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A PREDICTIVE MODEL TO IDENTIFY CAREGIVERS AT RISK OF MUSCULOSKELETAL DISORDERS

by

ABDULELAH M. ALI B.S. Industrial Engineering, King Abdul-Aziz University, 2008 M.S. Industrial Engineering, University of Central Florida, 2012

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Industrial Engineering and Management Systems in the College of Engineering and Computer Science at the University of Central Florida Orlando, Florida

Spring Term 2016

Major Professor: Gene Lee

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ABSTRACT

Healthcare systems face several challenges due to the aging workforce, recruitment shortages, increasing patient acuteness, and increasing patient size and weight. The most costly, leading, and prevalent problem in the healthcare industry and nursing professions is work-related Musculoskeletal Disorders (MSDs). MSDs are common among caregivers because of the nature of their work, which requires repetitive heavy physical activity. The development of MSDs among caregivers negatively impacts the quality of care, and incurs high costs such as worker compensation, days away from work, turnover, rehabilitation, and lower productivity. Therefore, it is essential to determine the factors that contribute to musculoskeletal disorder injuries among caregivers, in order to reduce or eliminate risks within healthcare environments which might cause such ramifications.

This dissertation develops a framework to identify risk factors for MSDs and to determine which ones show significant contribution to be included in a developed predictive model. The data was obtained from caregivers who work in Saudi Arabian healthcare institutions, with 104 participating nurses to determine which risk factors would be included in the predictive model. Logistic regression analysis was used to investigate the association of the identified work related and non-work related risk factors for musculoskeletal disorders in healthcare organizations among caregivers. The development of the predictive model provides insights into risk factors which can guide the development of policies and recommendations to reduce and eliminate the development of MSDs among caregivers.

To my beloved mother Samia Mansoury, who always prays for me and motivates me To my beloved father Mamdouh Ali, who has inspired and supported me To my wonderful sister Halah Ali, who has supported and helped me Without you all none of my success would have been possible

ACKNOWLEDGMENTS

I would like to express my special appreciation and thanks to my advisor Dr. Gene Lee, you have been a tremendous mentor for me. I would like to thank you for your endless encouragement in my research and for allowing me to grow as a research scientist. I am extremely grateful to my committee members Dr. Ahamd Elshennawy, Dr. Luis Rabelo, and Dr. Ahmad Rahal, I have learned a lot from you and thank you for sharing your knowledge with me.

I would also extend my thanks to all of the faculty and staff in the Department of Industrial Engineering and Management Systems at the University of Central Florida (UCF) who directly and indirectly contributed to my doctoral study.

Special thanks to my parents, family, friends, and colleagues. Words cannot express how grateful I am for all of the sacrifices that you've made on my behalf. Your prayer for me was what sustained me thus far.

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LIST OF ACRONYMS/ ABBREVIATIONS

ANA	American Nurses Association
HFE	Human Factor and Ergonomics
MSDs	Musculoskeletal Disorders
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
РН	Patient Handling
SPH	Safe Patient Handling

CHAPTER ONE: INTRODUCTION

1.1 <u>Overview</u>

In the past few decades, many articles have been published which give emphasis to the roles that both quality and Human Factors and Ergonomics (HFE) have in caregiver and patient safety. In any industry, maintaining high quality requires the most important measures which need to be implemented to the highest level in order to reach the customer (patient) satisfaction. More specifically, the healthcare industry is a critical industry that has to apply quality in all areas since professionals handle people's lives and health. In order to improve the quality of care in the health care industry, great attention needs to be given to the patient and caregiver.

Therefore, healthcare providers have to reach levels of perfection in terms of service delivery, reliability, and safety. Patients are being admitted to hospitals in order to receive a high level of care, and it is essential that they receive high quality care in a non-harmful healthcare environment. An unsafe healthcare environment leads to numerous ramifications such as high costs, permanent injury, and even life threatening incidents.

On the other hand, caregivers and nurses face too many challenges while performing their everyday duties. One of these challenges is performing high-risk tasks such as Patient Handling (PH) / Manual Handling. Manual patient handling tasks are considered to be one of the leading causes to the development of Musculoskeletal Disorders (MSDs). Healthcare providers and caregivers should have greater awareness and receive more attention regarding their physical health, fitness, and capability in order to perform their jobs and tasks safely without harm to themselves and their patients. Since caregivers are responsible for taking good care of others, they must first know how to take good care of themselves. Moreover, caregivers must have full awareness regarding occupational hazards and injuries that might happen to them in workplace as well as how to prevent such injuries from happening.

Patient handling is one of the most important duties that caregivers have to frequently perform. As a result of frequent exposure to these risks, too many injuries have occurred while performing this repetitive heavy physical activity. Therefore, caregivers face a multitude of challenges with safe patient handling (SPH).

For that reason, it is an important objective to minimize or eliminate the risks within healthcare environments which might cause such consequences. Accordingly, there is a need for more improvement in terms of patient and caregiver safety and the building of non-dangerous healthcare environments.

The objective of this research is to develop a predictive model that will determined the association of work related and non-work related risk factors with repetitive heavy physical activity such as manual patient handling activities, which are considered to be high-risk tasks in healthcare settings (Fadul, Brown, & Powell-Cope, 2014), in order to prevent musculoskeletal disorder (MSD) injuries and consequences for both patients and caregivers. The predictive model will also determine the relationship between caregivers' everyday tasks and musculoskeletal disorders.

1.2 <u>Research Problem Statement</u>

The healthcare system is one of the most critical systems and is facing many challenges due to the aging workforce, recruitment shortages, increasing patient acuteness, and increasing patient size and weight (Letourneau, 2013; "Safe patient handling can reduce MSDs in residential care industries, OSHA says," 2014). Moreover, if any injury occurs to a caregiver while they are performing their job, there will be a high cost associated with the incident such as rehabilitation, absence from work, and workers' compensation. Figure 1.1 presents injuries and illnesses rates which result in days away from work and in each average occurring case 11 days away from work are required (BLS, 2012).

Hospitals are considered the most hazardous place that one can work in, even compared to a heavy physically demanding occupational areas such as construction. In addition, injuries and illnesses reported for caregivers were considerably more than the injuries and illnesses reported for construction workers. Approximately 50% of the reported incidents for caregivers were musculoskeletal disorders MSDs ("Safe patient handling can reduce MSDs in residential care industries, OSHA says," 2014).

Furthermore, a shortage in available nursing staff is a problem presented by an aging workforce. As the nursing workforce ages, more nurses are entering retirement. Also, the recruitment level of nurses has decreased due to high possibility of disabling injuries. In some studies, it has been shown that the risk of serious injury for caregivers is seven times higher than any other occupation (Enos, 2013).

The increases in patient size and weight complicates the problem of overexerting caregivers' musculoskeletal system. An increase in patients' size and weight places a greater strain on the caregiver. Another problem is that the use of proper body mechanics alone has not been effective in reducing disorders from lifting patients (Krill, Staffileno, & Raven, 2012). Combined, all of these problems place caregivers at a high risk of musculoskeletal disorder.

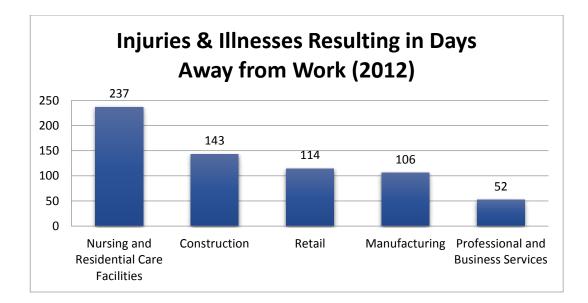


Figure 1 Injuries & Illnesses Resulting in Days Away from Work - Cases per 10,000 Full Employee (2012) adapted from Bureau of Labor Statistics

The problem is that Work Related Musculoskeletal Disorders (MSDs) in healthcare and especially in nursing are the leading occupational health problem in the United States, and the most costly (Nelson, Harwood, Tracey, & Dunn, 2008). There is a need to understand the association of MSDs and risk factors during manual patient handling activities and other activities that caregivers have to perform daily in order to reduce or eliminate their effect on caregivers.

This means that there is a need to understand the relationship of the impact of risk factors on MSDs in order to determine the controllable risk factors which can help in reducing their occurrence. In response to these challenges, it is crucial to develop a predictive model based on risk factors, as well as identifying and prioritizing high risk factors associated with manual patient handling in order to prevent injuries and reduce its financial impact to healthcare provides. Also, there is a need to understand the implications of those risk factors on the musculoskeletal disorders.

1.3 <u>Research Objectives</u>

The purpose of this research is to determine which factors contribute to injury resulting from caregivers' daily tasks such as manual patient handling tasks, and to prioritize those factors. This research also seeks to develop a predictive model in order to determine the association of the identified work related and non-work related risk factors with the musculoskeletal disorders. This model will allow for the identification of factors which can be managed and controlled in order to reduce the prevalence of musculoskeletal disorders among caregivers.

The information from this research can be used to develop and assist current policies on manually lifting, which in turn will prevent serious injury to the patient and caregiver. It will also help set standards in the decision making processes which nurses use to determine the best way to move or transfer patients. This information can be used to conduct further research on mechanical lifts and injuries. The objective of this research is aimed at predicting the development of MSDs in caregivers, as well as identifying and prioritizing high risk factors that contribute to injury and MSDs when performing heavy physical responsibilities.

Correspondingly, this study will develop a predictive model to understand the relation with risk factors from caregivers' activities and musculoskeletal disorders. The model will further identify which factors can be controlled in order to reduce the occurrence of MSD incidents. To accomplish these aims, this study seeks to:

- Examine the correlation between work related and non-work related risk factors with musculoskeletal disorders
- Develop a predictive model for musculoskeletal disorders among caregivers
- Determine from the model which risk factors can be controlled and how MSDs could be prevented

1.4 <u>Research Questions</u>

In order to identify, prioritize, and develop the predictive model to understand the relation of work related and non-work related risk factors which are linked with heavy physical tasks that cause musculoskeletal disorders, this research intends to answer the following questions:

- Should the predictive model include only work related risk factors, or both work related and non-work related risk factors?
- Among the significant risk factors included in the predictive model, what are the manageable factors?

1.5 Contributions of this Research

This research will make contributions to the knowledge of Human Factors and Ergonomics (HFE) in healthcare systems by developing a predictive model that will determine the association of work related and non-work related injury risk factors with musculoskeletal disorders while caregivers perform their daily responsibilities manual patient handling. It will also provide support for current policies of manual patient lifting and Work Related Musculoskeletal Disorder (MSDs). These contributions are important for reducing injuries among caregivers and patients alike. A noticeable decrease in injury will help by increasing staffing levels and patient levels. Also, a decrease in injuries among caregivers will result in a decrease in lost time and the amount of worker compensation claims filed as well as days away from work. Caregivers who are supported by better injury prevention policies will feel they are at a lower risk of being injured while working. Subsequently, this will have a substantial impact on a hospital's financial status, caregiver job satisfaction, and eventually result in the improvement of the overall quality of care.

CHAPTER TWO: REVIEW OF PREVIOUS RELATED LITERATURE

2.1 Introduction

Nursing is one of the top ten occupations for work related disorders. As a result in unfavorable conditions in moving and transferring tasks, nurses are susceptible to developing musculoskeletal disorders (BLS, 2012). Traditional lifting and body mechanics training was used to reduce injuries, but have continuously failed (Krill et al., 2012). Furthermore, healthcare workers such as caregivers rank amongst the worker group which has the highest rates of developing work related musculoskeletal disorders (BLS, 2012). Additionally, those injuries are leading to a higher rate of days away from work (Fadul et al., 2014; Olkowski & Stolfi, 2014). According to Carayon, many of the accidents that patients and caregiver experience are a result of a flaw in ergonomics (Carayon, Anping, & Kianfar, 2014). "Be Well Work Well" (Sembajwe et al., 2013).

It is very important to recognize the relation between manual patient handling and musculoskeletal disorders because of the evidence presented by various researchers. First, caregivers have been found to be increasing in age, with the average age of nurses being 44.3 years. With this average age, it is important to adopt strategies to retain nurses (Long, Johnston, & Bogossian, 2012), which is considered to be critical if caregivers from this group suffer from musculoskeletal disorders. Consequently, MSDs will account for caregiver shortages (Graham & Dougherty, 2012).

Age is a factor associated with increased risk for work related injury. Younger workers tend to have less experience or exposure which makes them more prone to injuries. A study by Siow, Ngan, Yu, & Guzman observed age and job length and how they contribute to injuries. New workers consisted of individuals who were hired within the past six months, and young workers were individuals 24 years old and younger. Their findings determined that young and new workers were at a high risk for cuts or punctures, but at a low risk for musculoskeletal disorders. Older, more experienced workers were found to be at the highest risk due to repeated exposure. It was suggested that strategies be developed to evaluate the risks (Siow, Ngan, Yu, & Guzman, 2011)

Due to the obesity problem, patient weights are growing, such that 300lb patients are very common to see in hospitals, and this factor would increase the risk of musculoskeletal disorders to caregivers. Furthermore, the obesity issue in the United States results in problems for caregivers (Graham & Dougherty, 2012; Randall, Pories, Pearson, & Drake, 2009). More than 50% of the US population are either overweight or suffer from obesity. This means that heavier patients are being handled, and patient weight is becoming a significant component that increases the risk amongst caregivers to develop musculoskeletal disorders (Watters, 2008).

Manual patient handling activities are considered to be hazardous even under normal weight patients. However, it is even more dangerous to caregivers, and it is increasing their risk of musculoskeletal disorders (N. N. Menzel, Hughes, Waters, Shores, & Nelson, 2007). The patient obesity problem is not only seen in adult healthcare facilities, but it is also occurring in pediatric settings as well. Obesity is increasing among children, with rates of approximately

20%, and now it is two times what it was in the last 25 years (Haglund, Kyle, & Finkelstein, 2010).

Caregiver injuries increase costs for organizations through workers' compensation. Effective manual patient handling helps reduce injuries and in turn reduces costs (Cantrell, 2013). For example, between 2006 and 2010, the University of Wisconsin Hospital and Clinics (UWHC) reported that the cost associated with manual patient handling activities from caregivers' claims through workers' compensation was starting from \$114,000, reaching up to \$814,000 per year (Stevens, Rees, Lamb, & Dalsing, 2013).

