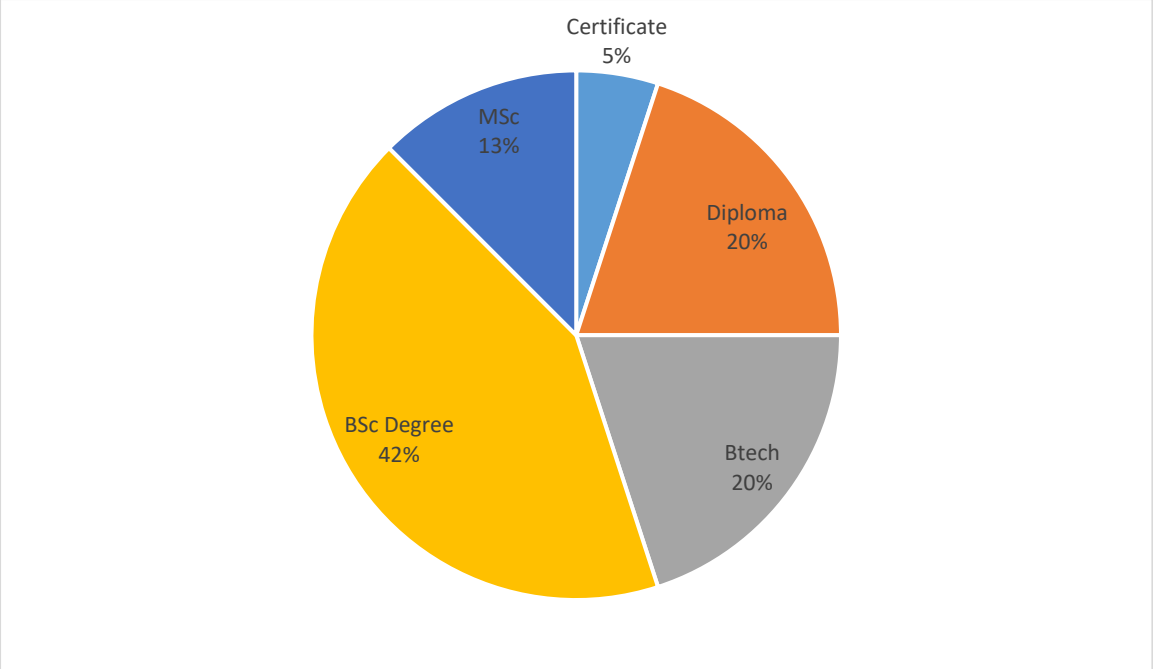

Figure 2: Respondents' qualification/training in Orthotics and Prosthetics

Orthotics and Prosthetics is an established discipline in the field of health science and therefore requires formal training and education according to the 2005 published WHO guidelines for training personnel in developing countries. 42.5% of respondents had a Bachelor of Science (BSc) degree, 20.0% had obtained a Bachelor of Technology (BTech), 20.0% had a Diploma, 12.5% a Master of Science (MSc) and 5% had obtained a Certificate. No Doctor of Philosophy (PhD) qualifications were recorded from the respondents in this study and currently, there are no registered PhD holders in O&P registered in the Eastern Cape.

Majority of the respondents (69.8%) worked in the public health sector, 23.3% worked in the private health sector and 7.0% divided their time between both the private and public health sectors. The number of years the respondents had worked in the public health sector ranged from 1 year to 27 years, with an average of 7.69 years (SD=6.10 years; CV=79.31%). In the private health sector, the minimum number of years worked was recorded as 0 years. It is however uncertain whether this should be interpreted as the respondent never having worked in the private health sector before, or only having worked for a few months in the private health sector. The maximum number of years worked by the respondents in the private sector was 7 years with a mean of 2.33 years (SD=2.13 years; CV 91.30%).

Only 29.3% of the respondents had worked in other provinces outside the Eastern Cape but within South Africa, while 70.7% of the respondents had only worked in the Eastern Cape. Most of those who had worked outside the Eastern Cape had worked in the Gauteng province (7 respondents), some in Free State (3 respondents), and a few had worked in North-West (1 respondent), KwaZulu-Natal (1 respondent) and Western Cape province (1 respondent).

WORK SYSTEM ENABLERS AND CHALLENGES

Descriptive Analysis

Section two of the questionnaire interrogated various aspects of the O&Ps' work system to determine the work systems enablers and challenges faced. Questions focused on the different macro- and micro-ergonomic factors, such as the organization, environment, work demands, tools/machines/materials, as well as the outcomes of their interactions on health & well–being, and productivity.

In the following tables, the most frequently answered responses have been shaded. Furthermore, as part of the analysis all responses that agreed with a statement (i.e., strongly agree, agree, agree somewhat, and hereinafter collectively referred to as "agreed") were added up, as were all the responses that disagreed with a statement (i.e., strongly disagree, disagree, disagree somewhat; collectively referred to as "disagreed").

Table 3: Results (sample size (N)), mean rating score, standard deviation (SD)) of responses to the questions relating to "Organization".

S/No	Item	N	Mean	SD	Strongly Disagree	Disagree	Disagree Somewhat	Agree Somewhat	Agree	Strongly Agree
1										
1.1	I have a competent manager/ supervisor with adequate knowledge of an O&P's job.	43	4.30	1.37	4 (9.3%)	2 (4.7%)	0 (0%)	12 (27.9%)	20 (46.5%)	5 (11.6)
1.2	I have a good manager who looks after the interests of the employees and is fair.	43	4.23	1.23	3 (7.0%)	1 (2.3%)	4 (9.3%)	13 (30.2%)	19 (44.2%)	3 (7.0%)
1.3	I am remunerated on time, including for my overtime hours.	42	4.57	1.25	0 (0%)	5 (11.9%)	2 (4.7%)	9 (21.4%)	16 (38.1%)	10 (23.8%)
1.4	I have regular working hours.	43	4.63	1.22	1 (2.3%)	4 (9.3%)	2 (4.7%)	2 (4.7%)	28 (65.1)	6 (14.0%)
1.5	On average, I work a maximum of 40 hours a week.	43	4.77	1.07	0 (0%)	2 (4.7%)	5 (11.6%)	3 (7.0%)	24 (55.8%)	9 (20.9%)
1.6	I receive an annual performance bonus/ payment.	43	4.36	1.50	2 (4.7%)	6 (14.0%)	1 (2.3%)	9 (20.9 %)	14 (32.6%)	10 (23.3%)
1.7	I have sufficient task diversity (i.e., I employ a wide range of skills / activities during my daily work)	43	4.56	1.48	4 (9.3%)	1 (2.3)	3 (7.0%)	5 (11.6%)	19 (44.2%)	11 (25.6%)
1.8	There is good collaboration/ teamwork with other health disciplines (physiotherapists, occupational therapists, surgeons, etc.).	43	4.16	1.66	6 (14.0%)	2 (4.7%)	5 (11.6%)	4 (9.3%)	18 (41.9%)	8 (18.6%)

The respondents mostly agreed to having a good organizational structure at their workplaces. Many of the respondents felt that they had good managers with adequate knowledge of the job (86.0%), and managers/supervisors who looked after their interests (81.4%). Between 83.3% and 83.7% of respondents also responded that they were remunerated on time, including for overtime work, that they worked regular hours and that they worked a maximum of 40 hours a week. Over three-quarter of respondents confirmed that they received an annual performance bonus payment and

most respondents (81.4%) also confirmed that they had sufficient task diversity. However, although most respondents (69.8%) felt that they had a good collaboration/teamwork with other health disciplines, almost a third of respondents (30.2%) felt that this was not the case (question 1.8). This is also evident in the standard deviation for question 1.8 which had the largest variance of all questions in Section 1.

Table 4: Results (sample size (N), mean rating score, standard deviation (SD)) of responses to the questions relating to "Environment".

S/No	Item	N	Mean	SD	Strongly Disagree	Disagree	Disagree Somewhat	Agree Somewhat	Agree	Strongly Agree
2										
2.1	The physical layout of the workshop promotes good workflow.	43	4.16	1.43	2 (4.7%)	6 (14.0%)	3 (7.0%)	11 (25.6%)	14 (32.6%)	7 (16.3%)
2.2	The workshop is well ventilated to prevent dust exposure.	42	3.93	1.42	2 (4.8%)	7 (16.7%)	5 (11.9%)	11 (26.2%)	12 (28.6%)	5 (11.9%)
2.3	The workshop has a functional chemical extraction system.	43	3.44	1.48	4 (9.3%)	11 (25,6%)	6 (14.0%)	8 (18.6%)	12 (27.9%)	2 (4.7%)
2.4	There is sufficient lighting in the different areas of the workshop.	42	4.19	1.21	2 (4.8%)	3 (7.1%)	4 (9.5%)	11 (26.2%)	20 (47.6%)	2 (4.8%)
2.5	The temperature in the workshop is well adjusted and controlled (temperature is not too hot or cold, but at ambient temperature).	43	3.47	1.58	7 (16.3%)	7 (16.3%)	5 (11.6%)	9 (20.9%)	13 (30.2%)	2 (4.7%)
2.6	I am provided with ear protection gear from noise.	43	3.53	1.74	7 (16.3%)	10 (23.3%)	2 (4.7%)	5 (11.6%)	15 (34.9%)	4 (9.3%)
2.7	We have gloves for molding (molding gloves).	43	4.47	1.50	5 (11.6%)	1 (2.3%)	1 (2.3%)	6 (14.0%)	22 (51.2%)	8 (18.6%)
2.8	We have gloves for welding (welding gloves).	43	4.37	1.46	4 (9.3%)	3 (7.0%)	0 (0%)	9 (20.9%)	20 (46.5%)	7 (16.3%)
2.9	I have goggles for eye protection during welding and machining.	43	4.91	0.89	1 (2.3%)	0 (0%)	0 (0%)	9 (20.9%)	24 (55.8%)	9 (20.9%)
2.10	I have protective clothing for working (e.g., lab coat, apron, work coat, safety boots)	43	4.58	1.40	3 (7.0%)	2 (4.7%)	3 (7.0%)	3 (7.0%)	23 (53.5%)	9 (20.9%)
2.11	We have good housekeeping practices to ensure cleanliness and neatness.	43	4.63	0.90	0 (0%)	1 (2.3%)	3 (7.0%)	13 (30.2%)	20 (46.5%)	6 (14.0%)
2.12	There is sufficient lighting in the consultation rooms.	43	4.91	0.95	0 (0%)	1 (2.3%)	3 (7.0%)	6 (14.0%)	22 (51.2%)	11 (25.6%)
2.13	The consultation rooms are well ventilated to allow proper airflow.	42	4.57	1.19	0 (0%)	4 (9.5%)	2 (4.8%)	12 (28.6%)	14 (33.3%)	10 (23.8%)

2.14	I have gloves for clinical consultations (e.g., latex gloves).	43	4.91	1.21	1 (2.3%)	3 (7.0%)	0 (0%)	5 (11.6%)	20 (46.5%)	14 (32.6%)

Respondents generally responded positively to questions about their work environments; however, four questions highlighted some environmental concerns. Most participants strongly agreed, agreed, or somewhat agreed that they worked in well-designed workshops (85.3%) and were provided with some of the necessary protective gear. They also generally agreed that the workshops had favourable environmental conditions such as lighting (78.6%), temperature (55.8%), and noise. However, there were some variations on how respondents perceived their working environments. For example, 33.4% of respondents disagreed that they worked in a well-ventilated workshop (question 2.2), 48.9% disagreed about their workshop having a functional chemical extraction system (question 2.3), 44.2% of the respondents felt the temperature in the workshops was not favourable (question 2.5) and 44.3% of respondents were not provided with ear protection gear to safeguard them from noise (question 2.6). Having said that, respondents felt they were adequately supplied with the rest of the personal protective equipment, such as moulding gloves, welding gloves, goggles, and protective clothing (83.8%, 83.7%, 97.6%, and 81.4% respectively). Furthermore, good housekeeping seemed to be standard practice in all workshops, with 90.7% responding positively to this question. Finally, consultation rooms were reported to have good lighting, be well ventilated, and have sufficient supply of latex gloves for consultations (90.8%, 85.7% and 90.7% respectively).

Table 5: Results (sample size (N), mean rating score, standard deviation (SD)) of responses to the questions relating to "Work Demands".

S/No	Item	N	Mean	SD	Strongly Disagree	Disagree	Disagree Somewhat	Agree Somewhat	Agree	Strongly Agree
3										
3.1	Tasks are physically demanding.	43	4.70	1.21	2 (4.7%)	2 (4.7%)	0 (0%)	7 (16.3%)	24 (55.8%)	8 (18.6%)
3.2	I have enough time to complete tasks.	43	4.30	1.19	3 (7.0%)	1 (2.3%)	2 (4.7%)	13 (30.2%)	22 (51.2%)	2 (4.7%)
3.3	Most tasks are completed in standing positions.	43	4.86	1.19	1 (2.3%)	2 (4.7%)	2 (4.7%)	5 (11.6%)	20 (46.5%)	13 (30.2%)
3.4	Work is regularly done in awkward/non-neutral postures (e.g., bending and twisting)	43	4.16	1.29	0 (0%)	8 (18.6%)	2 (4.7%)	14 (32.5%)	13 (30.2%)	6 (14.0%)
3.5	I regularly do a lot of heavy load lifting on the job.	43	4.23	1.32	0 (0%)	8 (18.6%)	3 (7.0%)	9 (20.9%)	17 (39.5%)	6 (14.0%)
3.6	I regularly encounter repetitive movements when completing some tasks.	43	4.65	0.97	0 (0%)	2 (4.7%)	2 (4.7%)	12 (27.9%)	20 (46.5%)	7 (16.3%)
3.7	Tasks are regularly cognitively demanding (e.g., problem-solving, memory and decision-making).	43	4.81	0.96	1 (2.3%)	0 (0%)	2 (4.7%)	8 (18.6%)	24 (55.8%)	8 (18.6%)

As with the work organization and the environmental conditions, there was general consensus amongst the O&Ps' impressions of the work demands. Respondents agreed that tasks were physically demanding (90.7%), most tasks had to be completed in standing positions (88.3%), work was performed in awkward/ non-neutral postures (76.7%), there was a lot of heavy load lifting on the job (74.4%), and respondents regularly encountered repetitive movements (90.7%). Tasks were also considered to be cognitively demanding (93.0%). However, fortunately, most respondents (86.1%) agreed that they had enough time to complete tasks.

Table 6: Results (sample size (N), mean rating score, standard deviation (SD)) of responses to the questions relating to "Tools/Machines/Materials".

S/No	Item	N	Mean	SD	Strongly Disagree	Disagree	Disagree Somewhat	Agree Somewhat	Agree	Strongly Agree
4										
4.1	We have a good level of (up to date) technology at our disposal.	43	3.37	1.56	6 (14.0%)	10 (23.3%)	5 (11.6%)	8 (18.6%)	12 (27.9%)	2 (4.7%)
4.2	In the workshop, we have the appropriate machines to complete work tasks	43	4.05	1.33	4 (9.3%)	2 (4.7%)	5 (11.6%)	10 (23.3%)	21 (48.8%)	1 (2.3%)
4.3	In the workshop, we have well-functioning machines to complete tasks	43	4.00	1.33	3 (7.0%)	2 (4.7%)	9 (20.9%)	11 (25.6%)	14 (32.6%)	4 (9.3%)
4.4	In the workshop, we have the right tools needed to complete work tasks.	43	4.00	1.02	1 (2.3%)	1 (2.3%)	12 (27.9%)	13 (30.2%)	15 (34.9%)	1 (2.3%)
4.5	In the workshop, we have the right quantity of materials to produce orthotic/prosthetic devices.	43	3.81	1.24	3 (7.0%)	3 (7.0%)	8 (18.6%)	16 (37.2%)	11 (25.6%)	2 (4.7%)
4.6	The consultation rooms are well equipped with appropriate equipment (e.g., examination beds, tables, chairs, bed screens/ partitions, parallel bars, etc.)	43	4.42	1.20	1 (2.3%)	4 (9.3%)	2 (4.7%)	10 (23.3%)	21 (48.8%)	5 (11.6%)
4.7	We have the right quality of materials to manufacture orthotic/prosthetic devices	43	3.93	1.37	3 (7.0%)	5 (11.6%)	5 (11.6%)	12 (27.9%)	15 (34.9%)	3 (7.0%)
4.8	We do routine maintenance of machines and tools as recommended by the manufacturers.	43	3.51	1.58	5 (11.6%)	9 (20.9%)	7 (16.3%)	7 (16.3%)	11 (25.6%)	4 (9.3%)

There were noticeable differences in the responses regarding tools, machines, and materials. 51.2% of respondents agreed to have a good level of technology at their disposal, while 48.9% of the respondents disagreed with this statement (SD=1.56). Although 67.5% of respondents agreed to have the appropriate machines to perform their jobs and that these machines were well-functioning (67.5% of respondents), almost a third of respondents disagreed with these statements. Furthermore, 67.4% agreed to having the right tools to complete tasks and 67.5% said they had the right

quantity of materials for production, while 32.6% and 32.5% of respondents disagreed with these statements, respectively. Respondents also differed in opinion about routine maintenance of machines and tools as recommended by manufacturers, with 51.2% agreeing that proper maintenance was being conducted, while 48.8% disagreed. The variance for this question (SD=1.58) was the highest of all questions and indicates the greatest spread of responses.

Table 7: Results (sample size (N), mean rating score, standard deviation (SD)) of responses to the questions relating to "Health and Well-being".

S/No	Item	N	Mean	SD	Strongly Disagree	Disagree	Disagree Somewhat	Agree Somewhat	Agree	Strongly Agree
5										
5.1	Physical injuries on duty (IODs) are common occurrences in the workplace	42	2.93	1.09	3 (7.1%)	14 (33.3%)	11 (26.2%)	11 (26.2%)	3 (7.1%)	0 (0%)
5.2	Physical injuries on duty are not always reported.	42	3.92	1.31	2 (4.8%)	5 (11.9%)	7 (16.7%)	11 (26.2%)	14 (33.3%)	3 (7.1%)
5.3	I feel discomfort / pain when bending / twisting my trunk.	42	3.29	1.25	2 (4.8%)	12 (28.6%)	9 (21.4%)	11 (26.2%)	7 (16.7%)	1 (2.4%)
5.4	I feel discomfort / pain when standing for long periods.	42	3.83	1.45	3 (7.1%)	8 (19.0%)	2 (4.8%)	11 (26.2%)	16 (38.1%)	2 (4.8%)
5.5	I feel discomfort / pain when picking up / carrying heavy loads.	42	3.67	1.44	3 (7.1%)	9 (21.4%)	6 (14.3%)	6 (14.3%)	17 (40.5%)	1 (2.4%)
5.6	I am physically fatigued / exhausted at the end of the workday.	42	4.10	1.23	1 (2.4%)	5 (11.9%)	5 (11.9%)	12 (28.6%)	16 (38.1%)	3 (7.1%)
5.7	I feel mentally fatigued / exhausted at the end of the workday.	41	3.95	1.34	1 (2.4%)	7 (17.1%)	6 (14.6%)	10 (24.4%)	13 (31.7%)	4 (10.0%)
5.8	I struggle with the emotional demands of the job resulting from interacting with patients / clients.	42	3.00	1.36	4 (9.5%)	16 (38.1%)	7 (16.7%)	7 (16.7%)	7 (16.7%)	1 (2.4%)
5.9	I am frustrated by the lack of resources available for the job.	42	4.05	1.71	5 (11.9%)	6 (14.2%)	2 (4.8%)	7 (16.7%)	13 (31.0%)	9 (21.4%)
5.10	I am bored as a result of lack of task diversity.	42	3.45	1.58	4 (9.5%)	12 (28.6%)	4 (9.5%)	10 (23.8%)	7 (16.7%)	5 (11.9%)

5.11	When I am at work, I feel stressed / overwhelmed as a result of the job.	42	3.43	1.47	3 (7.1%)	11 (26.2%)	8 (19.0%)	9 (21.4%)	7 (16.7%)	4 (9.5%)
5.12	I exercise to relax and keep fit.	42	4.43	1.23	1 (2.4%)	3 (7.1%)	5 (11.9%)	7 (16.7%)	20 (47.6%)	6 (14.3%)
5.13	I attend therapy to deal with work-related pressures / stresses.	42	2.83	1.54	8 (19.0%)	16 (38.1%)	4 (9.5%)	5 (11.9%)	7 (16.7%)	2 (4.8%)
5.14	I take prescription medication to deal with stress / anxiety.	42	2.14	1.26	12 (28.6%)	23 (54.8%)	1 (2.4%)	3 (7.1%)	1 (2.4%)	2 (4.8%)
5.15	I take pain medication to deal with physical pain.	43	3.21	1.55	6 (14.0%)	13 (30.2%)	4 (9.3%)	8 (18.6%)	10 (23.8%)	2 (4.7%)
5.16	I attend physical therapy to deal with physical pain.	43	2.44	1.31	10 (23.3%)	20 (46.5%)	2 (4.7%)	6 (14.0%)	5 (11.6%)	0 (0%)
5.17	I smoke / drink to cope with stressors / pressure at work.	43	2.51	1.52	14 (32.6%)	13 (31.0%)	3 (7.0%)	8 (18.6%)	3 (7.0%)	2 (4.7%)
5.18	We have an employee wellness support program at work, for mental support and health.	42	3.45	1.50	6 (14.3%)	8 (19.0%)	4 (9.5%)	9 (21.4%)	15 (35.7%)	0 (0%)

Health and well-being of employees should be a priority in any organisation. Unfortunately, the responses from the questionnaire indicate that, overall, health and well-being of O&Ps was negatively affected. Two-thirds (66.6%) of respondents disagreed that physical injuries on duty were a common occurrence at their workplaces; however, one-third (33.3%) also believed that physical injuries on duty were not always reported. Majority of the respondents agreed to feeling discomfort/pain when standing for long periods of time (69.1%), when picking/ carrying heavy loads (57.2 %), and feeling discomfort after carrying out tasks that require bending/ twisting movements (45.3%). Ultimately, 73.8% of respondents agreed that they felt physically exhausted at the end of the workday. Similarly, many respondents acknowledged mental fatigue/ exhaustion (66.1%), yet only 35.8% reported struggles with the emotional demands of the job. 69.1% expressed frustration because of lack of resources and just over half (52.4%) boredom due to the lack of task diversity. The latter two questions (5.9 and 5.10) did however show the largest standard deviations of all questions, with 1.71 and 1.58, respectively. The respondents' opinions were divided about whether they felt stressed/overwhelmed because of the job (47.6%

supported this statement, while 52.4% disagreed). Participants also employed a range of self-care activities or coping mechanisms. Exercise and relaxation (78.6%), and the employee wellness support programme (57.1%) were the most frequently used tools to cope with the work demands and challenges, as was the use of pain medication (47.1%). Therapy (physical: 25.6% and psychological: 33.4%), prescription medication (14.3%), smoking, and drinking (30.3%) were less frequently reported coping mechanisms.

Table 8: Results (sample size (N), mean rating score, standard deviation (SD)) of responses to the questions relating to "Productivity".

S/No	Item	N	Mean	SD	Strongly Disagree	Disagree	Disagree Somewhat	Agree Somewhat	Agree	Strongly Agree
6.										
6.1	I accomplish all my tasks within the expected timeframe.	42	4.24	1.23	1 (2.4%)	4 (9.5%)	3 (7.1%)	16 (38.1%)	12 (28.6%)	6 (14.3%)
6.2	I have to put in extra effort and time to achieve my expected level of performance.	43	4.00	1.36	2 (4.7%)	7 (16.3%)	4 (9.3%)	8 (18.6%)	20 (46.5%)	1 (2.3%)
6.3	My patients always come back for frequent repairs.	43	3.12	1.20	3 (7.0%)	14 (32.6%)	6 (14.0%)	15 (34.9%)	5 (11.6%)	0 (0%)
6.4	My patients always come back for adjustments.	43	2.95	1.15	3 (7.0%)	16 (37.2%)	8 (18.6%)	12 (27.9%)	4 (9.3%)	0 (0%)
6.5	I do a lot of re-fittings on the same devices in a short period of time.	42	2.71	1.15	4 (9.5%)	20 (47.6%)	8 (19.0%)	5 (11.9%)	4 (9.5%)	1 (2.4%)

In terms of their work performance, respondents generally agreed that they completed tasks on time (81.0%), but also believed they had to put in extra effort to achieve their expected level of performance (67.4%). Respondents were divided in their opinion on the frequency of repairs demanded by their patients (46.5% agreed, while 53.6% disagreed). Majority of the respondents (62.8%) disagreed that their patients always came back for adjustments, while a further 76.1% claimed that not a lot of re-fittings of orthotic and prosthetic devises had to occur within a short period of time.