2.2 <u>Culture of Safety</u>

Hallmark has examined safe patient handling practices and factors that impact those practices. The injuries that nurses and nurse assistants experience result from moving patients. Organizations recommend not lifting more than 35 pounds to reduce injury. This can be accomplished by using lifts and other equipment, however the high cost of equipment unawareness hinders organization from preventing hazards. Implementing a program that incorporates equipment will be cost effective over time because it reduces the need for additional staff and compensation paid to injury claims. Continued efforts are being made to create a culture of safety in healthcare. Early education is an important key and safe handling, and should be a part of nursing school curricula, yet finding equipment to teach students with is an issue for some institutions. Leaders of different organizations need to make it known that care giver safety

is a priority. Many different safe patient programs can be selected from when a facility is implementing a program. Institutions should model one that would best suit their needs based on assessments, and pilot programs can be implemented to accomplish this. Support leaders should be selected because they are a key in influencing and sustaining a program. Different types of equipment can be designed to aid in different types of lifts, and selections can be made on the equipment from various vendors that meet the needs from the assessment. Caregivers should be provided with annual education updates to show support in maintaining programs. As a patients' needs change, so should the mobility assessment and plan of action. Since injuries do occur, facilities need to have a plan of action to rely on. Evaluations of the programs impact should be on going. To create a safe culture, all department professionals need to support a safe patient handling program (Hallmark, Mechan, & Shores, 2015).

Examples have been put forward by researchers for applying this culture of safety with the help of using technology in healthcare industry. Duffy suggests analyzing new and existing research by focusing on a list of ten specific questions known as the "list of 10 ways". This list incorporates aspects of the scientific method, and identifies new areas to study. The culture of safety is described as having impacts all over the field of healthcare. With new technological advances, medical errors can be reduced through a variety of ways. E-prescribing is described as time saving and has the potential for better safety outcomes. The safety impact of e-prescribing is unclear due to the open availability of use of the system to other staff, and there needs to be more openness to adopt new systems. Duffy suggests that safety is hindered by a lack of such openness. The bar coding system, which promotes openness, was developed for administrating

medication alerts to address potential concerns in safety. It is proposed that human errors can be reduced by 50 percent with new technological systems. Duffy calls for more research to determine how efficient these contributions improve practices (Duffy, 2011).

2.2.1 Culture of Patient and Caregivers Safety

The institute of medicine suggests adopting a culture of safety to improve patient and caregivers' safety. The current culture of safety must first be assessed, to help identify strengths and weaknesses in the facility. Creating trusted communication and shared perceptions are characteristics of a safe culture. Stavrianopoulos reviewed literature on developing a culture of safety, and found that developing a safe culture included seven broad areas: leadership, teamwork, care based on evidence, communication, learning, a just and balanced accountability, and care centered on patient needs. Strong supportive leadership is needed for success in sustaining positive safe culture. If leadership does not support changes in culture, then the changes will not be sustainable over time. The results of this study show that more attention needs to be given the characteristics of developing a safe culture because human factors impact perception, which in turns effects any changes in culture that are being implemented (Stavrianopoulos, 2012)

2.2.2 Caregivers and Safety Culture

Implementing safe patient handling programs has been slow. Among caregivers, women represent the majority of caregivers in the medical field. Caregiving is physically and emotionally demanding, and most of the time caregivers place the needs of others before their own. The focus for improving safety needs to be on a combination of patient care and giver safety. Hignett's paper studies how engineering products could contribute to safety and how new designs and principles apply to safety. Musculoskeletal disorders are still prevalent. Even with an understanding of human factors and ergonomics, sustaining safe patient handling programs is a challenge. This is where designing products can help. The products that nurses use can be designed to cut risks and reduce human errors. Efficient training on the newly designed products is necessary to understand any enhancements made to products. Higher also highlights that a culture of safety needs to be established and maintained. For instance, efforts in safe culture need to be made when a patient is transitioning between units. New designs can help minimize such risks in the healthcare environment. The importance and relevance of human factors and ergonomics is gradually growing. This growth in safe practices is protecting both caregivers and patients (Hignett, Carayon, Buckle, & Catchpole, 2013)

Many nursing homes are transforming from an institution-like culture to a culture that encompasses an elder quality of life. A study by Burack focused on factors that impact an elder's quality of life, such as staff and the environment. This change in culture is still growing among nursing home facilities. Many holistic changes have resulted in an increase of satisfaction of care. A change in culture impacts multiple domains of a facility. In Burack's study, the factors that impact an individual's quality of life were examined in relationship to nursing home satisfaction.

The results found a positive correlation between an elder's satisfaction of care with not only the physical well-being but also a spiritual and psychological well-being. Dignity was the most important factor of satisfaction with staff and includes aspects such as personal coverings to communication. Spiritual aspects and food enjoyment impact the perception and satisfaction between elder and nursing home. The results support culture change in dining and spiritual experiences (Burack, Weiner, Reinhardt, & Annunziato, 2012)

For example, managers in Sweden developed an approach to transfers based on the situation. This approach included assessments and plans of actions. The study examined if these plans and assessments improved life and work at elderly care homes. All employees from two care homes in northern Sweden were interviewed and completed risk assessments for providing care to their patients. Of the assessments that showed risks would be involved in moving the patient, the employee was then required to develop a plan of action to reduce risk. This type of intervention improved overall safety.

Moreover, many of the caregivers who were interviewed described this approach as beneficial to caregivers as well as to patients. All but one of the caregivers deemed the assessments as practical in daily application. The assessment highlighted the patient's abilities as flexible and changing. This helped caregivers adjust the plan of actions needed to transfer the patients safely. The assessment and plans of action highlighted awareness to new approaches among the employees. Assessments take into account daily changing needs of the elderly patients. The results of another study found that team assessments improved life and work for caregivers and patients (Skoglind-Ohman & Vayrynen, 2013)

2.2.3 Culture Safety: Caregivers' Perception

In healthcare, back injuries are caused by moving and lifting patients or equipment. Limited space is a factor that contributes to injuries because of the awkward positions that nurses have to work in. Manual patient handling is complex and often one type of intervention strategy is not universal in reducing injuries. For this reason, many administrators are in support of multidimensional programs. Holman has examined nurses' perceptions of safety in regards to environment, culture, and organization. To obtain perceptions, nurses were asked to complete a survey on their working environment. The results show that nurses deem or perceive the most difficult transfers to be within confined spaces. For example, most bathrooms have limited space and the probability that lifting equipment will fit in the bathroom is low. Emergency situations do not permit time to utilize lifting equipment. Some facilities do not even have lifting equipment available for use. Nurses perceive the organizations they work for as promoting safety but place emphasis on patient needs above their own safety needs. This study can aid in the future development of safe patient handling programs and equipment (Holman, Ellison, Maghsoodloo, & Thomas, 2010)

2.3 **Quality in Healthcare**

Different aspects of healthcare should be considered to ensure quality services are delivered to patients. Carayon has identified six dimensions that should be used to define quality healthcare: safety, effectiveness, patient-centered care, timeliness, efficiency, and equity (Carayon, 2012). Moreover, those six objectives for improvement in healthcare can be explained as the following (Ransom, Joshi, & Nash, 2005):

- Safety: The level of care in healthcare facilities must be very safe for both caregivers and patients as if they are in their home.
- Effectiveness: Application of healthcare resulted from sciences and evidence must function as standard in providing care.
- Efficiency: Cost associated with delivering care and services must be effective and waste must be eliminated form healthcare system.
- Timely: When delivering care and service for patient, they must not experience any waiting or delays.

- Patient Centered: Healthcare system must be focusing in patients and respect patients' preference and them in control.
- Equitable: All patients must receive treatment equally and any differences between patients should be eliminated.

According to Manjunath, healthcare services should be defined by managers as a construction of quality (Manjunath, 2008). Currently, there is an important role for quality in the healthcare system, especially in improving the quality and decreasing adverse events that would undesirably affect the safety of both caregivers and patients (Polites et al., 2014).

2.4 Human Factors and Ergonomics (HFE)

In the healthcare field, Human Factors and Ergonomics (HFE) encompasses many aspects, from work stations to patient moving. Injuries from handling patients result in missed days from work and high costs to facilities. The high statistically probability of sustaining a musculoskeletal injury makes implementing a safe handling program important. Many guides were developed to promote awareness of safe patient handling and in turn many facilities enacted safe patient handling programs (Hallmark et al., 2015).

Some progress has been made in implementing safe handling procedures. Relevant areas for progress are slow or overlooked. There are opportunities for science to change and improve safety. Salas provides insights to promote changes in safety, revealing that there are several areas for improvement that the medical community is interested in. Human factors and ergonomics is a credible science and has had positive impacts where it has been implemented. More research in natural settings and studies on different strategies are a few of the things that can be done in the future. There is a high demand for more success in this area. The successful safety changes made in healthcare represent an area to model after as long as other areas are also taken into consideration. All parties involved with improving safety must reach an understanding of the importance of forming partnerships. It is important to show that the science supporting ergonomics and human factors matters in improving safety. Communication of findings and conclusions is essential in creating change. Educating the relevance is imperative (Salas, Baker, King, & Battles, 2006).

2.4.1 Implementing Human Factors and Ergonomics in Healthcare

Incorporating ergonomic programs are complex and often result in less concern of employee safety. However, Missar focused on three areas an acute-care facility improved on. The first was hazard identification, the second was reducing the need for employees to lift patients for transfers, and the third area involved implementing a five step program. Reports showed that the majority of injuries reported were from manual patient handling activities. To aid in improving safety, the facility hired a professional ergonomist. A program was developed to address ergonomics and safety issues.

First, hazards were assessed and corrected which provided aid in being proactive towards safety instead of reactive. Over 100 employees were trained in preventing and controlling hazards. Then these employees were spread across all shifts and all areas of the facility. When hazards were identified, the employee signed on to a web-based program and filed a report that notified the correct department. A monthly goal was set to identify hazards to maintain focus on the program. This program was 92 percent effective in identifying hazards.

Second, the ergonomist over saw equipment purchasing and lifting team development. The lift team focused on training each member for a specific lifting procedure. The equipment purchased was reviewed to ensure it would be utilized. Compliance with equipment and lifting teams reduced the occurrence of injuries significantly.

Thirdly, the five step program implemented aspects of organization. This helps eliminate tripping hazards. This program progressed in phases and once a group passed one phase the next phase was added on to the first phase. After four years, this facility has shown significant improvement in the number of monthly employee injuries (Missar, Metcalfe, & Gilmore, 2012)

2.4.2 Human Factors and Ergonomics and Safety

Patient and caregiver safety is a huge concern in the healthcare community. While most specialists focus on improving one certain area, ergonomics and human factor specialists focus on the whole facility. A human factors and ergonomics specialist can assess risk factors that contribute to an unsafe environment because they have a better understanding. They can improve upon the situation and the healthcare facility. A specialist is better equipped to make recommendations for change than other experts who conduct investigations. They can design ways to reduce human error whereas other expert could only emphasize using a more careful approach or more education.

A human factors ergonomics specialist offer many tools and solutions to improve safety that can be sustained over time. Healthcare facilities need to avoid quick fixes and apply sustainable solutions. More human factors and ergonomic specialists are needed as well as efforts in changing design of products to avoid potential hazards. A change in regulations that would require the knowledge of a specialist would also impact the improvement of safety. Incorporating the science of systems and improving communication would also improve safety. Progress in safety is achieved by embracing the knowledge of human factors and ergonomic specialists (Gurses, Ozok, & Pronovost, 2012).

2.5 Patient Handling (PH)

Patient handling (PH) is identified as the primary cause of musculoskeletal disorders. Also, a substantial number of patient handling tasks injuries result in MSDs (Black, Shah, Busch, Metcalfe, & Lim, 2011; Darragh et al., 2013; Garg & Kapellusch, 2012; Lee, Faucett, Gillen, & Krause, 2013; Stubbs, 2009). Amongst caregivers, injuries caused by patient handling activities account for 31-66% of entire musculoskeletal disorders incidents (Lee et al., 2013). Pompeii pointed out that almost 33% of musculoskeletal injuries are caused by PH activities (Pompeii, Lipscomb, Schoenfisch, & Dement, 2009). There is clear evidence that caregivers are injured more than patients when they are performing any task that has a physical demand such as patient handling (Stubbs, 2009).

Moreover, patient handling contributes to an enormous number of MSDs (Olkowski & Stolfi, 2014; Reme et al., 2014; Stubbs, 2009). Lifting and moving a patient is a main factor that contributes to musculoskeletal disorders in nurses (Lowe, Douglas, Fitzpatrick, & Golub-Victor, 2013; Oermann, 2013). Manual handling has been deemed unsafe and resulted in injuries to workers which impacted costs with high worker compensation claims (Stevens et al., 2013).

Caregivers are at high risk due to the nature of their job, because their job carries a high physical demand. This risk is even increasing when caregivers are performing patient handling tasks and activities (Yassi & Lockhart, 2013). It is also important to remember that when caregivers are performing patient handling activities such as patient transfers, they also have to do other tasks such as adjusting the bed brakes and moving the patient. This is another element that participates in increasing caregivers' risk of developing work related musculoskeletal disorders and injuries (S. Kim, Barker, Jia, Agnew, & Nussbaum, 2009).

Kim explores the relation and assesses the connotation between patient handling (PH) and musculoskeletal disorders (MSDs) through workers' compensation claims (WC) filed during 2003-2009 by healthcare workers. His study shows that from the 3,452 claims, 76% of those claims were recognized as MSDs. This study determined that just about 50% of the MSDs claims resulted from patient handling activities.

Furthermore, figure 2.1 clearly shows that high percentage of musculoskeletal disorders resulted from performing patient handling among caregivers (H. Kim, Dropkin, Spaeth, Smith, &

Moline, 2012). Also, Lipscomb has supported Kim's study, findings from workers' compensation claims filed by caregivers from two hospitals (n=1,543) that patient handling was accountable for 72% of musculoskeletal disorders. Also, it was found that PH is liable for 53% of caregivers' compensation costs (Lipscomb, Schoenfisch, Myers, Pompeii, & Dement, 2012)

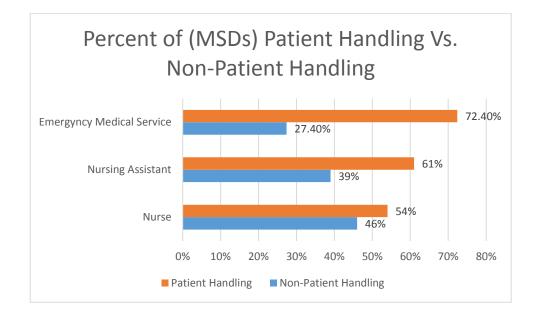


Figure 2 Percent of (MSDs) Patient Handling Vs. Non-Patient Handling

According to Waters and Rockefeller, patient handling is identified as one of the most physically demanding everyday jobs that performed by caregivers. Furthermore, patient handling is considered as a critical factor for MSDs, performing patient handling task will increase the risk of developing musculoskeletal disorders (T. R. Waters & Rockefeller, 2010). Holtermann et al. emphasized that patient handling activities are the leading reason of lower back pain amongst caregiver (Holtermann, Clausen, Jørgensen, Burdorf, & Andersen, 2013). Unsafe patient handling results in injuries and increased medical costs for patients and caregivers (Engel & Love, 2013). In order to have a considerable reduction in musculoskeletal disorders (MSDs) among caregivers, more attention must be given to patient handling (H. Kim et al., 2012).