Comparative Analyses

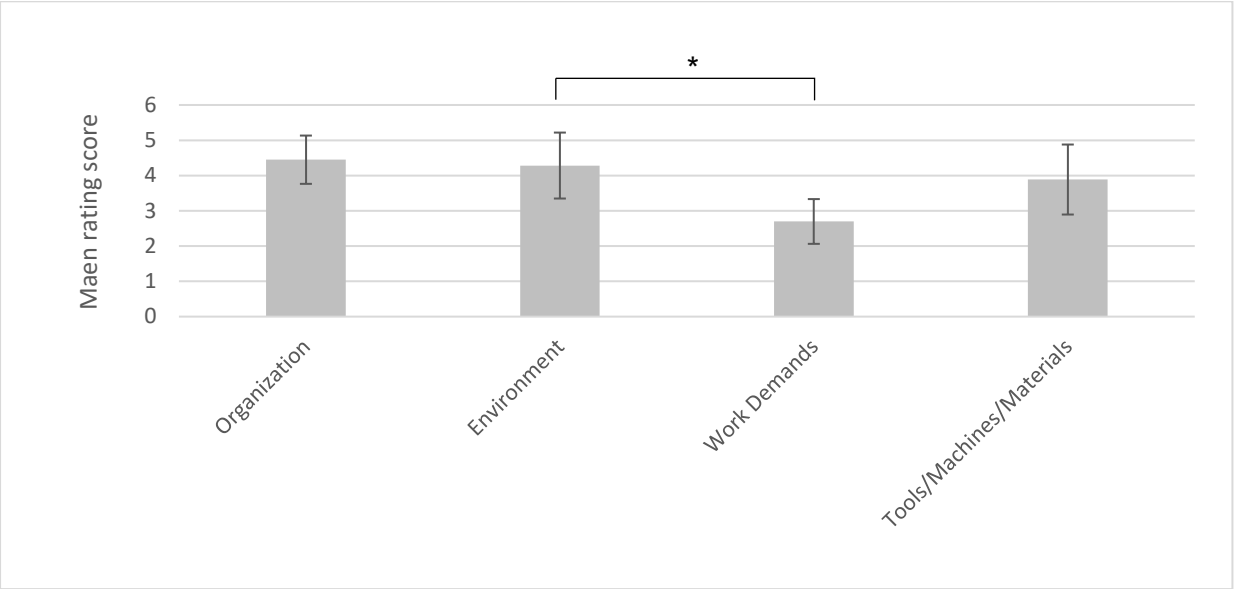

Figure 3: Mean rating scores and standard deviations of system components (brackets with asterisk indicate a significant difference at $p<0.05$).

Figure 3 shows the summary of the questions in Section 2 of the questionnaire relating to system components by depicting the mean scores of the factors that influence the O&P work systems. Since some questions on the questionnaire were negatively phrased, meaning that agreeing with a statement reflected negatively on the work system, while agreeing to other questions reflected positively on the system, reverse scoring was applied to these questions. The mean rating score of each system component (organization, environment, work demands, and tools, machines, and materials) was calculated and used to plot the summary graph. The higher the mean, the more positive the response from participants was about the work system, while lower scores reflected more negatively on the work system. The component 'Organization' had the highest mean score of 4.45, closely followed by 'Environment' with 4.28. However, 'Tools/machines/materials', as well as 'Work demands' were perceived more negatively by respondents with average scores of 3.89 and 2.70, respectively. For all the system components, the standard deviations had a low dispersion of less than 1.0 from the mean. The lowest dispersion was 0.63 and the highest dispersion from the mean was 0.99. The analysis using the general linear models option and revealed a significant difference between the scores of the work system components ($p=0.03$). The subsequent Tukey post-hoc test revealed a

significant difference in the mean rating scores between the “Environment” and “Work demands”, with a p-value of 0.03.

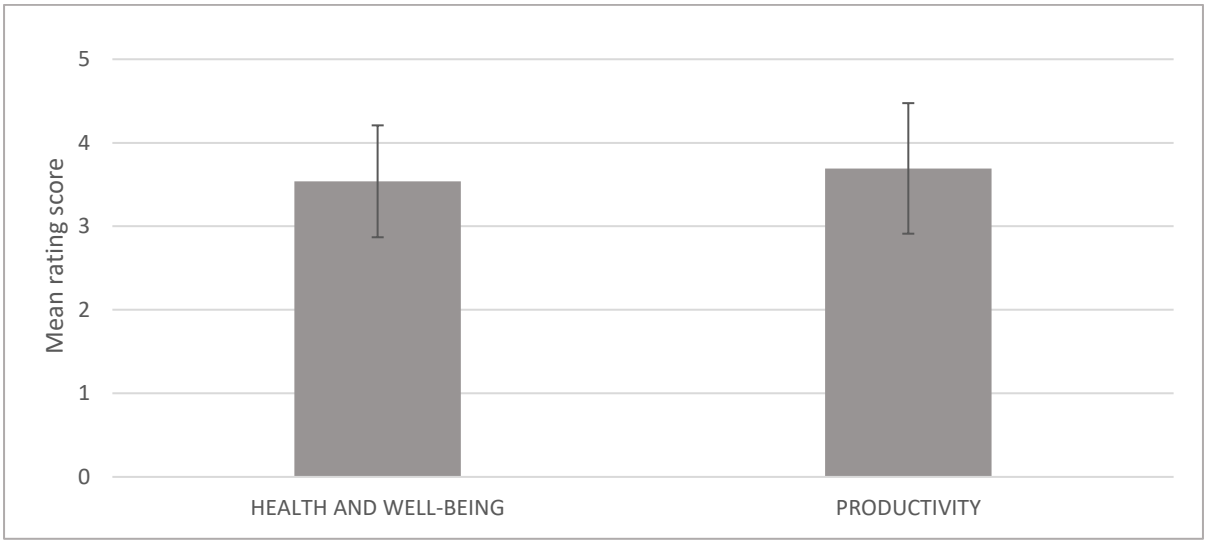

Figure 4: Outcomes of system interactions with standard deviation bars

The figure above shows the mean rating score of the outcomes of the system interactions. Health and well-being had a mean score taking of 3.74 and productivity had a mean rating score of 3.89. Both health and well-being, and productivity had a small SD variability of 0.67 and 0.78, respectively. No significant difference was found in the mean ratings between the health and well-being and the productivity outcomes.

Content Analysis of Open–ended Questions

The last two questions of the questionnaire were open-ended question. Respondents were asked if there was anything not mentioned in the questionnaire that made their job as an O&P or work in the field of O&P enjoyable. Only 19 responses were recorded. Of these, 16 respondents said they had nothing to add. However, of the remaining three respondents, one respondent merely hoped the study would bring interesting results, while another praised having a good relationship with colleagues and the third respondent stated that they were passionate about helping patients.

In the second question, participants were asked if there was anything not mentioned in the questions about factors which made their jobs as O&Ps difficult, or work in O&P difficult. 21 responses were recorded in this question. 16 respondents indicated they had nothing to add. However, five respondents referred to issues of high work

demands due to lack of material diversity, insufficient technological utilization, lack of O&P staff and patient administrative staff, lack of proper equipment and workload.

Correlation Analyses

Table 9: Correlation coefficient of “system components” versus the “outcomes” of the system interactions.

	Organization	Environment	Work Demands	Tools/ Machines/ Materials
Health & Well-being	0.971 *	0.971 *	0.958 *	0.973 *
Productivity	0.959 *	0.961 *	0.973 *	0.985 *

(Asterisked correlation coefficients indicate significant correlations at $p<0.05$)

Table 8 shows the relationships between the system components and the outcomes. The correlation coefficients indicate that there were very high positive correlations (ranging between 0.95 and 0.99) between all the system components and the outcomes of the system interactions. All correlations were found to be statistically significant.

COMPARISON OF PRIVATE VS PUBLIC SECTORS

The South African healthcare system is divided into the public and private healthcare sectors. O&Ps have the choice to work in any sector, even both, if they so choose. The following results show a summary of the responses split by sector.

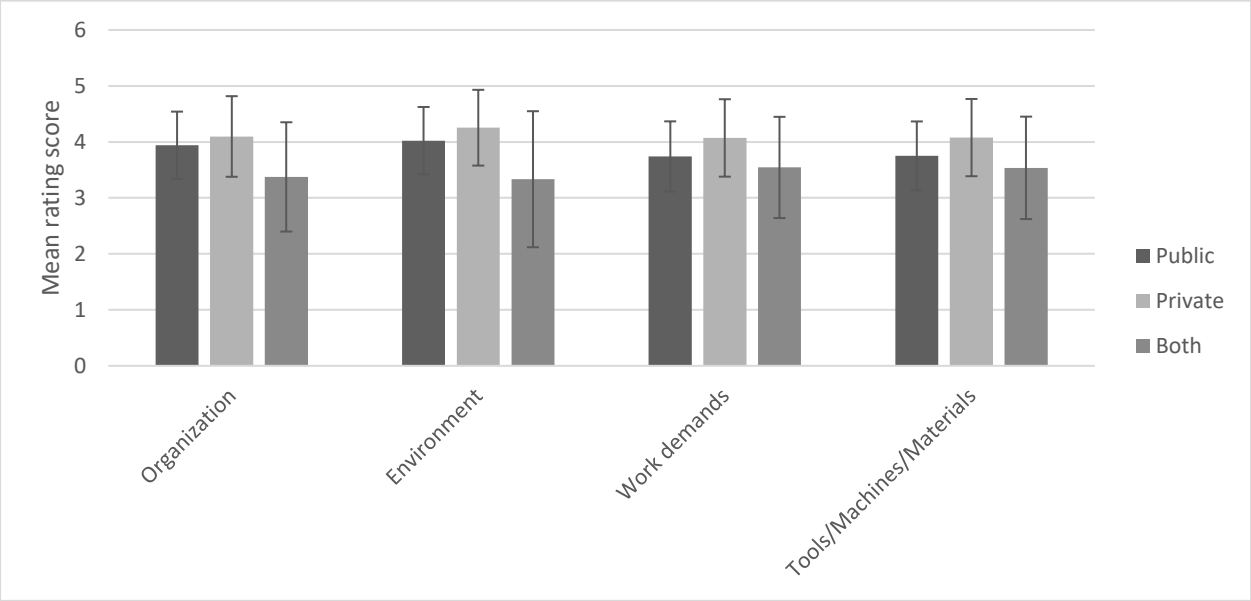

Figure 5: Summary of system components split by sector.

Figure 5 compares the mean scores of those respondents who work in the public health sector, the private health sector and those who work concurrently in both health sectors. Scores 1,2,3 indicate negative impressions, while scores 4,5,6 reflect positively on the work system component. Any score greater than 3 is thus a positive response, and the greater the score, the more positive people rate a certain component.

In the public health sector, respondents were generally happy with their organizational structure with a mean rating of 3.94 (SD=0.69); in the private health sector, respondents felt they had good organizational structure with a mean rating of 4.10 (SD=0.72); and those who worked in both sectors were happy with their organizational structure with a mean rating of 3.38 (SD=0.98). Respondents in the public health sector found their work environment pleasant with a mean rating of 4.02 (SD=0.63); respondents in the private health sector were even more pleased with the environmental conditions in their workplace, with a mean rating of 4.25 (SD=0.68). Respondents working in both sectors were pleased with their physical work

environments with a mean rating of 3.33 (SD=1.21), but not as much as respondents who only worked in one of the two sectors.

All respondents working in all sectors (mean rating of 3.74 (SD=0.60) for O&Ps in the public sector, 4.07 (SD=0.69) in the private sector, and 3.54 (SD=0.90) for O&Ps working in both sectors) were least happy with the work demands.

Respondents from both health sectors (mean rating of 3.54, SD of 0.91) were the least content with the supply of tools, machines, and materials. Respondents working in the private sector were the most satisfied (mean rating of 4.08, SD of 0.69) with the supply and provision of tools, machines, and materials. Respondents from the public health sector were satisfied with the supply and provision of tools, machines, and materials in their workplaces with a mean rating of 3.75, SD of 0.60.

Looking at Figure 5, the highest mean ratings were always in the private sector, while the lowest ratings were always in the respondents who work concurrently in both sectors. The SD was higher for responses from respondents working concurrently in both sectors as there was a very low sample size. The general linear models comparing mean rating scores for work system components in Appendix D, Table 15 shows a significant p-value of 0.028426 between the work demands and the environment.