The National Institute for Occupational Safety and Health (NIOSH) has recommended that if an object is being lifted, its weight should not exceed 51 lbs under ideal circumstances. However, in patient handling, the case is different and the caregiver should not lift more than 35 lbs. The NIOSH lifting equation, from material handling, is not applicable in patient handling because of the several reasons (Thomas R. Waters, 2007). First, it is very difficult to predict patient' movements. This lifting scenario is different from a static object. There are additionally no handgrips when lifting patients, making them more difficult to handle than boxes which can be ergonomically designed to incorporate grips. Lastly, patient size prohibits caregivers from getting close to the loads they lift, meaning they lift in extended positions.

Lifting equipment can provide safe patient handling for both patients and caregivers. Nevertheless, the actual availability and caregiver usage of such equipment is far from ideal (Lee et al., 2013). Hignett review the related literature, between 1960-2003, of interventions that have been made to reduce the risk of injuries occurring to caregivers while performing patient handling activities. Hignett concluded that providing training to the caregivers will not change the manual handling practice. Also, he stated that there was no change in the rate of injuries even if training were provided (Hignett, 2003).

Therefore, performing patient handling activities will possibly require caregivers to be more experienced and well trained in physical demand, due to patient weight and their dependability (Lemo et al., 2012).

2.5.1 Manual Patient Handling

Safe patient handling policies have had little success in preventing injuries. Some strategies have been developed to go along with safe handling programs but have had little success in light of the rate of injuries reported. Kay reviews the interventions developed for manually handling practices. Manual handling encompasses more than just using hoists for lifting and moving patients. For example, it involves twisting and turning or even moving equipment. The main focus in injury prevention has been on utilization of hoists. Prevention strategies need to be tailored around people because unlike inanimate objects people can move when transferring them. The term "manual handling" needs to be redefined to include other physical characteristics. When statistically reviewing injury rates, consideration needs to be given to incidents that may go unreported. The biomechanical model explains how loads impact the musculoskeletal system. It explains how the load impacts the forces generated to perform the tasks. The lack of evidence of excessive forces and risk of injury may be preventing the success of some programs (Kay, Glass, & Evans, 2014).

Many studies on this topic have contributed important findings for prevention strategies. The impact of injuries is both physically and emotionally taxing. For organizations, injuries impact them directly and indirectly also. Techniques to improve the risk of injury generally focus on education or incorporating other programs. A strategy that is multi-dimensional needs to be adopted to prevent injuries, one that encompasses ergonomics. The context in handling activities needs to be taken into consideration when developing strategies.

A culture of safety needs to be developed from individual beliefs and attitudes which can be influenced by the organizational show of safety commitment. To achieve a higher level of safety, human error should be factored in and designs should reflect that knowledge accordingly. The risk of injury from manually handling still exists which supports the need for the development of more strategies and programs (Kay et al., 2014)

2.5.2 Safe Patient Handling and Movement Program (SPHM)

According to Powell-Cope, even though equipment for transferring and repositioning patients is available, it has not been found to be effective in reducing MSDs. Although education and training were provided to caregivers, the injury rate in the United States is increasing (Koppelaar, Knibbe, Miedema, & Burdorf, 2009; Powell-Cope et al., 2014). As a result of injuries, safe patient handling programs have been implemented. Safe patient handling programs contain specific polices in regards to lifting and equipment. Rehabilitation professionals are resistant in some cases due to the belief that the use of equipment in the rehabilitation process impedes functional independency (Theis & Finkelstein, 2014).

Safe patient handling and movement programs have been implemented in transferring patients due to the large number of musculoskeletal injuries that have resulted in the healthcare setting. Nurses may have a positive impact on implementing programs due to their knowledge of patient care, nursing procedures, and organizational requirements. Even though it is well known that manually lifting patients can lead to musculoskeletal disorders, it is still commonly done to move patients. There is strong evidence that proper body mechanics alone is not enough to reduce injury rates.

Sedlak examined a nurse's role in influencing a movement program and how that impacted injuries and costs. Data was collected one year before the program was implemented and one year after. The program incorporated specialized equipment for moving patients. The results show that in this extended care facility, a safe handling program could decrease the number of injuries related to moving patients. As a result of the decrease in injuries, there would be a decrease in costs paid out for claims and compensation. These findings lend support to the claim that nurses can impact and influence safety changes. Preventing injuries will save costs to the facility and improve morale among nurses (Sedlak, Doheny, Jones, & Lavelle, 2009).

On the other hand, regarding safe patient handling and mobility programs, it is important to explore efforts in order to discover the most effective procedures for using patient handling equipment (Darragh, Shiyko, Margulis, & Campo, 2014). Even with the installation of safe patient handling equipment, manually lifting of patients continued at the University of Wisconsin Hospital and Clinic (UWHC) (Stevens et al., 2013). In addition, Letourneau stated in his review of the related literature that in a setting where Safe Patient Handling and Movement (SPHM) programs are implemented, there is a decrease in caregiver injuries and an increase in employee satisfaction. An alternate to SPHM are lift teams. Lift teams consist of individuals who are physically fit and specifically trained in high risk transfers. Physical therapists and occupational therapists are other professional who experience musculoskeletal disorders but perceive the injury as a negative reflection on themselves and may change their professional focus (Letourneau, 2013).

A SPHM program would be beneficial to physical therapists and occupational therapists. In rehabilitation centers patients receive higher functional independence measures when a SPHM program is implemented and fears that patients will become dependent on mechanical lifts were not supported. Nursing schools are incorporating more SPHM programs into their curriculum. SPHM contributes to longevity of organizations that implement them (Letourneau, 2013).

2.5.3 Patient Handling, Lifting, and Transferring Equipment

The practice of using handling, lifting, transferring, and repositioning equipment is limited between the caregivers because either the equipment is not available or time is insufficient to use the equipment (Lee, Faucett, Gillen, Krause, & Landry, 2010; Porter & Choi, 2015). Some caregivers don't have available handling equipment, and even if it was available they don't prefer to use them due to the following (Callison & Nussbaum, 2012; Koppelaar et al., 2009):

• Caregivers are not aware whether the handling equipment is available or not in their unit

- Caregivers observe that using handling equipment will take more time than manually transfer
- Caregivers notice that it is difficult to use handling equipment
- Caregivers realized that space constraints in the place that they want to use handling equipment
- Patients have a preference that caregivers to perform handling, lifting, repositioning, or transferring instead of equipment

Concerning patient handling equipment, availability of those devices alone may possibly not be helpful to ensure caregivers safety. On the other hand, there are many reasons that handling equipment can be ineffective in order to reduce physical demand for caregiver such as unavailability of patient handling equipment when needed, shortages in providing sufficient training in the use of those equipment, and caregivers believe that it is difficult to use and takes more time than manual handling (Mehta, Horton, Agnew, & Nussbaum, 2011).

On the other hand, there is a doubt of how practical, usable, and feasible that equipment is for both caregiver and healthcare facilities (Roll, Czuba, Sommerich, & Lavender, 2012). Also, there is a lack of evidence indicating that patient handling equipment is suitable and applicable for particular population, patients who are exceedingly overweight and oversized (Galinsky, Hudock, & Streit, 2010). There are some design and logistical constraints which complicate patient handling devices. For that reason, it cannot be certain that lifting equipment could help in decreasing the risk of work related musculoskeletal disorders (Burdorf, Koppelaar, & Evanoff, 2013). According to a recent study, there is no definite positive impact on risk reduction of developing musculoskeletal disorders and the use of handling equipment (Holtermann et al., 2015). Furthermore, there some obstacles that face the healthcare industry in order to use patient handling equipment and devices, and those obstacles are (Monaghan, Murray, Severson, & Kissing, 2013):

- Resistance from either patients themselves or their family
- Resistance from caregivers
- Financial resources shortage for healthcare providers
- Environmental difficulties such as (room size and storage space)

2.6 <u>Musculoskeletal Disorders (MSDs)</u>

Musculoskeletal disorders (MSDs) are considered to be the leading reason for and workrelated injuries amongst caregiver in the U.S. and are the most common. (Garg & Kapellusch, 2012; Jakobsen et al., 2014; H. Kim et al., 2012; Stubbs, 2009; T. Waters, Collins, Galinsky, & Caruso, 2006; Thomas R. Waters, Nelson, & Proctor, 2007). Furthermore, caregivers have a tendency to have musculoskeletal disorders and injuries at higher rate comparing to other occupational group population (Graham & Dougherty, 2012; Yassi & Lockhart, 2013).

Musculoskeletal disorders injuries produced by patient handling activities occurs at high rates among caregivers. Furthermore, musculoskeletal disorders MSDs are increasing among caregivers due to handling, lifting, transferring, and repositioning patients. Manually assisting patients is physically demanding and often results in back injuries. Musculoskeletal disorders arise from repetitive risky handling and overexertion. The recommended weight limit for handling is 35 lbs. under optimal conditions (T. Waters et al., 2006). Additionally, musculoskeletal disorders occurs in almost 43%-78% between caregivers (Jellad et al., 2013).

Furthermore, musculoskeletal disorders are considered to be a worldwide phenomenon (Schoenfisch & Lipscomb, 2009). For example, in Sweden, musculoskeletal disorders have accounted for almost 33% of all sick leave time (Hubertsson, Petersson, Arvidsson, & Thorstensson, 2011). Correspondingly, musculoskeletal disorders and injuries in caregivers are pricey and it frequently occurs between them (Nelson et al., 2006). Also, in Nigeria, 84.4% of surveyed caregivers (n=118) had suffered from musculoskeletal disorders at one point in their career, mostly in their lower back (Tinubu, Mbada, Oyeyemi, & Fabunmi, 2010). Another example stems from a large teaching hospital in Japan. Between 844 caregivers participating in the study, 85.5% had experienced musculoskeletal disorders at any part of their body in the past 12 months from the time they responded (Smith, Mihashi, Adachi, Koga, & Ishitake, 2006). In the United Kingdom, a study has been conducted over 10 years periods, and given that the working population was approximately 25 million workers, musculoskeletal disorders every year bring about 52 million days away from work, or as they call it in the study, "lost working days" (Macfarlane et al., 2009). Another study in Canada shows that among caregivers in nursing homes, only 37 MSDs injuries and illnesses per 100 full time workers was reported (Thomas & Thomas, 2014).

Simply put, musculoskeletal disorders and injuries are occurring in caregivers when working physical demand exceeds caregivers' physical capacity (Jakobsen et al., 2014). Currently, there are several approaches being applied among caregivers in order to reduce their chance of having musculoskeletal disorders from patient handling tasks such as training and education in caregivers' body mechanism, manual handling, lifting, transferring, and repositioning techniques, and the usage of back belts. Nevertheless, studies and researches suggested that those methods are not showing significant outcomes in decreasing MSDs (Koppelaar et al., 2009; Slusser, Rice, & Miller, 2012).

2.6.1 Musculoskeletal Disorders Risk Factors

Activities throughout manual patient handling can lead to lower back pain which is the most common sign of Musculoskeletal disorders (MSD) (Holtermann et al., 2015). Musculoskeletal disorders resulting from manual patient handling tasks have undesirable associations toward caregivers (Lipscomb et al., 2012). Holterman suggested in his study that manual patient handling activities should not exceed ten per day among female caregivers, especially with those who already have some signs of lower back pain. Manual patient handling activities every so often consist of handling, lifting, transferring, and repositioning either patients and all this activities are causing awkward back postures and high exerted forces for caregivers (Holtermann et al., 2013).

Moreover, caregivers' jobs require extreme physical demand while providing care responsibilities to the patients. These responsibilities repeatedly consist of awkward positions, lengthy sitting or standing in a long period of time, and repetitive heavy tasks such as handling, lifting, transferring, or repositioning. In addition, two factors should be considered when addressing musculoskeletal disorders and injuries issue; load and exposure time (Schoenfisch & Lipscomb, 2009).

On the other hand, there is some blame on the nursing education as there is a gap between what caregivers are educated, concerning manual patient handling and movement, in classroom compared to what they are actually doing in the practical sitting (N. N. Menzel et al., 2007).

Musculoskeletal injuries are costly and reduce earnings, encompassing one third of all injuries and leading to long-term disability. Healthcare workers have the highest risk of injury among people in the healthcare field. The level of physical activity may be a contributing factor of musculoskeletal disorders. Activities that improve strength and endurance may have a positive effect on musculoskeletal disorder. Social support in the environment has shown to have an effect on the reported number of musculoskeletal disorders (Caspi et al., 2013).

Some unfavorable long conditions have shown to result in musculoskeletal injuries. Some psychosocial exposures that contribute to stress on the body (Long et al., 2012). Also, the social environment influenced the use of safe or unsafe practices. Managerial support for safe patient handling also influences the work environment (Adams, 2013).

In general, work surrounding factors may affect caregivers, and their job is considered to have a high demand with low control over it. Examples of these factors are, are psychosocial stress, which caregivers can have no control over, extreme physical demand, restricted job control, and absence of social support either from work superiors or colleagues (Sembajwe et al., 2013).

Musculoskeletal injuries are known health problems among medical personnel. Musculoskeletal disorders are often the result of heavy load transfers. Abedini et al. assess the risk and the association to musculoskeletal disorders with attention to load; the belief being that ergonomic programs would reduce the risk of injury. Nursing personnel provided data via questionnaires. The results showed that 90 percent of the nurses were at high risk of musculoskeletal injuries from load transfers. The lower back was the most affect part of the body. The results also showed that older workers with more exposure were at a higher risk for musculoskeletal disorders than younger worker with less job exposure. Shift workers were also at a high risk due to the fact that night shift generally has fewer staff and in turn results in an increase in work load. These areas should be focused on when implementing a safe patient handling program (Abedini, Choobineh, & Hasanzadeh, 2013).

Lifting heavy objects results in a high strain on the lower spine. Even though guidelines in regard to lifting patients have been established, the scientific evidence supporting them shows that their effectiveness is unclear. The lack of training in regard to the equipment results in higher physical demands. A study by Jaeger et al. examined how specific manual tasks impact the spine. Two nurses participated in this study. Their posture and force exerted for procedures were examined in how they impact the lower spine. To measure the force exerted when a nurse

would move of lift objects, force sensors were used. The force sensors gathered the data on the amount of forced used and video cameras gathered data on postures.