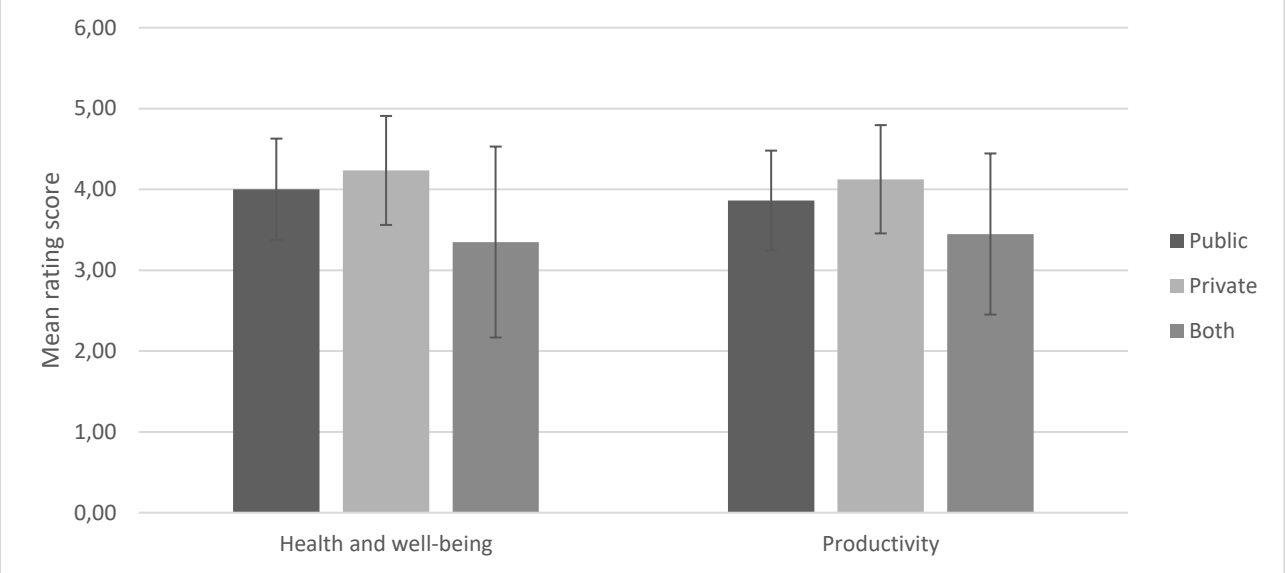

Figure 6: Outcomes split by sector

Respondents from the private health sector felt they had good health and well-being (mean rating of 4.23, SD of 0.67), as did respondents from the public health sector

(mean rating of 4.00, SD of 0.63). Respondents working in both sectors had the lowest mean rating score for health and well-being (mean rating of 3.35, SD of 1.18).

Respondents working in the public (mean rating of 3.86, SD of 0.62) and private (mean rating of 4.12, SD of 0.67) health sectors were content with their work productivity; and respondents working in both (mean rating of 3.45, SD of 1.00) of the respondents working in both sectors were the least pleased with their work productivity.

Looking at Figure 6, the highest mean rating scores were recorded in the private sector and the lowest ratings were recorded from the respondents who work concurrently in both sectors. The SD was higher for those working concurrently in both sectors due to a very low sample size.

CHAPTER 5 - DISCUSSION

A study recently published by Mduzana, Tiwari, Lieketseng, & Chikte (2020) confirmed that there is a dearth of research on Medical Orthotists and Prosthetists. In South Africa, no study has profiled the O&P workforce and identified factors that affect O&Ps in their profession. It is therefore important to understand the systems within which O&Ps operate to provide better healthcare to O&P patients, while also looking after the health and well-being of these healthcare professionals.

SAMPLE CHARACTERISTICS

According to the study conducted by Mduzana et al. (2020), the Eastern Cape was estimated to have 49 O&P in 2018. The study's response rate based on this estimate was therefore 87.75%. In a survey of a general population which aims to describe knowledge or behaviours, a 60% response rate might be acceptable, although 70% would be preferable (Fincham, 2008). The overall response rate of this study could therefore be considered very good. More males responded to the study than females, as there are said to be more male O&Ps than females in South Africa (Mduzana et al., 2020). Even so, according to Mduzana et al. (2020), the representation of females within the profession in South Africa has grown from 6.9% in 2003 to 27% in 2018, while the percentage of male O&Ps has decreased from 93.1% to 73% between 2003 and 2018, respectively.

The age variations of the respondents calculated using the coefficient of variance (CV) was 19.45%, which is quite a high ratio but is acceptable in age diversity. A CV of less than 10% is very good and a CV greater than 30% means there is a greater spread around the mean (Reed, Lynn, & Meade, 2002). The oldest respondent in the study was 53 years old, and 60% of respondents fell into the 30–39-year-old range. Age diversity in the workplace brings about different experiences, expectations, styles, and perspectives (Patrick & Kumar, 2012). Age diversity, when managed properly, can be a source of strength to a company as the older employees bring experience and the younger employees are more innovative, particularly within a manufacturing setting such as O&P workshops. However, several studies have shown that an individual's capacity for physical and mental work tends to decrease with advancing age (Garg, 1991). In general, specific demands are more likely to overtax the capacities of older workers than those of younger workers in high-demand jobs. This means there are

greater repercussions for health, although these effects also vary considerably within age cohorts (Sluiter, 2006). Aging influences health; as people age, they become more susceptible to disease and disability (McMurdo, 2000). For example, the risk for carpal tunnel syndrome increases for both men and women as they age (Jilcha, 2014). Functional tests for job-specific work ability should therefore be developed for high-demand jobs such as O&P to monitor individual functional ageing and to facilitate well-timed intervention (Sluiter, 2006). Many of the respondents felt they were in good health because most of the respondents were young, with an average age of 34.35 years.

The race distribution of the respondents was 92.9% Black (African), 4.8% White (Caucasian) and 2.4% Asian. In 2018, the profile of registered O&Ps in South Africa who identified as white was 61%, followed by Black (22%), Indian (7%) and Coloured (2%) (Mduzana, Tiwari, Lieketseng, & Chikte, 2020). In this study many of the respondents were Black, and this reflects the country's race distribution (Statistics South Africa, 2020).

Many of the respondents had only worked within the EC, and within the public sector (69.8%). Since the Eastern Cape is one of the poorer provinces in SA, even its infrastructure development is slower compared to the more developed and better resourced provinces such as Gauteng and Western Cape (Econex, 2013). Also, the infrastructure of health institutions differs between the public and private sectors. In South Africa, the private healthcare sector offers better quality healthcare services than the public healthcare sector, is better equipped and resourced, even though the public healthcare sector services most of the population (Kula & Fryatt, 2014).

In terms of training and qualifications, the data revealed that no PhDs were recorded. South Africa needs a highly skilled workforce not only to increase productivity but also to contribute to research in O&P and rehabilitation studies. In South Africa, there is a relative shortage of highly skilled workers, which could increase in the future if higher education expansion maintains its current pace (Foko, 2015). Progress in diversifying training is relatively slow in South African universities, with an increase in science and technology courses that remains inadequate compared to other middle-income countries (Foko, 2015). There is a need to foster the development of high-level skills

to support the economy's transition to high levels of productivity and innovation-driven growth (Internation Labour Office, 2011).

Workplace diversity, as evidenced from the socio-demographic data in this study, refers to the variety of differences between people in an organization (Patrick & Kumar, 2012). Diversity encompasses race, gender, ethnic group, age, personality, cognitive style, tenure, organizational function, education, background, and more (Patrick & Kumar, 2012). Workplace diversity impacts on how people interact with each other and their work environment. Health and well-being in the workplace are the outcomes of the interaction between individual characteristics and those of the working and organizational environment (Biggio & Cortese, 2013).

FACTORS THAT INFLUENCE O&P HEALTH AND WELL-BEING

For many healthcare workers across the world, unhealthy working conditions are prevalent. Health and safety of employees must always be treated as a priority by all organisations as human resources are a key factor for an organisation's success (Osborne & Hammoud, 2017). An organisation's strength is its staff, and the sustainability of the organisation depends on the physical, psychological, and spiritual health of the staff (Osborne & Hammoud, 2017). Well-being has also been shown to predict workplace safety outcomes (Kleiner et al., 2015). It is for this reason that it was important to study the factors influencing health and well-being of O&Ps within their job as these factors influence safety outcomes.

Physical Complaints during Clinical Work and Manufacturing

Healthcare workers in general face considerable ergonomic risks and therefore have greater potential for developing musculoskeletal issues along with other work-associated injuries (Hamid, et al., 2018). O&P work is physically demanding as O&Ps do a lot of manufacturing within their jobs, which in turn requires physical capabilities and skills. The interaction of O&Ps with their workplace may consist of identifying the relationship between the job physical risk factors and physiological responses (Bhattacarya, Talbott, & Kincl, 2012). Based on anecdotal evidence, when capturing the shape of the residual limb (casting) of a patient, an O&P will assume awkward positions of bending and twisting to ensure they acquire the correct mould of the negative cast. Modification of a positive cast and moulding with polypropylene (thermoplastics) or lamination with thermosetting are done in a standing position which

can cause discomfort and fatigue, especially if one is standing on hard surfaces. During modifications of orthotics or prostheses, O&Ps may need to carry and support heavy casts, depending on which part of the body was cast. For example, a positive plaster mould could weigh more than 25 kilograms (Nodooshan et al., 2015). At times carrying such devices alone is not possible and one requires assistance from co-workers. Job activities involving heavy lifting, awkward postures and high physical exertion like O&P work demands can have adverse effects over time on their bodies, specifically their cardiovascular health, and as such, O&Ps are likely to die prematurely (Petersen, et al., 2012). Excessive workload combined with time pressures for completion, or work with a high physical load and insufficient rest, results in high levels of fatigue and stress creating biological responses increasing the risk of injury including WMSD (Anderson et al., 2016). Even so, women are likely to experience more musculoskeletal symptoms than men (Campos-Serna, Ronda-Perez, Artazco, Moen, & Benavides, 2013). This might be related to differences between women and men in the exposure to work-related hazards even working under the same job title (Campos-Serna, Ronda-Perez, Artazco, Moen, & Benavides, 2013). This is because women, on the average, have smaller body dimensions, lower muscle force, and a lower aerobic capacity, therefore tasks performed with the same (absolute) exposure will, in most cases, result in a higher relative workload for women, which could lead to more complaints (Hooftman, van Poppel, van der Beek, & Bongers, 2004).

From the data collected in this study it was identified that one third of respondents had suffered physical injuries while on duty (IODs) and it is likely that injuries are not always reported. This finding corresponds with studies conducted by Hamid et al. (2018) and Anderson et al. (2016) which concluded that healthcare workers were unlikely to report MSDs or were more likely to under-report injuries and only claim compensation when seriously injured. Reasons for the underreporting could be a perceived lack of practical usefulness, issues of time and effort wasted on filling out forms and following up on a claim in a busy clinic with competing priorities, and putting the patients' needs ahead of their own (Galizzi, Miesmaa, Punnett, Slati, & PHASE IN HEALTHCARE RESEARCH TEAM, 2010).

There were notable differences between the ratings of respondents from the public and private health sectors, with more respondents working in the private sector feeling healthier than those in the public health sector. The correlation coefficients in Table 8

indicated that there was a very high positive correlation between the environment and O&P health and well-being. This means there is a strong relationship between the environment and health and well-being as both variables move in tandem. The correlation coefficients in Table 8 further indicated that there was a very high positive correlation between the 'tools, machines and materials' and health and well-being. Again, this means there was a strong relationship between tools, machines and materials and health and well-being. These relationships were the result of the differences between the public and private sectors. From this study, the respondents from the private health sector had a better provision of tools, machines, and materials.

Cognitive and psychological challenges

O&P tasks were also considered to be cognitively demanding by many of the respondents in this study. Ironically, while the health care system is designed to help patients achieve good health, it often comes at the price of high stress levels and poor health for the employees (Chang, Hancock, Johnson, Daly, & Jackson (2005); McClafferty & Brown (2014); Smith (2014); Saliba & Barden (2017)). The mental health and well-being of an individual employee also plays a huge role in their overall productivity and effectiveness at work. Majority of the current study's respondents reported mental fatigue and frustration because of lack of resources available for the job. An individual experiences strain as a negative outcome when they appraise stressors in the work environment as either being beyond their coping ability or as a threat to available resources (Matthews, Gallus, & Henning, 2011). Mental health problems result in the inability to complete job functions, thus reducing motivation, increasing stress, fear, and concerns (Armandi, Aghadavood, & Davoodi, 2015). Any factor that disrupts or interferes with an employee's ability to concentrate and work effectively will ultimately affect productivity. Ensuring health workers' physical and mental health is critical to sustain their availability and productivity over time, especially considering that they have been identified as being at high risk of poor psychological wellbeing due to their work demands (Lohman & Dzay, 2019). Various factors associated with poor psychological wellbeing were identified by Lohman & Dzay (2019), including excessive workload, inter- and intra-professional conflict, adverse management styles and poor management support, lack of autonomy, shift work, and effort-reward imbalance. These factors are echoed by the responses from the current study, in which factors such as excessive workloads, professional conflicts like poor

collaboration, lack of task diversity and low productivity were identified. Poor mental health amongst healthcare professionals has been linked to low quality of patient care, patient safety issues, poor empathic ability, and absenteeism as well as negative effects on productivity. Furthermore, absenteeism, which is an employee's intentional or habitual absence from work (Kocakülâh, Bryan, & Shymanski, 2018), causes unnecessary expenses while resulting in decreased output levels. Poor health will also result in employees taking extended leave days. This also results in unnecessary expense, due to replacement costs, or alternatively, increased workload on other staff. While employers expect employees to miss a certain number of workdays each year, excessive absences can equate to decreased productivity and can have a major effect on company finances, morale, and other factors (Kocakülâh, Bryan, & Shymanski, 2018).

Influence of Environmental Factors on Health and Well-being

A range of characteristics in the O&P environment were identified as concerns to health and well-being. These include the absence of a functional chemical extraction systems, not having a good level of technology, poor maintenance of machines and tools, increased risk of MSDs, and cognitively demanding tasks. An assessment of the chemical extraction system saw a difference in opinions, with 48.9% of the study respondents claiming their workshop did not have a functional chemical extraction system. A functional chemical extraction system is necessary to capture airborne contaminants and dust particles (Nodooshan, Booshehri, Daneshmandi, & Choobinesh, 2016). According to a study by Anderson et al. (2016), O&P manufacturing uses many hazardous substances such as fiberglass, styrene, acetone, toluene, and plaster of paris. Increased exposure times to fumes, particulates, and dust particles have a range of negative effects on short- and long-term health, including eye, skin, nose, and throat irritation, as well as effects on the nervous system, development of cancers and even foetal abnormalities (Anderson et al., 2016).

Employers are required by law to not only provide a safe workplace for their employees but to provide proper training on equipment as well. The Occupational Health and Safety Act of 1993 requires the employer to bring about and maintain, as far as reasonably practicable, a work environment that is safe and without risk to the health

of the workers (Republic of South Africa, 1993). Poor maintenance of machines was identified in the current study as a problematic issue and could be one of the reasons respondents had to put in extra effort to achieve expected levels of performance. A good level of technology would include adjustable workstations and properly designed hand tools to eliminate awkward postures and bending during working. Failure to routinely service and maintain equipment results in difficult working environments, having to put in extra effort to complete tasks and can even result in injury, or worse, death (Deouskar, 2017). Many workplaces and tools required by workers have been designed with men in mind, but without taking into account the anthropometric differences of women, thus could result in women experiencing more difficulties than men when working (Campos-Serna, Ronda-Perez, Artazco, Moen, & Benavides, 2013). Usually, when buying equipment, manufacturers will give manuals on maintenance of the equipment. This is to avoid unnecessary injuries and delays in production. Employers have a duty to inspect, repair, and replace machinery, equipment, and tools on a regular basis. Unfortunately, many employers do not do this, which can result in a tragic workplace accident. When equipment is not well serviced, it stops performing at peak efficiency, thus reducing productivity as employees take longer to complete tasks, and increases prevalence of injury among the employees, which could result in increased absenteeism amongst employees (Deouskar, 2017). Severe funding constraints, particularly in South Africa, make it difficult for public hospitals to maintain or purchase equipment (Maphumulo & Bhengu, 2019). For now, the best prospects for advanced technology and equipment remain in the private sector (Econex, 2013).

Coping Mechanisms

Coping mechanisms are management strategies to help maintain emotional well-being, especially during stressful or traumatic periods. O&P work was identified as being cognitively demanding. These mechanisms can assist in negating the effects that a work system has on employees which may result in fatigue, stress, burn-out and musculoskeletal disorders. The questions in the current study relating to coping mechanisms indicated that exercise and relaxation were mostly used; however, a considerable proportion of employees also made use of their companies' employee wellness support programmes. Unfortunately, a small proportion did resort to smoking and alcohol consumption to cope with stressors at work. Men and women have been

found to use different coping strategies for dealing with occupational stressors, and this difference could result in different outcomes (Hooftman, van Poppel, van der Beek, & Bongers, 2004). Finding ways to help employees manage their stress through health promotion in the workplace is typically conducted through workplace wellness programs, which include both lifestyle and disease management programs (Caloyerans, Hangsheng, Exum, Broderick, & Mattke, 2014; Mattke, et al., 2013; Saliba & Barden, 2017). More than half of the respondents in this study claimed to have access to employee wellness support programmes in their workplaces. Employee wellness support programmes lower employee health insurance costs, support mental health, and recruit and retain quality employees (Caloyerans, Hangsheng, Exum, Broderick, & Mattke, 2014; Liu, Olivier, Beaudouin-Lafon, Lecolinet, & Mackay, 2014). These programs are said to promote and support healthy lifestyle choices (e.g., not smoking, and drinking alcohol) and have a positive influence on productivity, reduction of absenteeism amongst employees, and retaining or attracting quality employees within an organisation. The presence of healthy and happy employees at work ensures high productivity, quality delivery and commitment towards improving the performance of the organization in terms of productivity and effectiveness of human resource management (Raja & Gupta, 2019).

FACTORS THAT INFLUENCE JOB PERFORMANCE OF O&Ps

A range of characteristics in the O&P environment were identified as challenges to O&P work. These included the absence of a functional chemical extraction systems; poor collaboration with other health disciplines; unfavourable workshop temperature, and noise; lack of hearing protective gear; lack of resources; having to put in extra effort to achieve expected level of performance; poor maintenance of machines and tools; and high work demands. Poor collaboration with other health disciplines was identified as an issue by some of the respondents. Sherry (2015) mentions the importance of including rehabilitation therapists (e.g., O&Ps, occupational therapists, physiotherapists, and etc.) in primary healthcare. Ned et al. (2017) pointed to the challenges faced by rehabilitation therapists in primary healthcare. The lack of collaboration between healthcare workers resulted in inadequate rehabilitation services and lengthened the institutional stay for older patients (Steihaug, Johannessen, Ådnanes, Paulsen, & Mannion, 2016). This results in poor patient outcomes. Poor collaboration with other health disciplines occurs when other health

professionals have a poor understanding of the work undertaken by O&Ps (Anderson et al., 2016). This results in health professionals setting service deadlines and misinforming the patients on timing related to the delivery of devices (Anderson et al., 2016). O&Ps identified that the pressures placed on them by other health staff and patients not only increased their workloads, but it also resulted in unrealistic time pressures to complete tasks (Anderson et al., 2016), as they must put in extra effort and time to achieve expected level of performance. Although rehabilitation services are known to be an important aspect of a holistic treatment approach and effective healthcare system, the constraints experienced in the healthcare in general, but particularly in the Eastern Cape, means that rehabilitation professionals are under-valued, under-resourced and deal with great challenges that impact their health and well-being and work performance.

In terms of positive workplace findings, respondents were generally satisfied with the organizational structure of their workplaces. They felt they had good managers with adequate knowledge of the job. Managers are instrumental in ensuring the success of an organization by motivating and engaging employees to be more productive and can play an effective role in increasing productivity through certain plans and incentives, including rewards, employee empowerment, and a friendly and compassionate climate (Afsharian, Mirghasemi, Ebadzadeh, & Khodabakhshi, 2013). Respondents in the current study felt they were remunerated on time and worked regular hours. Both factors have been said to retain staff and reduce stress and anxiety (Bhui, Dinos, Galant-Miecznikowska, de Jongh, & Stansfeld, 2016). Responses from the O&Ps revealed that they had different views on having sufficient task diversity and having good collaboration with other health disciplines in their workplaces. According to Morley & Cashell (2017), a collaborative, interdisciplinary team approach supports high quality and safe care, patient, and staff satisfaction and engagement, and organizational efficiency and innovation. Therefore, it is important that rehabilitation specialists such as O&Ps are recognised and included in primary healthcare. The difference in opinion regarding task diversity could be due to the differences in resources in the private and public healthcare sectors. It is possible to apply different skills if one has adequate material, tools, and equipment provision at one's disposal.

Respondents were satisfied with the physical layout of the workshops and felt they had well-designed workshops. Workplace design is one of the major determinants of

employee job performance in all organization (Mendis, 2016) as workplace design not only refers to the environmental conditions but also the physical design of the space. Human beings share a need to be comfortable when working and therefore encouraging an environment that allows for good posture, less strain, fewer motions, and better heights and reaches, will help to create a much more productive staff (Deouskar, 2017). Productivity is the measure of the effectiveness of the labour and resources (Sauermann, 2016).

With regards to the physical environment, the respondents in the private health sector responded more positively than those in the public health sector; and respondents working in both sectors provided the lowest ratings. Respondents were satisfied with the provision of PPE and lighting in the workshops; however, there was a difference of opinion about the environmental factors such as temperature, and noise in the workshops. Most of the respondents found these environmental conditions favourable; however, those who deemed these conditions unfavourable cannot be ignored as their percentages were high as well (the prevalence of responses rating temperature as unfavourable was 44.2% and prevalence of poor provision of hearing protection gear was 44.3%). The differences in responses relating to temperature can be attributed to the private health sector having better resources and infrastructure than the public health sector.

The conditions in the public and private sector differ in SA. The private health sector is presumed to be better equipped and resourced than the public health sector. From this study, it appears that respondents working in the private health sector work in better organizational and work environments than their public counterparts. This is because they are thought to have better management of funds and resources (Maphumulo & Bhengu, 2019). This concurs with the literature, which states that the private health sector is better equipped than the public health sector in South Africa (Maphumulo & Bhengu, 2019).

Sub-optimal environmental conditions can also negatively influence work performance. For example, noise can be disruptive when an individual needs to focus. Noise interruptions can hinder an individual's performance at work as heard noises could decrease employee performance because it may cause concentration loss (Dianat, Vahedi, & Dehnavi, 2015/16). Respondents differed in opinion with regards

to the provision of ear protection gear from noise. 44.3% of the respondents disagreed to being provided with ear protection gear. Ear protection gear reduces noise that causes inner ear damage, which in the long term could result in noise induced hearing loss, and which in turn will hinder the employee's ability to verbally interact with others. Similarly, a temperature (ambience) that is too hot or cold will cause discomfort while working, which leads to a decrease in performance. The findings of the current study correlate with other past research by Vimalanathan & Ramesh, (2013); Ali, Chua, & Lim, (2015); Tarcan, Varol, & Ates, (2004); Saleem, et al., (2012); and Dianat, Vahedi, & Dehnavi, (2015/16), who stated that high room temperature negatively affected performance although these findings by the above-mentioned authors contradict with results from Manggo (2014) who stated that temperature had no effect on performance.

Lighting in the workplace is one of many significant factors that can affect performance (Vimalanathan & Ramesh, 2013). Appropriate lighting in working areas can facilitate job performance and this is corroborated by Manggo (2014), who found that lighting is the most dominant factor in affecting employee performance. Service delivery and the state of health facilities in the public sector have continually deteriorated over the last two decades (Econex, 2013). This appears to be related to mismanagement, as well as a lack of accountability and monitoring of funds (Rangongo, Mohlakwana, & Beckmann, 2016).

Work demands were identified as factors that negatively influence O&P work as they increase prevalence of injuries. O&Ps working in the public and private sectors had a higher mean score regarding productivity compared to healthcare workers working concurrently in both the private and public healthcare sector. It is assumed that this is as a result of multi-tasking and poor time management as they see patients and manufacture devices in both the public and private healthcare sectors. Furthermore, most participants in this study identified concerns related to workload and lack of good level technology. High workloads combined with unreasonable time frames are likely to lead to a stress response, high fatigue levels and other physiological changes – a 'hazardous personal state', and subsequently an increased risk of injury (Anderson et al., 2016).