Jaeger et al. analyzed 9 different types of transfers and found all manual transfers to have a high load forces with possibility of disc compression in women. This data suggests that manually handling patients is unacceptable for women because of the potential or possibility of the disc in the spine being compressed. The use of small aids reduces friction which reduces the amount of force exerted. Therefore small aids reduce the possibility of disc compression. This study recommends implementing the use of aids to decrease the overload risk on the spine (Jaeger et al., 2013)

Patient care can result in physical and psychological injuries for workers. A combination of risk factors impact a workers safety and have increased the amount of musculoskeletal injuries reported. The physical injuries acquired by workers result in a decrease of work effectiveness. Facilities are affected by higher costs, high turnover rates, and staff shortages. A patient's higher level of required care increases the level of responsibility placed on the care giver. This increase in responsibility increases risk factors for musculoskeletal injuries in the care giver. Obese patients create a greater risk when they are moved manually.

A worker's own personal characteristics are shown to be contributing risk factors for injury. One example of a personal characteristic would be age. As age increases so does the risk factor for injury. Increased levels of stress are shown to correlate to increased physical and psychological risk factors. A caregiver's schedule also impacts risk factors for injury. For example, working overtime provides less time for a worker to recover from strain or fatigue. Risk factors for injury have been linked to the adopted culture of safety in an organization. Administrative support in safety procedures is linked to risk factors for injury. Worker injuries result in direct costs and indirect costs to organizations. Patients can also become affected directly and indirectly when caregivers become injured. The risk for re-injury for caregivers is high and they often consider a career change. Worker injuries impact care due to a change in workflow or style. Increased workloads result in a decrease of quality of care. Nursing shortages result in increased risk factors for worker and patient injury. Incorporating ergonomics in the workplace benefits both care giver and patients by reducing the risk of injury, and also benefits organizations by reducing the indirect impact to patient care (Miller K, 2013).

2.6.2 Lower Back Pain (LBP)

Low-back pain is often judged on a scale of one to ten, and the cost for treating individuals with low-back is unclear because not all individuals, especially those with less pain, seek treatment. There are many definitions of lower-back pain and Thiese et al. tried to show the prevalence of low-back pain in occupational settings. Participants for their study varied by: facility, employer, state, and job category. The results of this study showed that 63.4 percent of the participants reported having at least one day of lower-back pain. The average rate in pain was 6.8 on a scale of 10. Ten percent of the employees reported having low-back pain that rated 5 out of 10 even before being hired. The prevalence of low-back pain increases with age but was hard

to determine in this study because of the variation of individual threshold pain rating. The results also did not show any relationship between body mass and low-back pain (Thiese et al., 2014)

Lower back pain affects many who work in the healthcare field. It is also believed that other stress factors contribute to pain. Garg et al. examine ergonomic factors and the risk for low back pain. 800 participants from over 30 different facilities were selected. Some factors being analyzed are the prevalence of low back pain, occurrence rates, risk factors, interaction with risk factors, and assessing ergonomic models. This study is ongoing and did not present any results (Garg et al., 2013)

2.6.3 Musculoskeletal Disorders Consequences

Injuries among nurses and nursing assistances have caused early retirement and disability (Koppelaar et al., 2009; Slusser et al., 2012). Musculoskeletal disorders from manual patient handling is recognized to be a substantial concern for caregiver and their careers (Slusser et al., 2012).

Also, in order to substitute those skilled and retired caregivers, there is a cost associated with workers compensation and training the new personnel (Powell-Cope et al., 2014). Substantial effects have been felt in several professionals, organizations, governments, and societies due to the occurrence of musculoskeletal disorders (Jellad et al., 2013). Furthermore, musculoskeletal disorders are increasing and costly for care provider (Carton et al., 2013). The Occupational Safety and Health Administration (OSHA) estimated that the cost associated with

musculoskeletal disorders amongst caregiver is approximately \$20 billion yearly ("Safe patient handling can reduce MSDs in residential care industries, OSHA says," 2014). This cost includes workers' compensation, less productivity, and workforce turnover.

The cost associated with MSD injuries will be different from one healthcare worker to another. For example, older caregivers need more time to recover from MSD injuries than a younger one (H. Kim et al., 2012). Treating the caregivers' back injuries increases the cost of healthcare for an organization (Letourneau, 2013). The cost associated with musculoskeletal disorders is massive; the occurrence of any MSDs injuries will lead to a cost in terms of money, productivity, and effect of caregivers' availability. For example, musculoskeletal disorders and injuries amongst caregivers can result in illness, days away from work, and less productivity at work (Jakobsen et al., 2014; Vecchia, 2014).

Due to the high rate of injuries of work related musculoskeletal disorders, caregiver either consider to change their working area or completely leave their occupation (Olkowski & Stolfi, 2014). According to The American Nurses Association (ANA) caregivers (52%) who suffer musculoskeletal disorders ought to take sick leaves (38%), transfer to different department in the hospital (20%), or consider changing career (12%) (""Handle with Care" campaign fact sheet," 2006). Musculoskeletal disorders can be a reason form changing jobs, losing profession, and having chronic pain between caregivers (Pompeii et al., 2009).

The shortage of caregivers is about 6% and projected to go up to 20% and 30% by 2015 and 2020 correspondingly. This percentage is expected to increase, considering that caregivers are leaving their job, as a result of MSDs, at a ratio of 12% per year (Price, Sanderson, & Talarek, 2013). Twelve percent is an alarming especially considering that in the late 1990s, the percentage of caregivers who were leaving their career was 3% because of musculoskeletal disorders and injuries (Graham & Dougherty, 2012).

Musculoskeletal disorders could affect a lot of caregivers' body parts such as neck, shoulder, elbow, wrist(Nancy N. Menzel, Brooks, Bernard, & Nelson, 2004), upper back, lower back (Lemo et al., 2012; Macfarlane et al., 2009; Prairie & Corbeil, 2014), hip, knee (Nancy N. Menzel et al., 2004), and ankle (Campo, Weiser, Koenig, & Nordin, 2008; Ibrahim & Mohanadas, 2012; Jakobsen et al., 2014; Roll et al., 2012; Tinubu et al., 2010; Yasobant, 2014). However, some studies focus on what they believe are the most affected body site such as neck, shoulder, upper back, and lower back (Arial, Benoit, & Wild, 2014; Smith et al., 2006).

2.7 <u>Musculoskeletal Disorders Prevention</u>

Engineering based administrative and behavioral solutions for musculoskeletal disorders due to handling patients are three areas where efforts have been focused. Engineering solutions focus on incorporating lifts or modifying the environment, administrative solutions focus on training and procedures, and behavioral solutions focus on training and assessments tools. (Letourneau, 2013; Motacki & Motacki, 2009). Also, intervention could include eliminating risk factors (Black et al., 2011).

Currently, musculoskeletal disorders that resulted from manual patient handling activities frequently occur. Therefore, it is important to consider the stage after the injury occurs. Stubbs

suggested that training should be provided to the healthcare employees in order to reduce the occurrence of such injuries. Also, if a related injury takes place, support afterwards is important in order to reduce caregivers' musculoskeletal disorder and days away from work (Stubbs, 2009).

It is essential to understand the work components of handling patient tasks in order to reduce work-related musculoskeletal disorders among caregiver. Also, healthcare providers and hospitals need additional learning in regard to the concept of MSDs (Taehyung & Hyolyun, 2014). One the other hand, some studies show that performing some physical exercises would help caregivers to relive some back pain. It has been suggested that physical training should be provided to caregivers (Jakobsen et al., 2014)

In review, there is no clear evidence or contradictory evidence regarding intervention including stuff training, handling devices, and multifactor involvement in reducing the risk of musculoskeletal disorders and injuries (Thomas & Thomas, 2014).

2.8 <u>Regression Analysis in Medical Research</u>

Logistic regression analysis is commonly used in medical research in order to identify how risk factors are related to disease or death. Also, is will be used in order to model the relationship and association between risk factors (independent variables) and outcomes (musculoskeletal disorders MSDs among caregivers). The characteristics of the model, which present advantages that necessitate logistic regression, are:

- The outcome is binary (having MSDs vs not having MSDs) Y=1 or 0
- The predictors or risk factors $(X_1, X_2, ..., X_n)$
- Describing the degree and level of effect utilizing the odds ratios

2.8.1 Logistic Regression and MSDs Application

I. <u>Garments Industry:</u> Predictive Models of Work-Related Musculoskeletal Disorders (WMSDs) Among Sewing Machine Operators in the Garments Industry

 $\gamma = -31.681 + 0.236 X30 + 15.467 X15 + 13.7.88 X31 + 5.619 X6 - 6.722 X23$

Where:

 \hat{y} = Estimate of Pain Level from WMSD

X₃₀ = Independent Variable, Type of Breaktime Preferred

 X_{15} = Independent Variable, Gender

 X_{31} = Independent Variable, Degree of Difficulty of Sewing Task

 X_6 = Independent Variable, Empowerment

X₂₃ = Independent Variable, Company Policies

II. <u>Healthcare industry:</u> Association of Hypertension with Risk Factors Using Logistic Regression

 $g(x) = \beta 0 + \beta 1 Age + \beta 2 Gender + \beta 3 BMI + Systolic + \beta 5 Diastolic + \beta 6 CHOL$

III. <u>Food industry:</u> A Predictive Model of the Severity of Musculoskeletal Disorders among Poultry Layer Workers

Y = 0.019981 - 0.028982 Work Experience + 0.247106 UAP Feeding + 0.093594 Obesity + 0.124507 Blood Pressure + 0.107289 Feeding Frequency + 0.205666 NP Feeding + 0.047670 Feeding Duration + 0.142496 NP Collecting + 0.123649 TP Feeding -0.041096 Light - 0.069888 Height + 0.037025 WBGT

2.9 <u>Research Gap Analysis</u>

Workforces within the healthcare industry are facing a number of risk factors that would result in work related musculoskeletal disorders. Manual patient handling has accounted for these musculoskeletal disorders and injuries. (Koppelaar, Knibbe, Miedema, & Burdorf, 2012; Slusser et al., 2012). Musculoskeletal disorders have complex risk factors, with the leading cause being manual patient handling. Focusing only on patient handling activities and risk factors would significantly reduce musculoskeletal disorders and injuries amongst caregivers (Smith et al., 2006).

Kim stated that when evaluating the relationship between manual patient handling and musculoskeletal disorders, there is insufficient literature examining the main outcome manual patient handling task on musculoskeletal disorders (H. Kim et al., 2012). Also, more research needs to be done on the occupational profession of caregivers to support the findings of risk factors and the consequences of work injuries (Long et al., 2012). Despite the high risk to caregivers, only a small amount of knowledge is available about the relationship between work related musculoskeletal disorders and risk factors such as psychological, organizational, and psychosocial (Reme et al., 2014). More studies in the future have to be done in order to understand the complexity of musculoskeletal disorders to work such as patient handling. Besides physical and psychosocial factors, studies can focus on other factors such as type of patients, job tasks, and caregiver shortage (Warming, Precht, Suadicani, & Ebbehøj, 2009).

There is a need for more understanding of the association between musculoskeletal disorders' work-related and injuries and the risk factors (Jellad et al., 2013). According to the Centers for Disease Control and Prevention (CDC) occupational safety as well as health programs are encouraging research in order to identify work related musculoskeletal disorder injuries' risk factors (Forrest, 2015). Caregivers are playing an important role in our healthcare system, therefore it is preventing the growth of musculoskeletal disorders injuries is a most important health issue. Many studies look at the relation between MSDs and psychosocial and environment risk factors. However, only few attentions was giving to organizational risk factors and its connection to musculoskeletal disorders (Lamy et al., 2014).

There are too many studies focused on methodologies of how to keep both caregivers and patients safe and away from any injuries. However, other approaches than manual handling are essential to be discovered in order control MSDs and injuries' risk factors (Stevens et al., 2013).

Also, some studies have presented that single risk factor is significant for increasing risk related to musculoskeletal disorders between caregiver during manual patient handling. However, there is a need to have a multifactor involvement and this tending to be more accurate and effective (Yassi & Lockhart, 2013). As a conclusion, in order to have a control over risk factors that affecting caregiver and resulted in musculoskeletal disorders and injuries during manual patient handling, those risk factors must first be identified (Roll et al., 2012).

	Risk Factors Categories					
Study, Year	Organizational	Environmental	Caregivers' Characteristics	Patients' Characteristics	Psychological	Biomechanical
Holtermann, 2013			Х		Х	
Kim, Dropkin, Spaeth, Smith & Moline, 2012		Х	Х			
Reme et al., 2014	Х	Х	Х			
Lee et al., 2013		Х	Х		Х	
Warming, Precht, Suadicani, & Ebbehøj, 2009		Х	Х		Х	
Jellad et al., 2013			Х			
Pompeii et al., 2009			Х	Х		
Lamy et al., 2014	Х		Х			Х
Schoenfisch & Lipscomb, 2009		Х	Х			
Lee, Faucett, Gillen, Krause, & Landry, 2010	Х	Х	Х		Х	
Yasobant, 2014		Х	Х			
(Tinubu, Mbada, Oyeyemi, & Fabunmi, 2010		Х	Х	Х		
Smith, Mihashi, Adachi, Koga, & Ishitake, 2006		Х	Х		Х	
A Predictive Model to MSDs	•	-	•	•	•	-

Table 1 Research Gap Analysis

In order to bridge the gap between the identification of potential risk factors, from all risk factors categories, this study will support the effort to reduce the development of musculoskeletal disorders MSDs. Table 1 details identified risk factor categories from the reviewed literature. Logistic regression analysis by using multivariate analysis will help to find the best fitting predictive model in order to determine the correlation between risk factors and MSDs in order to manage the controllable significant risk factors.

CHPTER THREE: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

In this chapter, the research methodology will be described and demonstrated. Firstly, univariate analysis will be used in order to identify risk factors that contribute to musculoskeletal disorders MSDs. Also, assessments of the prevalence (odds ratios) of the risk factors and their association with MSDs will be obtained. Then, multivariate analysis will be conducted to determine the association of the significant risk factors with MSDs. Eventually, significant risk factors will become the inputs for the multiple logistic regression in order to build the predictive model for MSDs among caregivers.

Logistic regression will be used to predict the likelihood of developing MSDs for identified work and non-work risk factors. It will determine the best fitting predictive model to describe the data regarding the association of risk factors and MSDs, resulting in the best possible model. Logistic regression is a familiar tool for researchers in the medical field, where it is applied to predict risk factors for disease or death. In this situation, it is useful since its outcome is binary for its given inputs, providing "yes" or "no" results which correspond to the likelihood of having MSDs, or not having MSDs. Furthermore, logistic regression doesn't require the independent variable to have a linear relationship with the dependent variable, and doesn't require a particular distribution. This method also allows for the odds ratio of risk factors to be obtained, which is the size effect or level of effect.

3.2 <u>Research Methodology</u>

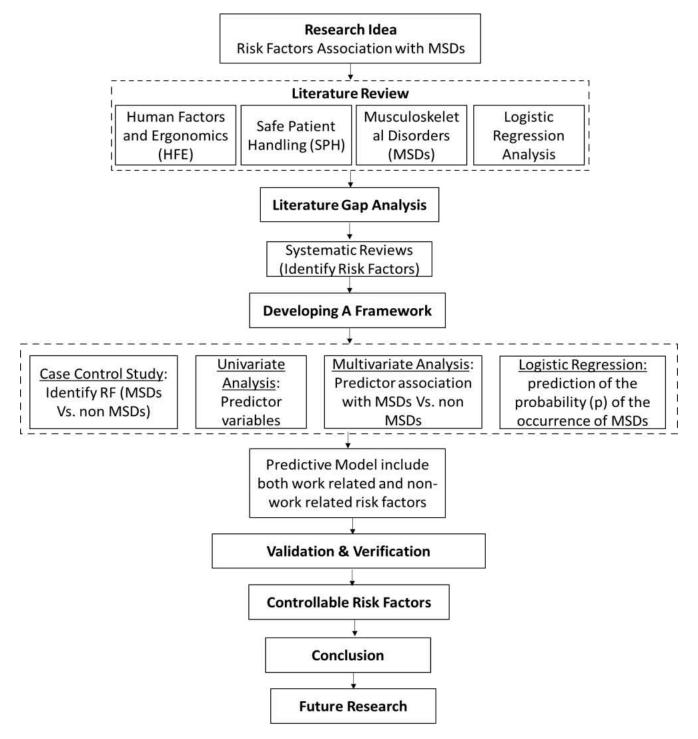


Figure 3 Research Methodology Diagram

3.3 Conceptual Framework

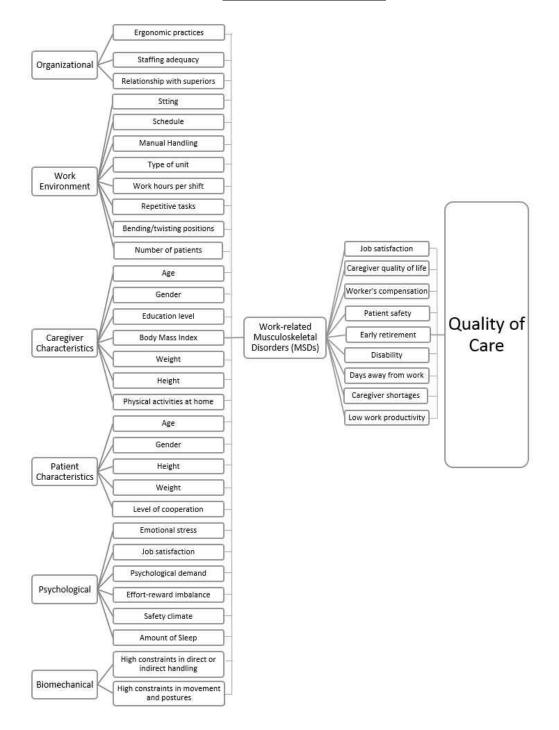


Figure 4 Conceptual Framework

3.4 Source of Data

Data was obtained from participating caregivers in a health risk assessment survey which questioned them about their injury characteristics and days away from work. They were also questioned about compensation claims, and how much they received from such claims. Nonwork related risk factors which participants were questioned about included their daily life styles which may affect their health.

3.5 **Population and Sample**

Participants included full time caregivers who are eligible for benefits in the Saudi German Hospital Group in Saudi Arabia, who reported injury while they were performing their job in their workplace. Also, participants were considered whether or not they had received compensation due to their injury.

- <u>"Case-Control" Study</u>: Identify the risk factors that might contribute in MSDs.
 Caregivers reported MSDs (case group) versus caregivers who did not report MSDs.
- 2- <u>Univariate Analysis</u>: Detect caregivers' general discerption (unique features, characteristics, trend) of caregivers with MSDs (predictor variables)
- 3- <u>Multivariate Analysis</u>: for each (predictor variable) determine the association (significant) for caregivers reported MSDs and caregiver who did report MSDs (calculate the probability that the case and control groups were both random from the same population)
- 4- Logistic Regression Analysis: will be applied to control the confounding risk factors

3.6 Statistical Analysis

Statistical tools including logistic regression analysis will be used in this research in order to collect, classify, summarize, organize, analyze, describe, explore, and interpret the available data. Descriptive statistics will be applied for characterizing the risk factors associated with musculoskeletal disorders MSDs.

3.7 Univariate / Multivariate Analysis

Univariate analysis will be conducted for all risk factors (variables) in order to determine which one of the risk factors are significant and which one is not. This process will start with analysis of univariate correlation of each risks factors (independent variables) and musculoskeletal disorders MSDs. Also, univariate analysis will help to identify the presence of any unique trends or characteristics.

Moreover, multivariate analysis will be implemented for significant multi-risk factors (predictors) that we have determined from the univariate analysis. The predictors will be the independent variables (risk factors)

3.8 Logistic Regression Analysis

Logistic regression will be used in order to predict the likelihood that caregivers will suffer from musculoskeletal disorders MSDs. Logistic regression was chosen to identify work related and non-work related risk factors that possibly will predict musculoskeletal disorders among caregiver. Also, logistic regression will help to find the best fitting predictive model with the least possible number of factors in order to describe the association risk factors and musculoskeletal disorders.

Logistics regression is a suitable tool that will be used in order to do the following:

- Model the likelihood of having (event occurring) MSDs among caregivers depending on the values associated with the (independent variables) risk factors.
- Estimate the likelihood that (randomly selected) a caregiver is expected to experience MSDs or not
- Predict the effect of (series of variables) risk factors on a (binary response variable) developing MSDs in caregivers
- Classify caregivers' characteristics as provided in the completed surveys as likely to have MSDs or not likely to have MSDs

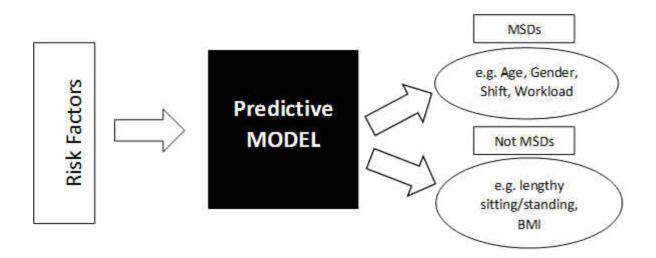


Figure 5 Logistic regression's conceptual model

Based on the developed dataset, the following major steps will be conducted:

- Developing a predictive model that will provide the probability and the odds of having MSDs for any given risk factor
- Discovering what risk factor are associated with a likelihood of 50% for having MSDs among caregivers
- Determining how managing the controllable risk factors would impact caregivers' likelihood and odds for having MSDs

3.8.1 Logistic Regression model

Regression analysis is an important statistical tool which is being used to analyze data to investigate the association between a two or more variables, which are the dependent and independent variables. In this research, logistic regression analysis will be used to determine the relationship between risk factors and musculoskeletal disorders (MSDs). Therefore, using logistic regression analysis will help to determine which risk factors have a significant impact (correlated) on MSDs and which ones do not. Consequently, finding the significant and potential risk factors will provide assistance in preventing and reducing the musculoskeletal disorders among caregivers. The data will be analyzed by using Statistical Package for Social Science (SPSS) 23.0.

Logistic regression analysis will provide the probability (p) of having musculoskeletal disorders amongst caregivers by fitting the data into a logit function. Below is equation of (p) between 0 and 1:

$$logit(p) = log\left(\frac{p}{1-p}\right) = log(p) - log(1-p)$$

In order to build the predictive model using the logistic regression analysis, multiple regression analysis will be used first. With the dependent variable Y (likelihood of developing musculoskeletal disorders), and the set of independent variable X_1 , X_2 , X_3 ,, X_n (risk factors), the according model will be as follows:

$$Z = \beta 0 + \beta 1X1 + \beta 2X2 + \dots + \beta nXn + \varepsilon = \beta 0 + \sum_{j=1}^{n} \beta jXj + \varepsilon$$

3.9 Odds Ratio

The odds ratio for a risk factor represents how the odds change with a 1 unit increase in that risk factor while holding other risk factors constant (β).

$$Odds = \frac{P(MSDs)}{P(not MSDs)} = \frac{P}{P-1}$$

Odds Ratio =
$$\frac{Odds(MSDs)}{Odds(not MSDs)} = \frac{\frac{P_1}{1-p_1}}{\frac{P_0}{1-p_0}}$$

This will determine if the odds of having MSDs in caregivers on a certain risk factor is greater than with another risk factor. The odds ratio can be interpreted in the following way:

Odds Ratio < 1: The risk factor is associated with lower odds of MSDs

Odds Ratio = 1: The risk factor doesn't affect the odds of MSDs

Odds Ratio > 1: The risk factor is associated with higher odds of MSDs

3.10 Hypothesis

H₀: Both work related and non-work related risk factors are not associated with musculoskeletal disorders among caregivers

H_a: Both work related and non-work related risk factors are associated with musculoskeletal disorders among caregivers

3.11 Gap Analysis

There is a need for more understanding of the association between musculoskeletal disorders' work-related and injuries and the risk factors (Jellad et al., 2013). According to the Centers for Disease Control and Prevention (CDC), occupational safety as well as health programs are encouraging research in order to identify work related musculoskeletal disorder injuries' risk factors (Forrest, 2015)

	Risk Factors Categories					
Study, Year	Organizational	Environmental	Caregivers' Characteristics	Patients' Characteristics	Psychological	Biomechanical
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Reme et al., 2014	Х	Х	Х			
Lee et al., 2013		Х	Х		Х	
Warming, Precht, Suadicani, & Ebbehøj, 2009		Х	Х		Х	
Jellad et al., 2013			Х			
Pompeii et al., 2009			Х	Х		
Lamy et al., 2014	Х		Х			Х
Schoenfisch & Lipscomb, 2009		Х	Х			
Lee, Faucett, Gillen, Krause, & Landry, 2010	Х	Х	Х		Х	
Yasobant, 2014		Х	Х			
(Tinubu, Mbada, Oyeyemi, & Fabunmi, 2010		Х	Х	Х		
Smith, Mihashi, Adachi, Koga, & Ishitake, 2006		Х	Х		Х	
A Predictive Model to MSDs		•	•		•	

Table 2 Gap Analysis

The knowledge gap in potential risk factors for MSDs (shown in table 2) can be bridged by studying the impact of all risk factor categories on the development of MSDs, which will support efforts to reduce the development of MSDs in caregivers. This can be done with logistic regression analysis, by using multivariate analysis to find the best fitting predictive model and determine the correlation between risk factors and MSDs in order to manage significant yet controllable risk factors. Developing a predictive model for the likelihood of developing MSDs among caregivers will support the efforts of researchers in managing controllable risk factors and reduce the effect on the overall quality of care.

3.12 Framework Description

The primary objectives of developing a predictive model is to identify caregivers who at risk of developing musculoskeletal disorders in healthcare organizations, and improve the total quality of care that healthcare systems provide to their stakeholders. By developing the predictive model, providers can understand which risk factors might lead to musculoskeletal disorders among caregivers while they are performing their everyday job. Also, through this model they can avoid some consequences of MSDs which may possibly affect their employees, patients, and eventually their quality of business. By understanding those risk factors and their ramifications, healthcare providers would try to reduce or even eliminate such risk factors and their effect on their industry. Risk factors have divided into six categories:

- 1. **Organizational Risk Factors:** Such as ergonomic practices, perceived staffing adequacy, and relationships with superiors,
- Work Environment: Such as work setting, work schedule, work load, type of unit, work hours per shift, job control, supervisor support, co-worker support, lengthy sitting / standing, rapid work pace, and repetitive motion patterns.
- <u>Caregivers Characteristics</u>: Such as age, gender, education, body mass index (BMI), tobacco consumption, how long they have been working in their job, and what physical activities they perform at their leisure time.
- 4. <u>Patient Characteristics</u>: such as age, gender, height, weight, and level of cooperation.

- 5. <u>Psychological Risk Factors:</u> Such as burnout / stress, job satisfaction, psychological demand, effort-reward imbalance, safety climate, and job strain.
- 6. **<u>Biomechanical Risk Factors:</u>** such as low / high constraints in direct / indirect handling, and low / high constraints in movement and postures.

Organizational	Work Environment	Caregivers Characteristics	Patients Characteristics	Psychological	Biomechanical
Ergonomics practices	Work setting	Age	Age	Burnout / Stress	Law / High constraints in direct / indirect handling
Staffing adequacy	Work schedule	Gender	Gender	Job satisfaction	Law / High constraints in movement and postures
Relationship with superiors	Work load	Education level	Height	Psychological demand	
	Type of unit	Body mass index (BMI)	Weight	Effort-reward imbalance	
	Work hour per shift	Tobacco consumption	Level of cooperation	Safety climate	
	Job control	Years of experience		Job strain	
	Sitting / standing for long time	Activities during leisure time			,

The above work related and non-work related risk factors (table 3) might have some effect on caregivers and the occurrence of musculoskeletal disorder injuries. Furthermore, such type of injury could lead to some consequences and eventually affect the provided quality of healthcare such as:

- Caregivers experience less job satisfaction
- Negative impact on caregivers quality of life
- High workers' compensation
- Undesirable effects on patient safety
- Caregiver early retirement
- Caregiver disability
- Many days away from work
- Shortages in caregivers and high turnover
- Low work productivity

3.13 Survey Design

The survey was adopted from two different sources in order to assess and evaluate both work related and non-work related risk factors associated with musculoskeletal disorders among nurses in Saudi Arabia. The survey consists of two main parts:

Part One (Work Related Risk Factors):

- Questions on demographic data
- Work-related health in caregiving practice
- Observations on work risk factors contribute to increasing the likelihood of developing a work related musculoskeletal disorders
- Caregivers' strategies to deal with reducing the risk of MSDs

Part Two (Caregiver Overall Health Assessment):

- Health and daily activities
- Physical health
- Pain
- Daily activities
- Emotions / feelings
- Social activities
- General health
- Sleep

Several types of questions were used to obtain data from the participating caregivers. Figure 6 shows a characteristic multiple choice question, used to elicit information on the participants' ages. Following each question, participants were instructed to select only one oval to indicate their choice.



Figure 6. Multiple choice question

Free response questions were also used to obtain metric data. Figure 7 shows a question representative of the free response type questions used in this study. Participants were asked to provide their height in meters, to ensure all responses were in the same unit.