Overall, in an O&P workshop, the factors that influence the system outcomes (health and well-being and productivity) were the components of the O&P work system. The physical complaints, psychological complaints, organizational and environmental factors, and coping mechanisms all had an impact on the health and well-being of the O&Ps, which also resulted in an impact on productivity as well. Some of the factors that influenced productivity that were identified were poor collaboration amongst healthcare workers, organizational and environmental factors, work demands and the differences between the different sectors.

CHAPTER 6 - CONCLUSION

The findings of this study indicate that healthcare in SA is still facing many challenges. The Eastern Cape province is especially challenged due to poor development, mismanagement of resources, maladministration, and poor implementation of policies. The exclusion of rehabilitation in primary healthcare is evidence of poor policy implementation and has resulted in rehabilitation specialists such as O&Ps having poor collaboration with other health professionals.

In terms of the orthotics and prosthetics profession, the work system components that were identified in the current study as enabling and challenging O&Ps in their work were environmental factors, cognitive and psychological challenges, poor collaboration, work demands and the differences between the different sectors. Outcomes of O&P work system components were identified as health and well-being and productivity. Correlation analyses of these system components showed strong positive correlations between the components and system outcomes. There was a very high positive correlation between the environment and health and well-being. There was also a very high positive correlation between the 'tools, machines and materials' and health and well-being. This means a strong relationship exists between these system components, as well as between the system components and the system outcomes.

There were differences between responses from participants working in the public, the private and those working concurrently in both sectors. Respondents working in the private sector rated their work system more positively than respondents working in the public sector and those working in both sectors, although this difference was not statistically significant. The more positive responses from the private sector do however indicate that the public sector is better equipped in terms of resources than the public sector.

This study is the only one of its kind that has focussed on the challenges and enablers of an O&P's work system by studying the system components and system outcomes. Understanding the interactions of these components of the O&P work system and the contextual challenges facing O&Ps working in the Eastern Cape Province of South Africa will allow for the development of recommendations to improve the health and

well-being of O&Ps, while providing service delivery to their patients, thus increasing productivity.

The work performed by O&Ps can have long-term negative effects on their health and well-being. Therefore, O&Ps deserve to be recognised for the work they do, and measures be implemented to ensure their health and well-being. The work demands of O&Ps need to be reviewed to determine what modifications can be made to improve the overall work system, in particular the work demands. O&P work systems in the public sector have more room to improve, so they can reach a similar standard to those in the private sector.

LIMITATIONS OF THE STUDY AND RECOMMENDATIONS FOR FUTURE STUDIES

The study had several limitations which should be considered in future research in this area.

Although questionnaires were used as an instrument of data collection, conducting interviews as part of a follow-up into the emerging factors from the questionnaires could have provided better insight into the results of this study.

Furthermore, the use of a cross-sectional is a limitation in itself, as cross-sectional studies focus on a snapshot in time and do not take into consideration variations over time. In a cross-sectional study, the investigator measures the outcome and the exposures in the study participants at the same time; and since this is a one-time measurement of exposure and outcome, it is difficult to derive causal relationships from cross-sectional analysis (Setia, 2016).

Although the response rate was high, a larger sample should have been chosen as the small sample size limited the identification of work system factors that significantly impacted the findings of the study. More participants would have provided a clearer picture of challenges faced by O&Ps in South Africa in general. In future, a similar study could not only be expanded to other provinces in South Africa but would also allow for comparisons of O&Ps in the Eastern Cape to, for example, those in a more developed provinces such as Gauteng or the Western Cape province. It could therefore highlight the unique challenges facing O&Ps in the Eastern Cape province.

Another limitation of the study was the lack of previous studies in orthotic and prosthetics ergonomics research areas. Few articles were available that related to O&Ps, and of these, none had been conducted in the South African context. More research sources could have provided better background information and different perspectives on the topic being explored.

The use of a self-developed questionnaire was identified as a limitation in the study. Testing and correcting the questionnaire was repeated for a number of times.

The unexpected national lockdown because of the global pandemic was a challenge. Alternative ways of administering the questionnaire had to be found, and it is believed that the opportunity to physically deliver the questionnaires and to provide an information session face-to-face could have resulted in an even better response rate especially from the older and more experienced O&Ps as well as more O&Ps from the private sector.

RECOMMENDATIONS

Further research on the work demands of O&Ps and even other rehabilitation professionals in the Eastern Cape Province, and indeed South Africa, is needed to highlight the challenges, enablers, and interventions that can be made to ease these work demands of O&Ps and other rehabilitation professionals. A suitable approach would be doing a work domain analysis of O&P work. This would help identify issues that are causing complaints with work demands, and thus provide possible solutions to these issues.

Further studies in O&P can extend the scope of the study and include O&Ps from other provinces, which would provide more valid findings about the challenges and enablers about O&Ps in South Africa as a whole, or the differences in the different provinces of South Africa. This would determine whether the challenges and enablers O&Ps experience in their jobs differ for each province or are the same, or whether there are similarities between the more rural and the more urban provinces. Further investigations into the psychosocial aspects of O&P work amongst O&Ps in South Africa could be done using the Copenhagen Psychosocial Questionnaire (COPSOQ).

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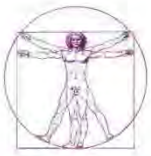
APPENDICES

APPENDIX A – QUESTIONNAIRE

RHODES UNIVERSITY
Grahamstown • 6140 • South Africa



Workplace Evaluation Questionnaire

This questionnaire has 2 sections. Please complete both Part I ("Socio-demographic Data") and Part II ("Work Demands and Challenges") and follow the instructions. While you have the option of not answering questions you do not feel comfortable answering, for the sake of the completeness of this research, if would be appreciated if you could answer ALL questions.

Note that all information on this questionnaire is confidential and no individual data will be used or shared. All participants' data will be collated and presented in summarized form. You can stop participating in this research at any time if you wish; however, it would be appreciated if you could complete the entire questionnaire.

CONSENT: By completing this questionnaire, I confirm that I have been fully informed of the study's purpose and processes (verbally and via the information letter), that I have had all my questions answered to my satisfaction and that I voluntarily consent to participating in this research project.

Part I: Socio-Demographic Data

Please tick the most appropriate response and/or neatly write your response.

1. Sex: male ◯ female ◯
2. Age: _____
3. Race: Black ◯ White ◯ Indian ◯ Coloured ◯
   Asian ◯ Other/Unspecified ◯ Prefer not to answer ◯

   If Other/Unspecified, please specify_____
4. In general, do you think you are in good health, i.e. physically and mentally fit?

   Yes ◯ No ◯

   If no, please state any health issues you may suffer from:

   _____

   _____
5. Do you have a physical or other disability? Yes ◯ No ◯ Prefer not to answer ◯

   If you answered 'yes' to the above question, please state the nature of your disability

   _____

   _____
6. What qualifications/training do you have specific to Orthotics and Prosthetics?

   Certificate ◯ Diploma ◯ BTech ◯

   BSc Degree ◯ MSc ◯ PhD ◯

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Section II: Work Demands and Challenges

Tick the most appropriate answer.

S/No	Item	Strongly Disagree	Disagree	Disagree Somewhat	Agree Somewhat	Agree	Strongly Agree
1	**ORGANIZATION**						
1.1	I have a competent manager/ supervisor with adequate knowledge of an O&P's job.						
1.2	I have a good manager who looks after the interests of the employees and is fair.						
1.3	I am remunerated on time, including for my overtime hours.						
1.4	I have regular working hours.						
1.5	On average, I work a maximum of 40 hours a week.						
1.6	I receive an annual performance bonus / payment.						
1.7	I have sufficient task diversity (i.e. I employ a wide range of skills / activities during my daily work)						
1.8	There is good collaboration/ teamwork with other health disciplines (physiotherapists, occupational therapists, surgeons, etc.).						

S/No	Item	Strongly Disagree	Disagree	Disagree Somewhat	Agree Somewhat	Agree	Strongly Agree
2	**ENVIRONMENT**						
2.1	The physical layout of the workshop promotes good workflow.						
2.2	The workshop is well ventilated to prevent dust exposure.						
2.3	The workshop has a functional chemical extraction system.						
2.4	There is sufficient lighting in the different areas of the workshop.						
2.5	The temperature in the workshop is well adjusted and controlled (temperature is not too hot or cold, but at ambient temperature).						
2.6	I am provided with ear protection gear from noise.						
2.7	We have gloves for molding (molding gloves).						
2.8	We have gloves for welding (welding gloves).						
2.9	I have goggles for eye protection during welding and machining.						
2.10	I have protective clothing for working (e.g. lab coat, apron, work coat, safety boots)						
2.11	We have good housekeeping practices to ensure cleanliness and neatness.						
2.12	There is sufficient lighting in the consultation rooms.						

S/No	Item	Strongly Disagree	Disagree	Disagree Somewhat	Agree Somewhat	Agree	Strongly Agree
2.13	The consultation rooms are well ventilated to allow proper airflow.						
2.14	I have gloves for clinical consultations (e.g. latex gloves).						
3	**WORK DEMANDS**						
3.1	Tasks are physically demanding.						
3.2	I have enough time to complete tasks.						
3.3	Most tasks are completed in standing position.						
3.4	Work is regularly done in awkward/non-neutral postures (e.g. bending and twisting)						
3.5	I regularly do a lot of heavy load lifting on the job.						
3.6	I regularly encounter repetitive movements when completing some tasks.						
3.7	Tasks are regularly cognitively demanding (e.g. problem-solving, memory and decision-making).						
4	**TOOLS/MACHINES/MATERIALS**						
4.1	We have a good level of (up to date) technology at our disposal.						
4.2	In the workshop, we have the appropriate machines to complete work tasks						
4.3	In the workshop, we have well-functioning machines to complete tasks						

S/No	Item	Strongly Disagree	Disagree	Disagree Somewhat	Agree Somewhat	Agree	Strongly Agree
4.4	In the workshop, we have the right tools needed to complete work tasks.						
4.5	In the workshop, we have the right quantity of materials to produce orthotic/prosthetic devices.						
4.6	The consultation rooms are well equipped with appropriate equipment (e.g. examination beds, tables, chairs, bed screens/ partitions, parallel bars, etc.)						
4.7	We have the right quality of materials to manufacture orthotic/prosthetic devices						
4.8	We do routine maintenance of machines and tools as recommended by the manufacturers.						
5	**HEALTH AND WELL-BEING**						
5.1	Physical injuries on duty (IODs) are common occurrences in the workplace						
5.2	Physical injuries on duty are not always reported.						
5.3	I feel discomfort / pain when bending / twisting my trunk.						
5.4	I feel discomfort / pain when standing for long periods.						
5.5	I feel discomfort / pain when picking up / carrying heavy loads.						
5.6	I am physically fatigued / exhausted at the end of the workday.						

S/No	Item	Strongly Disagree	Disagree	Disagree Somewhat	Agree Somewhat	Agree	Strongly Agree
5.7	I feel mentally fatigued / exhausted at the end of the workday.						
5.8	I struggle with the emotional demands of the job resulting from interacting with patients / clients.						
5.9	I am frustrated by the lack of resources available for the job.						
5.10	I am bored as a result of lack of task diversity.						
5.11	When I am at work, I feel stressed / overwhelmed as a result of the job.						
5.12	I exercise to relax and keep fit.						
5.13	I attend therapy to deal with work-related pressures / stresses.						
5.14	I take prescription medication to deal with stress / anxiety.						
5.15	I take pain medication to deal with physical pain.						
5.16	I attend physical therapy to deal with physical pain.						
5.17	I smoke / drink to cope with stressors / pressure at work.						
5.18	We have an employee wellness support programme at work, for mental support and health.						

S/No	Item	Strongly Disagree	Disagree	Disagree Somewhat	Agree Somewhat	Agree	Strongly Agree
6.	**PRODUCTIVITY**						
6.1	I accomplish all my tasks within the expected timeframe.						
6.2	I have to put in extra effort and time to achieve my expected level of performance.						
6.3	My patients always come back for frequent repairs.						
6.4	My patients always come back for adjustments.						
6.5	I do a lot of re-fittings on the same devices in a short period of time.						

9. Is there anything else you want to mention in addition to the above questions about factors that make your job as an O&P/ work in O&P enjoyable? (Please identify issues not mentioned above).

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

10. Is there anything else you want to mention in addition to the above questions about factors that make your job as an O&P/ work in O&P difficult? (Please identify issues not mentioned above).

_____

_____

_____

_____

_____

_____

_____

_____

_____

Questionnaire compiled from: Physical Workplace Evaluation, The University of Aarhus (2008); Korb (2012); Hamid et al. (2008); Health and Safety Executive (2005).