2. 2. What is your height? * (M)

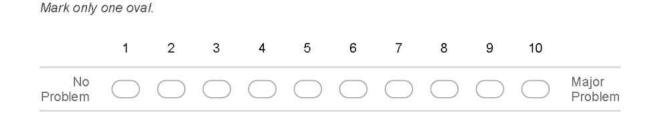
Figure 7. Free response question

Multiple-selection type questions were also used to obtain multiple responses from participants. Such as in figure 8, participants were asked to indicate all areas of their body related to the MSDs they experienced by checking all applicable boxes.

- Neck
 Shoulder
 Upper back (thoracic)
 Elbow/forearm
 Low back (lumbar/sacral)
 Wrist/hand
 Thumb
 Hips/Thighs
 Knees
 Ankles
- 15. 15. If you answered 'Yes' to Question 14, please check all that apply * Check all that apply.

Figure 8. Multiple selection question

Finally, scale based questions were used to indicate the degree of membership of a response in a question to two responses. For instance, in figure 9, participants were asked to indicate how much of a problem treating an excessive number of patients in one day was, on a scale from 1 to 10. Responses closest to 1 corresponded to "No problem", while responses closest to 10 corresponded to "Major Problem".



32. 32. Treating an excessive number of patients in one day *

Figure 9. Scale response question

3.14 Data Collection

This research will be conducted in Saudi Arabia, at a public hospital with permission from the Ministry of Health. At least 100 participants (caregivers) are needed to finish this study, in order to have at least 10 risk factors to be included in the predictive model, and this is estimated to be done in the period of two weeks. The investigator will meet with the participants and collect the needed data and each interview will take less than an hour. The survey contains an introduction and description of the nature of the study. The participants (caregivers) will be contacted before the actual interview will take a place, and they will be asked to participate in the study. Each interview will be conducted with only one participant at time. This study targets caregivers who work full time in the selected Saudi Arabian hospital. Participants must be 18 years of age or older to take part in this research study. Participants (caregivers) who are eligible for this study must meet the following criteria:

- Must be a full time employee
- Must have experienced injury at work place, or experienced pain or discomfort
- Received either compensation, treatment, or days away from work (sick leave) due to the injury at their work place

The following samples will be excluded in the final results:

- Samples that do not follow the eligibility criteria
- Surveys that are not completely filled out

3.15 Summary

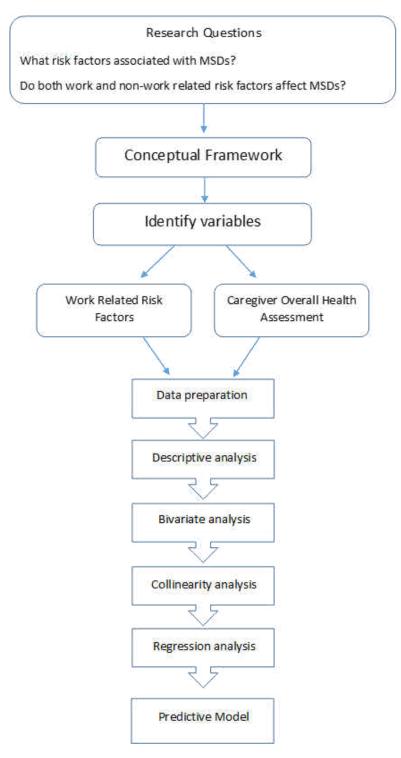


Figure 10 Model development process

- A. Develop a <u>conceptual framework</u> (Risk Factors, outcomes, and impacts)
- B. Build a <u>database</u> that includes both work related and non-work related risk factors from the review of previous literature
- C. <u>Descriptive statistics</u> will be used to describe the work related and non-work related risk factors related to caregivers who reported MSDs (Predictor risk factors)
- D. <u>Inferential statistical testing</u> will be used to draw a conclusion about caregivers who reported MSDs compared to the ones with no MSDs (Risk Factors will be included in the predictive model)
- E. The six <u>risk factor categories</u> will be analyzed to determine the best model that fits the data
- F. Predictive model: includes both work related and non-work related risk factors
- G. <u>Compare</u> the impact of individual risk factors on MSDs to determine which ones will be statistically significant and more representative of risk factors associated with MSDs
- H. Based on the estimate coefficients (β) (odds ratios) in the <u>final model</u>, a list of risk factors that have an association with MSDs will be created.
- I. Determine the <u>controllable risk factors</u> for future preventive strategies.
- J. Make <u>recommendations</u> for prevention policies based upon the insights gathered from the determination of controllable risk factors.

CHAPTER FOUR: RESULT

4.1 Introduction

Work-related Musculoskeletal Disorders (MSDs) are the most prevalent occupational health problem within the healthcare industry, and these types of injuries arise due to the nature of a caregiver's job, which involves frequent manual handling of patients, which is a risky task due to several factors. It is important to understand the associated risk factors during patient handling activities with MSDs, in order to determine the underlying causes and reduce the impact they have on caregivers. The development of MSDs negatively impact caregivers and patients alike, resulting in high costs due to compensation, time away from work, reduced staffing, and caregiver and patient satisfaction. In response to the threat that this problem poses to healthcare quality, practitioners and researchers have developed prevention policies such as zero-lift policies, lift teams, and have implemented lifting equipment, however research often shows that these measures have little impact on reducing the development of MSDs in caregivers. This study aims to support and inform the development of prevention policies for reducing injuries among caregivers and patients, while making contributions to the field of knowledge of human factors and ergonomics.

There is a need to better understand the relationship between risk factors and MSDs in order to determine which risk factors are controllable and can influence policy making designed to improve overall healthcare quality. To address this need, a predictive model was developed with logistic regression, based on both work and non-work related risk factors, which identifies and prioritizes high risk factors associated with MSDs. The use of logistic regression allows for the evaluation of a categorical dependent variable with metric or nonmetric independent variables. Since the sample size for the study was N=104, the method of logistic regression dictated a maximum of 10 variables to predict the development of MSDs.

The research is designed in order to develop a predictive model that will determined the association of both work related and non-work related risk factors among caregivers in healthcare settings, that would lead to musculoskeletal disorders (MSDs). Also, it seeks to develop a predictive model in order to determine the association of the identified work related and non-work related risk factors with the musculoskeletal disorders in Saudi Arabian healthcare organizations. Addressing and assessing those risk factors will help in preventing injuries and its consequences for both patient and caregiver, and eventually overall to improve the quality of care.

The research aims to answer the following questions:

- What are the work related risk factors associated with musculoskeletal disorders?
- What are the non-work related risk factors associated with musculoskeletal disorders?

4.2 Logistic Regression

Logistic regression is being used in this type of analysis because the primary dependent variable, the chance of having musculoskeletal disorders MSDs, is categorical (binary). It means that this dependent variable has two possible outcomes, either Yes (caregiver have a MSD) or No (caregiver doesn't have a MSD). Therefore, it is a useful tool in order to address the primary objective of this research about the association between one or more risk factor (as independent variable) to musculoskeletal disorders (as outcome / dependent variable). This tool will also evaluate the extent to which work related and non-work related risk factors as associated with MSDs status.

In addition, it is important to account for some further independent variables such as gender, body mass index (BMI), marital status, and others in order to evaluate the extent to which a risk factor such as manual patient handling is associated with MSDs, which are not the principal research interest. In order to achieve this, the logistic model or the predictive model from the logistic function Z defined as below:

$$Z = \alpha + \beta 1X1 + \beta 2X2 + \dots + \beta nXn$$

Where

$$f(z) = \frac{1}{1 + e^{-z}}$$

With the probability of the risk factors as P(X) where

$$P(X) = \frac{1}{1 + e^{-(\alpha + \sum \beta n X n)}}$$

4.3 <u>Sample Size</u>

Sample size in binary logistic regression analysis must be 10 times the number of predictors (Hair, 2010). This means for each dependent variable (predictors), 10 observations are necessary, whereas in the multiple logistic regression, 5 observations are needed for each predictor.

4.4 Assumption of Logistic Regression

The advantage of using binary logistic regression is that it can be used when the dependent variable is a categorical variable, and the independent variables are metric or nonmetric. Moreover, Logistic regression does not require a particular distribution, and the independent variable does not have a linear relationship with the dependent variable.

4.5 <u>Survey Analysis</u>

Table 4 displays the gender make-up of the sample population. Among a total of 104 participants, 25% (n=26) were male, while 75% (n=78) were female.

			Gender		
					Cumulative
		Frequency	Percent	Valid Percent	Percent
Valid	Male	26	25.0	25.0	25.0
	Female	78	75.0	75.0	100.0
	Total	104	100.0	100.0	

 Table 4 Gender Descriptive Statistics

Participants also provided their age by responding to three age categories: 20 to 30 years old, 30 to 40 years old, and 40 to 50 years old. As seen in table 5, 80.8% of participants were in the first age group (between 20 and 30 years old), while 11.5% were in the second age group (between 30 and 40 years old), while 7.7% were in the third age group (between 40 and 50 years old).

			Age Group		
					Cumulative
		Frequency	Percent	Valid Percent	Percent
Valid	20-30	84	80.8	80.8	80.8
	30-40	12	11.5	11.5	92.3
	40-50	8	7.7	7.7	100.0
	Total	104	100.0	100.0	

Table 5 Age Group Descriptive Statistics

Figure 11 shows the frequency of MSDs among both male and female participants. 20 female participants and 14 male participants reported having not experienced a MSD, while 58 female and 12 male participants reported that they experienced a MSD.



Figure 11 Experienced MSDs

According to figure 12, the most affected body part for participants with MSDs was reported to be the lower back (46%, n=48), followed by the knee (15.4%, n=16), shoulder (11.5%, n=12), wrist/hand (7.7%, n=8), neck (7.7%, n=8), hips/thighs (5.8%, n=6), upper back (3.8%, n=4), and elbow/forearm (1.9%, n=2).

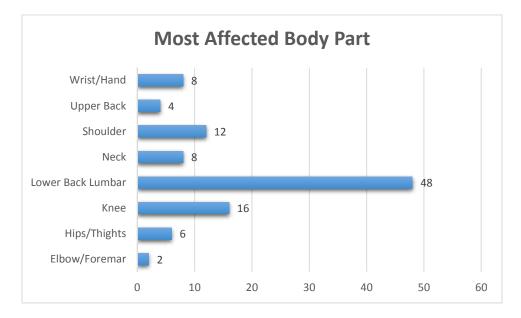


Figure 12 Most affected body part

In figure 13, participants with MSDs indicated when they experienced their first MSD. The highest reported time range was between 5 and 15 years after graduation, with 36 participants indicating that they received a MSD within this time. 24 participants indicated that they received a MSD within the first 5 years of their graduation, while 2 indicated having a MSD after 15 years after graduation. Among the other participants, 20 indicated getting a MSD as a student nurse, 12 indicated before training as a nurse, and 10 were uncertain. The year ranges most likely to develop MSDs indicate that the most experienced and newer participants were at risk. This could be due to a lack of experience for participants less than 5 years after graduation, and a long time of exposure to risks for experienced participants between 5 and 15 years after graduation.

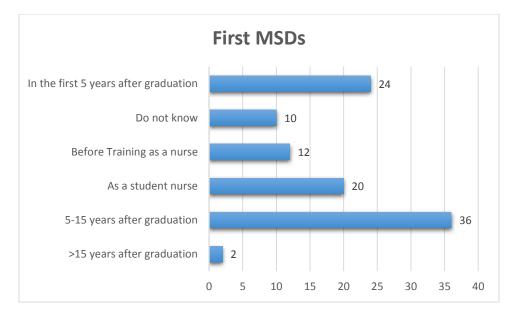


Figure 13 First MSDs

According to figure 14, among the participants, 20 indicated that they had changed their work area due to MSDs, while 84 reported that they did not. A work area change among 19.2% (table 6) of participants due to MSDs is somewhat high, indicating that they were forced to change due to the risks they were involved with.

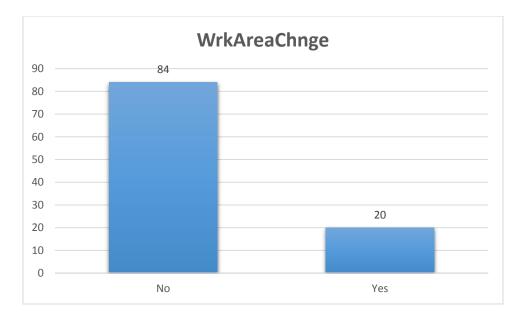


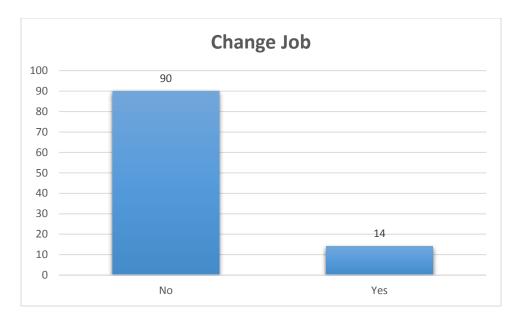
Figure 14 Change working area

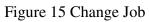
Table 6 Change working speciality Descriptive Statistics

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	84	80.8	80.8	80.8
	Yes	20	19.2	19.2	100.0
	Total	104	100.0	100.0	

Change area/speciality due MSDs

In addition to changing their work area, some participants also changed their career entirely due to MSDs. According to figure 15 and table 7, 14 participants indicated that they changed their career due to MSDs, while 90 indicated that they did not. Considering that 13.5% of participants changed their career due to MSDs shows the human cost that this injury has on caregivers, forcing them to make life changes.





		•	2		
-		F	Dement	Valid Dava ant	Cumulative
		Frequency	Percent	Valid Percent	Percent
Valid	No	90	86.5	86.5	86.5
	Yes	14	13.5	13.5	100.0
	Total	104	100.0	100.0	

Change career due MSDs

Association of Demographic Data Strategies with Musculoskeletal Disorders 4.6

Table 8 Case processing summary for demographic data model

Unweighted Cases	N	Percent	
Selected Cases	Included in Analysis	104	100.0
	Missing Cases	0	.0
	Total	104	100.0
Unselected Cases	;	0	.0
Total		104	100.0

Case Processing Summary

a. If weight is in effect, see classification table for the total number of cases.

The total participants who answered the survey were N= 104 with no missing data or cases as it is shown in table 8.

Table 9 Dependent variable encoding for demographic data model

Dependent Var	iable Encoding
Original Value	Internal Value
No	0
Yes	1

...

The above table 9 informs that how the procedure has handled the, MSDs, the dichotomous dependent variable that is helping in interpreting the values of the parameter coefficients.

Code 0: Indicates that caregiver has not experienced musculoskeletal disorder

Code 1: Indicates that caregiver has experienced musculoskeletal disorder

Categorical Variables Codings					
			Paramete	er coding	
		Frequency	(1)	(2)	
Age Group	20-30	84	1.000	.000	
	30-40	12	.000	1.000	
	40-50	8	.000	.000	

Table 10 Categorical variables codings for demographic data model

The independent (predictor) Age has been classified into several categories in order to
identify which age group has a significant effect on musculoskeletal disorder. As it is shown in
table 10 there are three age groups.

Table 11 Classification table for demographic data model

				Predicte	d
			Experience	ced MSDs	Percentage
	Observed		No	Yes	Correct
Step 0	Experienced MSDs	No	0	30	.0
		Yes	0	74	100.0
	Overall Percentage				71.2

Classification Table^{a,b}

a. Constant is included in the model.

b. The cut value is .500

Table 11 represents that among N=104 participants, n= 74 caregivers have experienced MSDs which is 71.2% from total caregivers who participated in this study, and n = 30 have not experienced MSDs which is 28.8%. This table is important to show the results with only the constant counted in before the independent variables are included into the predictive model.

Next, logistic regression compares this preliminary model with the predictive model to conclude whether the predictive model is more applicable and adequate. The table proposes that if there is no knowledge about the variables, and an estimate of a caregiver's chance of having MSDs was given, it would be 71.2% of the time correct.

	Omnibus Tests of Model Coefficients					
	Chi-square df Sig.					
Step 1	Step	40.971	8	.000		
	Block	40.971	8	.000		
	Model	40.971	8	.000		

Table 12 Omnibus tests of model coefficients for demographic data model

Table 12 shows the Omnibus test which determines how well the model performs. The Chi-square test determines the overall model's significance, and if the original model is accurate, or whether or not the model will be more accurate if the independent variables (predictors) are included. This test has two hypotheses for the relation to the overall fit of the model:

- H_{0:} The model is a good fitting model
- H₁: The model is not a good fitting model

Since the Chi-Square value is, 40.971, and significance of p-value < .000 with degree of freedom = 8, then the null hypothesis can be rejected, which states the initial model is a good fitting model.

Model Summary						
Cox & Snell R Nagelkerke R						
Step	-2 Log likelihood	Square	Square			
1	83.989ª	.326	.466			

Table 13 Model summary for demographic data model

a. Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.

In a logistic regression model, the R-Square statistic cannot be exactly calculated. Therefore, table 13 shows the approximation as an alternative of the exact value. Based on Cox and Snell's R-Square, 32.6% of the variation is explained by the predictive model. Based on Nagelkerke's R-Square, 46.6% of the variation is explained by the predictive model, which indicates a reasonably strong relation between the independent variables and the prediction.

Table 14 Hosmer and Lemeshow test for demographic data model

Hosmer and Lemeshow Test						
Step	Chi-square	df	Sig.			
1	5.678	8	.683			

The Hosmer and Lemeshow statistic or chi-square test from table 14 assumes the sampling adequacy, and the model has a significant level of 0.683, indicating that it is not statistically significant, so the predictive model is a good fit and it adequately fits the data.

		Predicted			
			Experienced MSDs		Percentage
	Observed		No	Yes	Correct
Step 1	Experienced MSDs	No	16	14	53.3
		Yes	6	68	91.9
	Overall Percentage				80.8

Table 15 Classification table for demographic data model

Classification Table^a

a. The cut value is .500

Table 15 helps in assessing the performance of the predictive model. The table indicates that the predictive model has predicted 68 caregivers to have musculoskeletal disorders out of 74 with 91.9% correct from the participants who actually experienced MSDs. On the other hand, the predictive model has predicted that 16 caregivers out of 30 (53.3% correct) do not have MSDs. This table shows that when including the independent variables (predictors) in the predictive model, the error rate has changed from the original model 71.2% to 80.8% from the predictive model.

	Variables in the Equation								
								95% C.I.fo	or EXP(B)
	_	В	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1 ^a	Age			.169	2	.919			
	Age(1)	095	2.280	.002	1	.967	.909	.010	79.323
	Age(2)	.415	2.045	.041	1	.839	1.515	.028	83.382
	Weight	.141	.057	6.162	1	.013	1.151	1.030	1.286
	Height	088	.045	3.824	1	.050	.916	.839	1.000
	Gender	3.372	1.087	9.625	1	.002	29.127	3.461	245.125
	GrdYr	082	.167	.241	1	.623	.921	.664	1.278
	Experience	.177	.183	.927	1	.336	1.193	.833	1.709
	HPW	.008	.050	.024	1	.878	1.008	.913	1.112
	Constant	140.979	334.278	.178	1	.673	1.684E+61		

Table 16 Variables in the equation for demographic data model

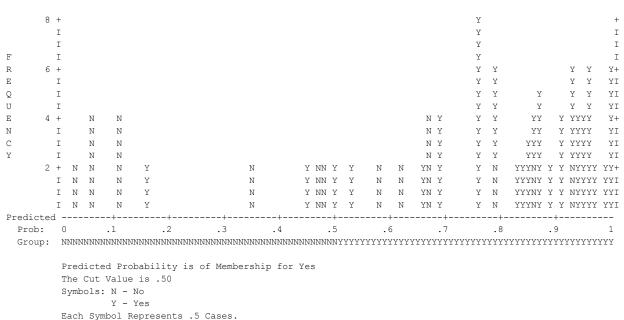
a. Variable(s) entered on step 1: Age, Weight, Height, Gender, GrdYr, Experience, HPW.

MSDs Predicted = 140.979 + 0.141 *(Weight) - 0.088 *(Height) + 3.372 *(Gender)

Weight: Increasing one (1) kilogram (Kg) in caregivers have an increased odds of having MSDs with 1.151 size effect and 95% confidence interval (1.030, 1.286).

Height: Increasing one (1) centimeters (cm) in caregivers' height correspond with decreasing odds of having MSDs with 0.916 size effect and 95% confidence interval (0.839, 1.000).

Gender: One unit increase in gender is associated with increased odds of having MSDs with 28.127 size effect and 95% confidence interval (3.461, 245.125).



Observed Groups and Predicted Probabilities

Figure 16 Classification plots for demographic data

Association of Ergonomic Practice with Musculoskeletal Disorders 4.7

Table 17 Case processing summary for ergonomic practice model

	ě –		
Unweighted Cases	a	N	Percent
Selected Cases	Included in Analysis	104	100.0
	Missing Cases	0	.0
	Total	104	100.0
Unselected Cases		0	.0
Total		104	100.0

Case	Proces	eina	Summarv
Case	FIDCes	Silly	Summary

a. If weight is in effect, see classification table for the total number of cases.

The total participants who answered the survey was N= 104 with no missing data or cases

as it is shown in table 17.

Table 18 Dependent variable encoding for ergonomic practice model

Dependent variable Encounty					
Original Value	Internal Value				
No	0				
Yes	1				

Dependent	Variable	Encoding

Table 18 informs how the procedure has handled MSDs, the dichotomous dependent variable that is helping in interpreting the values of the parameter coefficients.

Code 0: Indicates that caregiver has not experienced musculoskeletal disorder

Code 1: Indicates that caregiver has experienced musculoskeletal disorder

					d
			Experienced MSDs		Percentage
	Observed		No	Yes	Correct
Step 0	Experienced MSDs	No	0	30	.0
		Yes	0	74	100.0
	Overall Percentage				71.2

Table 19 Classification table for ergonomic practice model

Classification Table^{a,b}

a. Constant is included in the model.

b. The cut value is .500

Table 19 shows how many caregivers have experienced MSDs (n= 74) among participants (N=104), which is 71.2% from total caregivers who participated in this study, and how many of them have not experienced MSDs (n = 30) which is 28.8%. This table is important to show the results with only the constant counted in before the independent variables were included into the predictive model. Then, logistic regression compares this preliminary model with the predictive model to conclude whether the predictive model is more applicable and adequate. The table proposes that if there is no knowledge about the variables and the model estimated a caregiver's chance of having MSDs, it would be correct 71.2% of the time.

	Ommbus rests of Model Obemclents					
_		Chi-square	df	Sig.		
Step 1	Step	18.476	5	.002		
	Block	18.476	5	.002		
	Model	18.476	5	.002		

Table 20 Omnibus tests of model coefficients for ergonomic practice model

Table 20 shows the Omnibus test which determines how well the model performs. The Chi-square test determines the overall model's significance, and if the original model is accurate, or whether or not the model will be more accurate if the independent variables (predictors) are included. This test has two hypotheses for the relation to the overall fit of the model:

Omnibus Tests of Model Coefficients

H0: The model is a good fitting model

H1: The model is not a good fitting model

Since Chi-Square = 18.476, and significance of p-value < .002 with degree of freedom = 5, then the null hypothesis can be rejected which states that the initial model is a good fitting model.

Model Summary								
		Cox & Snell R	Nagelkerke R					
Step	-2 Log likelihood	Square	Square					
1	106.484ª	.163	.233					

Table 21 Model summary for ergonomic practice model

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

In the logistic regression model, the R-Square statistic cannot be exactly calculated. Therefore, the model summary (table 21) shows the approximation as an alternative of the exact value. Based on Cox and Snell's R-Square, 16.3% of the variation is explained by the predictive model. Based on Nagelkerke's R-Square, 23.3% of the variation is explained by the predictive model, which indicates a reasonably strong relation between the independent variables and the prediction.

Table 22 Hosmer and Lemeshow test for ergonomic practice model

Hosmer and Lemeshow Test								
Step	Chi-square	df	Sig.					
1	14.906	6	.021					

The Hosmer and Lemeshow statistic or chi-square test in table 22 assumes the sampling adequacy, and has a significant level of 0.021 which indicates that it is statistically significant, so the predictive model is not a good fit and it does not adequately fit the data. Therefore, Ergonomic practices factors only have no significant effect on musculoskeletal disorders.

			Predicted				
			Experienced MSDs		Percentage		
	Observed		No	Yes	Correct		
Step 1	Experienced MSDs	No	6	24	20.0		
		Yes	0	74	100.0		
	Overall Percentage				76.9		

Table 23 Classification table for ergonomic practice model

Classification Table^a

a. The cut value is .500

Table 23 helps in assessing the performance of the predictive model. The table indicates that the predictive model has predicted 74 caregivers to have musculoskeletal disorders out of 74 with 100.0% accuracy from the participants who actually experienced MSDs. On the other hand, the predictive model has predicted that 6 caregivers out of 30 with 20.0% accuracy don't have MSDs. This table shows that when including the independent variables (predictors) in the predictive model, the error rate has changed from the original model 71.2% to 76.9% from the predictive model.

	Variables in the Equation								
								95% C.I.fo	or EXP(B)
	-	В	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1 ^a	ErgonTrain	-1.232	.694	3.151	1	.076	.292	.075	1.137
	Q23AdjBed	2.416	.711	11.558	1	.001	11.205	2.782	45.121
	Q23SlidBord	067	.650	.011	1	.918	.936	.262	3.343
	Q23LiftBelt	.236	.588	.161	1	.688	1.266	.400	4.008
	Q23Splint	1.020	.711	2.060	1	.151	2.774	.689	11.173
	Constant	.130	.367	.125	1	.723	1.139		

Table 24 Variables in the equation for ergonomic practice model

a. Variable(s) entered on step 1: ErgonTrain, Q23AdjBed, Q23SlidBord, Q23LiftBelt, Q23Splint.

4.8 Association of Injury Prevention Strategies with Musculoskeletal Disorders

Table 25 Case processing summary for injury prevention strategies model

Unweighted Cases	a	N	Percent
Selected Cases	Included in Analysis	104	100.0
	Missing Cases	0	.0
	Total	104	100.0
Unselected Cases		0	.0
Total		104	100.0

Case Processing Summary

a. If weight is in effect, see classification table for the total number of cases.

The total participants who answered the survey were N=104 with no missing data or cases as shown in table 25.

Table 26 Dependent variable encoding for injury prevention strategies model

Original Value	Internal Value
No	0
Yes	1

Table 26 shows how the procedure has handled the MSDs, the dichotomous dependent variable that helps in interpreting the values of the parameter coefficients.

Code 0: Indicates that caregiver has not experienced musculoskeletal disorder

Code 1: Indicates that caregiver has experienced musculoskeletal disorder

				Predicte	d
			Experience	ced MSDs	Percentage
	Observed		No	Yes	Correct
Step 0	Experienced MSDs	No	0	30	.0
		Yes	0	74	100.0
	Overall Percentage				71.2

Table 27 Classification table for injury prevention strategies model

Classification Table^{a,b}

a. Constant is included in the model.

b. The cut value is .500

Table 27 shows that among participants (N=104), 74 caregivers have experienced MSDs (n=74) which is 71.2% from total caregivers who participated in this study, and 30 of them have not experienced MSDs (n = 30) which is 28.8%. This table is important to show the results with only the constant counted in before the independent variables included into the predictive model. Then logistic regression compares this preliminary model with the predictive model to conclude whether the predictive model is more applicable and adequate. The table proposes that without any knowledge about the variables, an estimate of a caregiver's chance of having MSDs would be 71.2% of the time correct.

-		Chi-square	df	Sig.			
Step 1	Step	17.306	9	.044			
	Block	17.306	9	.044			
	Model	17.306	9	.044			

Table 28 Omnibus tests of model coefficients for injury prevention strategies model

Table 28 shows the Omnibus test which determines how well the model performs. The Chi-square test determines if the overall model's significance, and if the original model is accurate, or whether or not the model will be more accurate if the independent variables (predictors) are included. This test has two hypotheses for the relation to the overall fit of the model:

Omnibus Tests of Model Coefficients

H0: The model is a good fitting model

H1: The model is not a good fitting model

Since Chi-Square = 17.309, and significance of p-value < .044 with degree of freedom = 9, then the null hypothesis can be rejected which states that the initial model is a good fitting model.

Model Summary						
		Cox & Snell R	Nagelkerke R			
Step	-2 Log likelihood	Square	Square			
1	107.654ª	.153	.219			

Table 29 Model summary for injury prevention strategies model

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

The model summary (table 29) shows the approximated R-square value as an alternative of its exact value. Based on Cox and Snell's R-Square, 15.3% of the variation is explained by the predictive model. Based on Nagelkerke's R-Square, 21.9% of the variation is explained by the predictive model, which indicates a reasonably strong relation between the independent variables and the prediction.

Table 30 Hosmer and Lemeshow test for injury prevention strategies model

Hosmer and Lemeshow Test					
Step	Chi-square	df	Sig.		
1	11.429	8	.179		

The Hosmer and Lemeshow statistic (table 30) or the chi-square test assumes the sampling adequacy, and it has a significant level of 0.179, indicating that it is not statistically significant, so the predictive model is determined to be a good fit and adequately fits the data.