Thank you for completing this questionnaire!

Please place in the envelope provided, and return it to the reception desk, or contact the researcher on 072-326 3500 or g08n2237@campus.ru.ac.za.

APPENDIX B – ETHICAL CCONSIDERATIONS

B.1 – Ethical Clearance Letter from RUESC

RHODES UNIVERSITY
Where leaders learn

Human Ethics sub-committee
Rhodes University Ethical Standards Committee
PO Box 94, Grahamstown, 6140, South Africa
t: +27 (0) 46 603 8055
f: +27 (0) 46 603 8822
e: ethics-committee@ru.ac.za

www.ru.ac.za/research/researchethics
NHREC Registration no.: REC-241116-049

17 April 2020

Aviwe MGIBANTAKA

Email: g08N2237@campus.ru.ac.za

Review Reference: 2020-1032-3299

Dear Mrs. Mattison

Title: Provisional title: An ergonomics study of Orthotics and Prosthetics workshops in the Eastern Cape of South Africa

Principal Investigator: Mrs. Miriam Mattison

Collaborators: Miss Aviwe Mgibantaka,

This letter confirms that the above research proposal has been reviewed and **APPROVED** by the Rhodes University Ethical Standards Committee (RUESC) – Human Ethics (HE) sub-committee.

Approval has been granted for 1 year. An annual progress report will be required in order to renew approval for an additional period. You will receive an email notifying when the annual report is due.

Please ensure that the ethical standards committee is notified should any substantive change(s) be made, for whatever reason, during the research process. This includes changes in investigators. Please also ensure that a brief report is submitted to the ethics committee on the completion of the research. The purpose of this report is to indicate whether the research was conducted successfully, if any aspects could not be completed, or if any problems arose that the ethical standards committee should be aware of. If a thesis or dissertation arising from this research is submitted to the library's electronic theses and dissertations (ETD) repository, please notify the committee of the date of submission and/or any reference or cataloging number allocated.

Sincerely,

Prof Arthur Webb

Chair: Human Ethics Sub-Committee, RUESC- HE

Page 1 of 1

B.2 - Gatekeeper Permission from Eastern Cape Department of Health

Province of the
EASTERN CAPE
HEALTH

Enquiries: Zonwabele Merile Tel no: 083 378 1202

Email: zonwabele.merile@echealth.gov.za Fax no: 043 642 1409

Date: 14 May 2020

RE: An orgonomics study of Orthotics and Prosthetics workshops in the Eastern Cape of South Africa. (EC_202004_004)

Dear Mrs M. Mattison

Ms A. Mgibantaka

The department would like to inform you that your application for the abovementioned research topic has been approved based on the following conditions:

1. During your study, you will follow the submitted protocol with ethical approval and can only deviate from it after having a written approval from the Department of Health in writing.

2. You are advised to ensure, observe and respect the rights and culture of your research participants and maintain confidentiality of their identities and shall remove or not collect any information which can be used to link the participants.

3. The Department of Health expects you to provide a progress update on your study every 3 months (from date you received this letter) in writing.

4. At the end of your study, you will be expected to send a full written report with your findings and implementable recommendations to the Eastern Cape Health Research Committee secretariat. You may also be invited to the department to come and present your research findings with your implementable recommendations.

5. Your results on the Eastern Cape will not be presented anywhere unless you have shared them with the Department of Health as indicated above.

Your compliance in this regard will be highly appreciated.

SECRETARIAT: EASTERN CAPE HEALTH RESEARCH COMMITTEE

TOGETHER, MOVING THE HEALTH SYSTEM FORWARD

APPENDIX C – LETTER OF INFORMATION

RHODES UNIVERSITY

DEPARTMENT OF HUMAN KINETICS AND ERGONOMICS

LETTER OF INFORMATION TO PARTICIPANTS

Dear _____,

Thank you for your interest in my study provisionally titled *"An ergonomics study of Orthotics and Prosthetics workshops in the Eastern Cape of South Africa."*

BACKGROUND AND AIM OF THE STUDY

My name is Aviwe Sihle Mgibantaka. I am a student in the Department of Human Kinetics and Ergonomics (HKE) at Rhodes University. For my Master's Degree, I am required to submit a written thesis under the supervision of Ms Miriam Mattison.

While conducting their daily work, O&Ps are exposed to a range of physical, physiological and psychosocial hazards, which could result in injuries and diseases, as well as impact their work output. Even so, some positive factors that enable O&Ps to do their work effectively. However, to the author's knowledge, nobody has ever investigated the work of O&Ps using a systemic approach. This study aims to assess the challenges and enablers experienced by individuals working in O&P workshops in the Eastern Cape (EC). This study is to be completed in two phases. Phase 1, which is what you are asked to participate in with this letter, will be a descriptive study during which a questionnaire will be administered to participants. A follow-up study will be conducted for the second phase of this project and will entail interviews with a small number of individuals based on the responses from Phase 1. Should you also want to participate in Phase 2, please contact me.

PROCEDURES

This study and its procedures have received approval by the Rhodes University Ethical Standards Committee *[2020-1032-3299]*, as well as the relevant gatekeepers. For public sector employees, permission to conduct the study has been obtained from the Eastern Cape Department of Health (ECDoH), hospital Chief Executive Officers (CEOs), and Heads of Department (HODs). For private-sector employees, permission has been received from the owners or managers of the O&P centres through emails and telephone communications. In addition to this letter, and where possible, I will attempt to also verbally explain the purpose, procedures, participation requirements, benefits of participation to the study for the O&P profession, as well as answer any questions you may have regarding the study and its procedures. Once all questions have been answered to your satisfaction, and you consent to participate, you will be given the questionnaire to complete. The questionnaire will take approximately 20-25 minutes to complete, and you can complete it in your own time, but ideally within a week of receiving it.

PARTICIPANT CHARACTERISTICS

To participate in the study, you should be employed as an O&P or Orthopaedic Footwear Technologist (OFT), working for either the public or private health sector with-in the Eastern Cape province of South Africa.

RISKS AND BENEFITS

There are known or anticipated risks associated with participation in this study. Firstly, you may feel uncomfortable reflecting on your work system, particularly if you are dissatisfied with that working environment. However, keep in mind that reporting on challenges and positive aspects in your workplace are important to develop interventions and optimize working conditions.
There is also the risk of loss of confidentiality. To minimize risk, the questionnaire will not require any personal or identifiable information, e.g. names, surnames, place of employment etc. Chances of an employee being identified by his/her responses to the questionnaire are therefore slim.
Finally, the study presents social and economic risks to the participants and/or employers as the study could reveal poor working conditions in certain workshops which could impact negatively on that hospital, the Eastern Cape Department of Health (ECDoH) or private workshops. It could also damage relationships between participants and other healthcare providers. However, in the questionnaire, no names of workshops (public or private), or hospitals will be asked; hence this risk is unlikely to occur.

The benefits of this study will be awareness of the ECDoH, other stakeholders and ergonomists of the work being done, and of the challenges faced by O&Ps and OFTs. The results of the study may provide guidance on intervention strategies to improve working conditions for its employees and highlight best practice. The results of this study may also open a new dialogue in forum discussions.

OTHER RIGHTS AND RESPONSIBILITIES

Apart from the above-mentioned issues about anonymity, the raw data will remain confidential and will be stored within the Human Kinetics and Ergonomics (HKE) department and will be used to inform phase two of the study.

Participation in this study is entirely voluntary. If you do not wish to participate in the survey, you can either (a) submit a blank questionnaire, or (b) not submit the questionnaire at all. To withdraw from the electronic version of the questionnaire, just close the web browser. Please note that by not consenting, or by withdrawing from the study, you will not suffer any negative consequences with the researcher, the HKE Department of Rhodes University. Participants may withdraw their questionnaire responses anytime until a week after data has been collected, as data analysis would have started after that point.

If you have any questions for the Rhodes University Ethical Standards Committee about this study, please contact the university's ethics coordinator, Mr Manqele via telephone at 046 603 7727 or via email at s.manqele@ru.ac.za. For any questions, comments or additional information regarding the study, you can also contact my supervisor, Ms Miriam Mattison at 046 603 8468, or you can email her at m.mattison@ru.ac.za. As the researcher, you can contact me directly at 072 326 3500 or email me at g08n2237@campus.ru.ac.za.

Yours sincerely,

Aviwe Mgibantaka
Tel: 046-603 8468
Cell: 072-326 3500
Email: g08n2237@campus.ru.ac.za

APPENDIX D – STATISTICAL TABLES

Descriptive Data

Variable	Descriptive Statistics (2021-01-22 Data with Reverse Scoring - Miriam)					
	Valid N	Mean	Minimum	Maximum	Std.Dev.	Coef.Var.
Age	42	34.38095	24.00000	53.00000	6.688003	19.45264
Yrs in public sector	39	7.69231	1.00000	27.00000	6.100707	79.30919
Yrs in private sector	27	2.33333	0.00000	7.00000	2.130367	91.30142
1.1 I have a competent manager/ supervisor with adequate knowledge of an O&P's	43	4.30233	1.00000	6.00000	1.372084	31.89167
1.2 I have a good manager who looks after the interests of the employees and is fa	43	4.23256	1.00000	6.00000	1.231283	29.09075
1.3 I am remunerated on time, including for my overtime hours.	42	4.57143	2.00000	6.00000	1.252176	27.39135
1.4 I have regular working hours.	43	4.62791	1.00000	6.00000	1.215441	26.26331
1.5 On average, I work a maximum of 40 hours a week.	43	4.76744	2.00000	6.00000	1.065413	22.34769
1.6 I receive an annual performance bonus / payment.	42	4.35714	1.00000	6.00000	1.495056	34.31275
1.7 I have sufficient task diversity (i.e. I employ a wide range of skills / activities du	43	4.55814	1.00000	6.00000	1.484881	32.57648
1.8 There is good collaboration/ teamwork with other health disciplines (physiothera	43	4.16279	1.00000	6.00000	1.660898	39.89867
2.1 The physical layout of the workshop promotes good workflow.	43	4.16279	1.00000	6.00000	1.429789	34.34689
2.2 The workshop is well ventilated to prevent dust exposure.	42	3.92857	1.00000	6.00000	1.420973	36.17022
2.3 The workshop has a functional chemical extraction system.	43	3.44186	1.00000	6.00000	1.484881	43.14182
2.4 There is sufficient lighting in the different areas of the workshop.	42	4.19048	1.00000	6.00000	1.214508	28.98257
2.5 The temperature in the workshop is well adjusted and controlled (temperature is	43	3.46512	1.00000	6.00000	1.578861	45.56444
2.6 I am provided with ear protection gear from noise.	43	3.53488	1.00000	6.00000	1.736839	49.13427
2.7 We have gloves for molding (molding gloves).	43	4.46512	1.00000	6.00000	1.501568	33.62887
2.8 We have gloves for welding (welding gloves).	43	4.37209	1.00000	6.00000	1.464228	33.49033
2.9 I have goggles for eye protection during welding and machining.	43	4.90698	1.00000	6.00000	0.894799	18.23523
2.10 I have protective clothing for working (e.g. lab coat, apron, work coat, safety l	43	4.58140	1.00000	6.00000	1.401233	30.58530
2.11 We have good housekeeping practices to ensure cleanliness and neatness.	43	4.62791	2.00000	6.00000	0.900351	19.45481
2.12 There is sufficient lighting in the consultation rooms.	43	4.90698	2.00000	6.00000	0.946521	19.28930
2.13 The consultation rooms are well ventilated to allow proper airflow.	42	4.57143	2.00000	6.00000	1.192310	26.08178
2.14 I have gloves for clinical consultations (e.g. latex gloves).	43	4.90698	1.00000	6.00000	1.211334	24.68596
3.1 Tasks are NOT physically demanding.	43	2.30233	1.00000	6.00000	1.205837	52.37472
3.2 I have enough time to complete tasks.	43	4.30233	1.00000	6.00000	1.185927	27.56479
3.3 Most tasks are NOT completed in standing position.	43	2.13953	1.00000	6.00000	1.186861	55.47283
3.4 Work is NOT regularly done in awkward/non-neutral postures (e.g. bending an	43	2.83721	1.00000	5.00000	1.289707	45.45689
3.5 I DO NOT regularly do a lot of heavy load lifting on the job.	43	2.76744	1.00000	5.00000	1.324444	47.85807
3.6 I DO NOT regularly encounter repetitive movements when completing some tas	43	2.34884	1.00000	5.00000	0.973059	41.42727
3.7 Tasks are NOT regularly cognitively demanding (e.g. problem-solving, memory	43	2.18605	1.00000	6.00000	0.957572	43.80381

Variable	Descriptive Statistics (2021-01-22 Data with Reverse Scoring - Miriam)					
	Valid N	Mean	Minimum	Maximum	Std.Dev.	Coef.Var.
4.1 We have a good level of (up to date) technology at our dispo	43	3.372093	1.000000	6.000000	1.558743	46.22478
4.2 In the workshop, we have the appropriate machines to complete v	43	4.046512	1.000000	6.000000	1.326533	32.78214
4.3 In the workshop, we have well-functioning machines to complete t	43	4.000000	1.000000	6.000000	1.327368	33.18419
4.4 In the workshop, we have the right tools needed to complete work	43	4.000000	1.000000	6.000000	1.023533	25.58832
4.5 In the workshop, we have the right quantity of materials to produc	43	3.813953	1.000000	6.000000	1.239351	32.49518
4.6 The consultation rooms are well equipped with appropriate equipr	43	4.418605	1.000000	6.000000	1.199852	27.15455
4.7 We have the right quality of materials to manufacture orthotic/pro	43	3.930233	1.000000	6.000000	1.369660	34.84934
4.8 We do routine maintenance of machines and tools as recommen	43	3.511628	1.000000	6.000000	1.579212	44.97093
5.1 Physical injuries on duty (IODs) are NOT common occurrences i	42	4.071429	2.000000	6.000000	1.090823	26.79215
5.2 Physical injuries on duty are not always reported.	42	3.166667	1.000000	6.000000	1.305087	41.21327
5.3 I DO NOT feel discomfort / pain when bending / twisting my trunk	42	3.714286	1.000000	6.000000	1.254955	33.78726
5.4 I feel discomfort / pain when standing for long periods.	42	3.166667	1.000000	6.000000	1.429935	45.15586
5.5 I DO NOT feel discomfort / pain when picking up / carrying heavy	42	3.333333	1.000000	6.000000	1.442671	43.28014
5.6 I am NOT physically fatigued / exhausted at the end of the workda	42	2.904762	1.000000	6.000000	1.225930	42.20414
5.7 I DO NOT feel mentally fatigued / exhausted at the end of the wor	41	3.048780	1.000000	6.000000	1.340732	43.97599
5.8 I DO NOT struggle with the emotional demands of the job resulting	41	3.975610	1.000000	6.000000	1.369084	34.43708
5.9 I am frustrated by the lack of resources available for the job.	42	2.952381	1.000000	6.000000	1.710119	57.92338
5.10 I am NOT bored as a result of lack of task diversity.	42	3.547619	1.000000	6.000000	1.580404	44.54830
5.11 When I am at work, I DO NOT feel stressed / overwhelmed as a	42	3.571429	1.000000	6.000000	1.467416	41.08765
5.12 I exercise to relax and keep fit.	42	4.428571	1.000000	6.000000	1.232544	27.83163
5.13 I DO NOT attend therapy to deal with work-related pressures / st	42	4.166667	1.000000	6.000000	1.544726	37.07343
5.14 I DO NOT take prescription medication to deal with stress / anxie	42	4.857143	1.000000	6.000000	1.260496	25.95139
5.15 I DO NOT take pain medication to deal with physical pain.	43	3.790698	1.000000	6.000000	1.551622	40.93236
5.16 I DO NOT attend physical therapy to deal with physical pain.	43	4.558140	2.000000	6.000000	1.314794	28.84496
5.17 I DO NOT smoke / drink to cope with stressors / pressure at wor	43	4.488372	1.000000	6.000000	1.517706	33.81419
5.18 We have an employee wellness support programme at work, for	42	3.452381	1.000000	5.000000	1.501258	43.48471
6.1 I accomplish all my tasks within the expected timeframe.	42	4.238095	1.000000	6.000000	1.225930	28.92643
6.2 I DO NOT have to put in extra effort and time to achieve my expec	43	2.976744	1.000000	6.000000	1.336099	44.88458
6.3 My patients DO NOT always come back for frequent repairs.	43	3.883721	2.000000	6.000000	1.199391	30.88252
6.4 My patients DO NOT always come back for adjustments.	43	4.046512	2.000000	6.000000	1.153741	28.51199
6.5 I DON'T do a lot of re-fittings on the same devices in a short perio	42	4.357143	1.000000	6.000000	1.185716	27.21316

Table 10: Descriptive Statistics Summary Data

Variable	Descriptive Statistics (2021-01-22 Data with Reverse Scoring - Miriam)					
	Valid N	Mean	Minimum	Maximum	Std.Dev.	Coef.Var.
Organization (mean)	43	3.932724	2.750000	5.625000	0.715017	18.18121
Environment (mean)	43	4.021992	2.428571	5.785714	0.697422	17.34020
Work demands (mean)	43	3.899765	2.625000	5.770833	0.754470	19.34655
Tools etc. (mean)	43	3.917251	2.627551	5.772959	0.736467	18.80061
Health (mean)	43	3.951494	2.672619	5.727183	0.698417	17.67475
escriptive Statistics (2021-01-22 Data with Reverse Scoring - Miriam)				52	5.738627	0.704264	17.86142

Table 11: Correlation Analyses

Variable	Correlations (2021-01-22 Data with Reverse Scoring - Miriam) Marked correlations are significant at p < .05000 N=43 (Casewise deletion of missing data)							
	Means	Std.Dev.	Organization (mean)	Environment (mean)	Work demands (mean)	Tools etc. (mean)	Health (mean)	Productivity (mean)
Organization (mean)	3.932724	0.715017	1.000000	0.933684	0.888107	0.906422	0.971836	0.959793
Environment (mean)	4.021992	0.697422	0.933684	1.000000	0.887342	0.914736	0.971003	0.961347
Work demands (mean)	3.899765	0.754470	0.888107	0.887342	1.000000	0.997992	0.958517	0.973826
Tools etc. (mean)	3.917251	0.736467	0.906422	0.914736	0.997992	1.000000	0.973162	0.985244
Health (mean)	3.951494	0.698417	0.971836	0.971003	0.958517	0.973162	1.000000	0.998189
Productivity (mean)	3.942933	0.704264	0.959793	0.961347	0.973826	0.985244	0.998189	1.000000

Correlations Analyses

Table 12: Correlation analysis for public sector

Variable	Sector=1 Correlations (2021-01-22 Data with Reverse Scoring - Miriam) Marked correlations are significant at p < .05000 N=31 (Casewise deletion of missing data)							
	Means	Std.Dev.	Organization (mean)	Environment (mean)	Work demands (mean)	Tools etc. (mean)	Health (mean)	**Productivity (mean)**
Organization (mean)	3.938940	0.688937	1.000000	0.939897	0.892212	0.908322	0.972306	0.959973
Environment (mean)	4.021289	0.629942	0.939897	1.000000	0.901692	0.924274	0.974064	0.965516
Work demands (mean)	3.882469	0.745196	0.892212	0.901692	1.000000	0.998455	0.963310	0.977311
Tools etc. (mean)	3.902335	0.720846	0.908322	0.924274	0.998455	1.000000	0.975389	0.986645
Health (mean)	3.947566	0.667105	0.972306	0.974064	0.963310	0.975389	1.000000	0.998277
Productivity (mean)	3.936258	0.677272	0.959973	0.965516	0.977311	0.986645	0.998277	1.000000

Table 13: Correlation analysis for private sector

Variable	Sector=2 Correlations (2021-01-22 Data with Reverse Scoring - Miriam) Marked correlations are significant at p < .05000 N=9 (Casewise deletion of missing data)							
	Means	Std.Dev.	Organization (mean)	Environment (mean)	Work demands (mean)	Tools etc. (mean)	Health (mean)	**Productivity (mean)**
Organization (mean)	4.097222	0.720183	1.000000	0.902426	0.813415	0.844062	0.956956	0.936186
Environment (mean)	4.253968	0.676794	0.902426	1.000000	0.805797	0.850423	0.952061	0.934222
Work demands (mean)	4.127315	0.744733	0.813415	0.805797	1.000000	0.996820	0.926906	0.954203
Tools etc. (mean)	4.145408	0.718536	0.844062	0.850423	0.996820	1.000000	0.951565	0.973415
Health (mean)	4.159502	0.674610	0.956956	0.952061	0.926906	0.951565	1.000000	0.996688
Productivity (mean)	4.155978	0.679140	0.936186	0.934222	0.954203	0.973415	0.996688	1.000000

Table 14: Correlation analysis for both the public and private sectors

Variable	Means	Std.Dev.	Organization (mean)	Environment (mean)	Work demands (mean)	Tools etc. (mean)	Health (mean)	**Productivity (mean)**
Sector=3								
Correlations (2021-01-22 Data with Reverse Scoring - Miriam)								
Marked correlations are significant at p < .05000								
N=3 (Casewise deletion of missing data)								
Organization (mean)	3.375000	0.976281	1.000000	0.971014	0.989309	0.986583	0.990562	0.989695
Environment (mean)	3.333333	1.214986	0.971014	1.000000	0.995491	0.997009	0.994611	0.995234
Work demands (mean)	3.395833	0.887070	0.989309	0.995491	1.000000	0.999844	0.999961	0.999996
Tools etc. (mean)	3.386905	0.933277	0.986583	0.997009	0.999844	1.000000	0.999649	0.999794
Health (mean)	3.368056	1.020847	0.990562	0.994611	0.999961	0.999649	1.000000	0.999981
Productivity (mean)	3.372768	0.998892	0.989695	0.995234	0.999996	0.999794	0.999981	1.000000

General Linear Models

Table 15: General linear models comparing mean rating scores for work system components

Effect	**SS**	Degr. of Freedom	MS	F	p
Repeated Measures Analysis of Variance (2021-01-22 Data with					
Sigma-restricted parameterization					
Effective hypothesis decomposition; Std. Error of Estimate: 1.408					
Intercept	2674.036	1	2674.036	1347.835	0.000000
Error	83.326	42	1.984		
COMPONEN	0.382	3	0.127	3.046	0.031242
Error	5.263	126	0.042		

Table 16: General linear models comparing mean rating scores for work system components

Cell No.	COMPONEN	Org 3.9327	Env 4.0220	Work dem 3.8998	**Tools 3.9173**
Tukey HSD test; variable DV_1 (2021-01-22 Data with Reverse Scoring - Miria					
Approximate Probabilities for Post Hoc Tests					
Error: Within MSE = .04177, df = 126.00					
1	Organization (mean)		0.178608	0.877647	0.985162
2	Environment (mean)	0.178608		0.028426	0.081644
3	Work demands (mean)	0.877647	0.028426		0.978856
4	Tools etc. (mean)	0.985162	0.081644	0.978856	

Table 17: General linear models comparing mean rating scores for outcomes

Effect	**SS**	Degr. of Freedom	MS	F	p
Repeated Measures Analysis of Variance (2021-01-22 Data with Re					
Sigma-restricted parameterization					
Effective hypothesis decomposition; Std. Error of Estimate: 0.9914					
Intercept	1339.922	1	1339.922	1363.282	0.000000
Error	41.280	42	0.983		
OUTCOME	0.002	1	0.002	1.735	0.194876
Error	0.038	42	0.001		

Table 18: General linear models comparing mean rating scores for work system components split by sector

Effect	Repeated Measures Analysis of Variance (2021-01-22 Data with Re Sigma-restricted parameterization Effective hypothesis decomposition; Std. Error of Estimate: 1.3945 SS	Degr. of Freedom	MS	F	p
Intercept	1102.963	1	1102.963	567.1833	0.000000
Sector	5.541	2	2.770	1.4246	0.252554
Error	77.785	40	1.945		
COMPONEN	0.059	3	0.020	0.4546	0.714558
COMPONEN*Sector	0.101	6	0.017	0.3903	0.884024
Error	5.162	120	0.043		

Table 19: General linear models comparing mean rating scores for outcomes split by sector

Effect	Repeated Measures Analysis of Variance (2021-01-22 Data with Re Sigma-restricted parameterization Effective hypothesis decomposition; Std. Error of Estimate: 0.9809 SS	Degr. of Freedom	MS	F	p
Intercept	551.9684	1	551.9684	573.7030	0.000000
Sector	2.7957	2	1.3979	1.4529	0.245967
Error	38.4846	40	0.9621		
OUTCOME	0.0001	1	0.0001	0.1141	0.737261
OUTCOME*Sector	0.0005	2	0.0002	0.2632	0.769886
Error	0.0376	40	0.0009		