	Classification Table ^a					
				Predicte	d	
			Experience	ced MSDs	Percentage	
	Observed		No	Yes	Correct	
Step 1	Experienced MSDs	No	6	24	20.0	
		Yes	6	68	91.9	
	Overall Percentage				71.2	

Table 31 Classification table for injury prevention strategies model

a. The cut value is .500

Table 31 assesses the performance of the predictive model. The table indicates that the predictive model has predicted 68 caregivers to have musculoskeletal disorders out of 74 with 91.9% accuracy from the participants who actually experienced MSDs. On the other hand, the predictive model has predicted that 6 caregivers out of 30 with 20.0% accuracy do not have MSDs. This table shows that when including the independent variables (predictors) in the predictive model, the error rate has not changed from the original model and remains 71.2% for the predictive model as well.

	Variables in the Equation								
								95% C.I.fo	or EXP(B)
		В	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1 ^a	GetHelp	.190	.669	.080	1	.777	1.209	.326	4.484
	PaitentsPostion	.283	.614	.213	1	.645	1.327	.399	4.420
	UseDiffBodyPart	152	.489	.097	1	.756	.859	.329	2.240
	WarmUp	063	.429	.022	1	.883	.939	.405	2.176
	ModAvoidInjuPart	.267	.505	.280	1	.597	1.306	.485	3.514
	NoPauseReg	1.664	.755	4.858	1	.028	5.283	1.203	23.207
	AdjBedToStrch	-1.121	.540	4.317	1	.038	.326	.113	.938
	UseTechToNtInju	.286	.637	.201	1	.654	1.331	.382	4.637
	StpWhnDiscomInc	824	.554	2.211	1	.137	.439	.148	1.300
	Constant	.383	1.385	.077	1	.782	1.467		

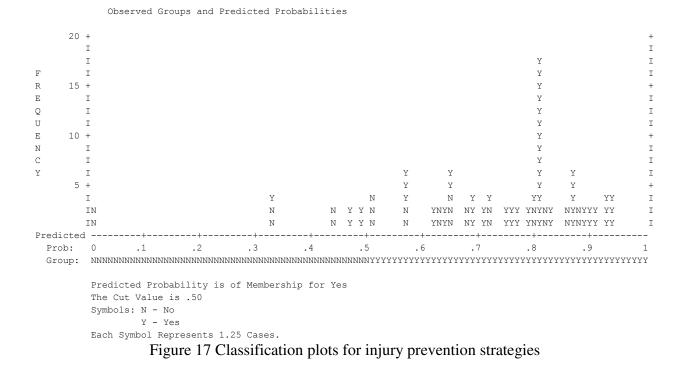
Table 32 Variables in the equation for injury prevention strategies model

a. Variable(s) entered on step 1: GetHelp, PaitentsPostion, UseDiffBodyPart, WarmUp, ModAvoidInjuPart, PauseReg, AdjBedToStrch, UseTechToNtInju, StpWhnDiscomInc.

MSDs Predicted = 0.383 + 1.664 *(Not Pausing regularly) – 1.121 *(Adjusting plinth/bed height to stretch and change posture)

Not Pausing Regularly: Increasing the value or the amount of caregivers who are not pausing regularly while performing a lifting task correspond with increasing odds of having MSDs with 5.283 size effect and 95% confidence interval (1.203, 23.207).

Adjusting plinth/bed height to stretch and change posture: Increasing the value or the amount of caregivers who are Adjusting plinth/bed height to stretch and change posture correspond with decreasing odds of having MSDs with 0.326 size effect and 95% confidence interval (.113, .938).



4.9 Association of Physical Health with Musculoskeletal Disorders

Table 33 Case processing summary for physical health model

Unweighted Cases	1	N	Percent
Selected Cases	Included in Analysis	104	100.0
	Missing Cases	0	.0
	Total	104	100.0
Unselected Cases		0	.0
Total		104	100.0

Case	Processing	Summarv
Ousc.	1 1000331119	ounnury

a. If weight is in effect, see classification table for the total number of cases.

The total participants who answered the survey were N=104 with missing data or cases as it is shown in table 33.

Table 34 Dependent variable encoding for physical health model

Dependent variable Encounty					
Original Value	Internal Value				
No	0				
Yes	1				

ependent Variable Encoding

Table 34 informs how the procedure has handled the MSDs, the dichotomous dependent variable that helps in interpreting the values of the parameter coefficients.

Code 0: Indicates that caregiver has not experienced musculoskeletal disorder

Code 1: Indicates that caregiver has experienced musculoskeletal disorder

			Predicted			
			Experienced MSDs Percentage			
	Observed		No	Yes	Correct	
Step 0	Experienced MSDs	No	0	30	.0	
		Yes	0	74	100.0	
	Overall Percentage				71.2	

Table 35 Classification table for physical health model

Classification Table^{a,b}

a. Constant is included in the model.

b. The cut value is .500

Table 35 represents that among 104 participants, 74 caregivers have experienced MSDs which is 71.2% from total caregivers who participated in this study, and 30 of them have not experienced MSDs which is 28.8%. This table is important to show the results with only the constant counted in before the independent variables are included into the predictive model. Then logistic regression compares this preliminary model with the predictive model to conclude whether the predictive model is more applicable and adequate. The table proposes that with no knowledge about the variables, if an estimate of a caregiver's chance of having MSDs is given, the model would be correct 71.2% of the time.

Omnibus Tests of Model Coefficients							
Chi-square df Sig.							
Step 1	Step	80.740	10	.000			
	Block	80.740	10	.000			
	Model	80.740	10	.000			

Table 36 Omnibus tests of model coefficients for physical health model

Table 36 shows the Omnibus test which tells how well the model performs. The Chisquare test determines the overall model's significance, and if the original model is accurate, or whether or not the model will be more accurate if the independent variables (predictors) are included.

This test has two hypotheses for the relation to the overall fit of the model:

H0: The model is a good fitting model

H1: The model is not a good fitting model

Since Chi-Square = 80.740, and significance of p-value < .000 with degree of freedom = 10, then the null hypothesis can be rejected, which states the initial model is a good fitting model.

Model Summary								
Cox & Snell R Nagelkerke R								
Step	-2 Log likelihood	Square	Square					
1	42.219ª	.506	.789					

Table 37 Model summary for physical health model

a. Estimation terminated at iteration number 9 because parameter estimates changed by less than .001.

The model summary (table 37) shows the approximation of the R-square value as an alternative of its exact value. Based on Cox and Snell's R-Square, 50.6% of the variation is explained by the predictive model. Based on Nagelkerke's R-Square, 78.9% of the variation is explained by the predictive model, which indicates a reasonably strong relation between the independent variables and the prediction.

Table 38 Hosmer and Lemeshow test for physical health model

Hosmer and Lemeshow Test							
Step	Chi-square	df	Sig.				
1	10.527	8	.230				

The Hosmer and Lemeshow statistic or chi-square test (table 38) assumes the sampling adequacy, and it has a significant level of 0.230, indicating that it is not statistically significant, so the predictive model is a good fit and it is adequately fits the data.

			Predicted			
			Experienced MSDs Percentage			
	Observed		No	Yes	Correct	
Step 1	Experienced MSDs	No	24	6	80.0	
		Yes	5	69	93.2	
	Overall Percentage				89.4	

Table 39 Classification table for physical health model

Classification Table^a

a. The cut value is .500

Table 39 assesses the performance of the predictive model. The table indicates that the predictive model has predicted 69 caregivers to have musculoskeletal disorders out of 74 with 93.2% accuracy from the participants who actually experienced MSDs. On the other hand, the predictive model has predicted that 24 caregivers out of 30 do not have MSDs with 80.0% accuracy. This table shows that when including the independent variables (predictors) in the predictive model, the error rate has changed from the original model 71.2% to 89.4% from the predictive model.

F						r			
									C.I.for P(B)
		В	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1 ^a	BodyPain	1.724	.695	6.159	1	.013	5.608	1.437	21.886
	HlthLmtWlkSevBloks	-4.318	3.067	1.982	1	.159	.013	.000	5.439
	PhysAbiltySatsfction	-2.035	1.041	3.825	1	.050	.131	.017	1.004
	NedAssisToMovArund	1.583	1.515	1.092	1	.296	4.870	.250	94.905
	MostDayInFxdPostin	3.238	1.226	6.974	1	.008	25.488	2.304	281.904
	FeelWornOut	1.703	.623	7.482	1	.006	5.490	1.620	18.600
	FeelFatigue	1.580	.615	6.602	1	.010	4.857	1.455	16.217
	FeelFullEnergy	-2.293	.935	6.019	1	.014	.101	.016	.631
	AfraidBcsHealth	1.128	.545	4.286	1	.038	3.088	1.062	8.981
	HIthIsSatsfction	-1.897	.660	8.269	1	.004	.150	.041	.547
	Constant	-4.320	3.087	1.958	1	.162	.013		

Table 40 Variables in the equation for physical health model

Variables in the Equation

a. Variable(s) entered on step 1: BodyPain, HlthLmtWlkSevBloks, PhysAbiltySatsfction, NedAssisToMovArund, AllDayInBedChair, FeelWornOut, FeelFatigue, FeelFullEnergy, AfraidBcsHealth, HlthIsWorryOfLife.

MSDs Predicted = -4.320 + 1.724 *(Having Body Pain) - 2.035 *(Physical Ability Satisfaction) + 3.238 *(Fixed Position for Long Time) + 1.703 * (Feel Worn out) + 1.580 *(Feel Fatigue) - 2.293 *(Feel Full of Energy) + 1.128 *(Stress: Afraid about Health) - 1.897 *(Health Satisfaction)

Having Body Pain: Increasing the severity of body pain corresponds with increasing odds of having MSDs with a 5.608 size effect and 95% confidence interval (1.437, 21.886).

Physical Ability Satisfaction: Caregivers who are satisfied with their physical ability have a decreased odds of having MSDs with 0.131 size effect and 95% confidence interval (0.017, 1.004).

Fixed Position for Long Time: Increasing the amount of time for sitting or standing in a fixed position corresponded with increasing odds of having MSDs with 25.448 size effect and 95% confidence interval (2.304, 281.904).

Feel Worn out: Caregivers who feel worn out have an increased odds of having MSDs with 5.490 size effect and 95% confidence interval (1.620, 18.600).

Feel Fatigue: Caregivers who feel fatigue have an increased odds of having MSDs with 4.857 size effect and 95% confidence interval (1.455, 16.217).

Feel Full of Energy: Caregivers who feel full of energy have a decreased odds of having MSDs with 0.101 size effect and 95% confidence interval (0.016, 0.631).

Stress: Afraid about Health: Increasing value or the amount of caregivers who are having more stress because they are afraid about their health correspond with increasing odds of having MSDs with 3.088 size effect and 95% confidence interval (1.062, 8.981).

Health Satisfaction: Caregivers who are satisfied with their health have a decreased odds of having MSDs with 0.150 size effect and 95% confidence interval (0.041, 0.547).

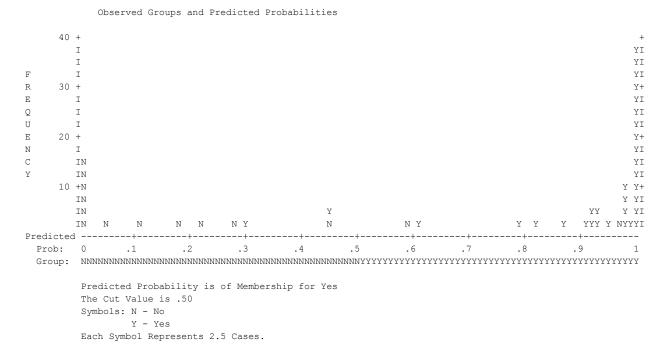


Figure 18 Classification plots for physical health

4.10 Association of Pain with Musculoskeletal Disorders

Case Processing Summary						
Unweighted Cases ^a N Percent						
Selected Cases	Included in Analysis	104	100.0			
	Missing Cases	0	.0			
	Total	104	100.0			
Unselected Cases		0	.0			
Total		104	100.0			

Table 41 Case processing summary for pain model

a. If weight is in effect, see classification table for the total number of cases.

A total of 104 participants answered the survey with no missing data or cases as it is shown in table 41.

Table 42 Dependent variable encoding for pain model

Dependent variable Encouring						
Original Value	Internal Value					
No	0					
Yes	1					

Dependent	Variable	Encoding
-----------	----------	----------

Table 42 informs how the procedure has handled the MSDs, the dichotomous dependent variable that is helping in interpreting the values of the parameter coefficients.

Code 0: Indicates that caregiver has not experienced musculoskeletal disorder

Code 1: Indicates that caregiver has experienced musculoskeletal disorder

			Predicted			
			Experienced MSDs Percentage			
	Observed		No	Yes	Correct	
Step 0	Experienced MSDs	No	0	30	.0	
		Yes	0	74	100.0	
	Overall Percentage				71.2	

Table 43 Classification table for pain model

Classification Table^{a,b}

a. Constant is included in the model.

b. The cut value is .500

•

Table 43 shows that among participants (N=104), 74 caregivers have experienced MSDs, which is 71.2% from total caregivers who participated in this study, and 30 of them have not experienced MSDs which is 28.8%. This table is important to show the results with only the constant counted in before the independent variables included into the predictive model. Then logistic regression compares this preliminary model with the predictive model to conclude whether the predictive model is more applicable and adequate. The table proposes that if an estimate is given of a caregiver's chance of having MSDs without knowledge about the variables, the model would be correct 71.2% of the time

	Oninibus rests of model obeincients				
-		Chi-square	df	Sig.	
Step 1	Step	41.864	9	.000	
	Block	41.864	9	.000	
	Model	41.864	9	.000	

Table 44 Omnibus tests of model coefficients for pain model

Table 44 is shows the Omnibus test which determines how well the model performs. The Chi-square test is determines the overall model's significance, if the original model is accurate, or whether or not the model will be more accurate if the independent variables (predictors) are included. This test has two hypotheses for the relation to the overall fit of the model:

Omnibus Tests of Model Coefficients

H0: The model is a good fitting model

H1: The model is not a good fitting model

Since Chi-Square = 41.864, and significance of p-value (0.000) with degree of freedom = 9, then the null hypothesis can be rejected, which states that the initial model is a good fitting model.

Model Summary					
		Cox & Snell R	Nagelkerke R		
Step	-2 Log likelihood	Square	Square		
1	83.096ª	.331	.474		

Table 45 Model summary for pain model

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

The model summary (table 45) shows the approximation of the R-square value as an alternative of the exact value. Based on Cox and Snell's R-Square, 33.1% of the variation is explained by the predictive model. Based on Nagelkerke's R-Square, 47.4% of the variation is explained by the predictive model, which indicates a reasonably strong relation between the independent variables and the prediction.

Table 46 Hosmer and Lemeshow test for pain model

Hosmer and Lemeshow Test						
Step	Chi-square	df	Sig.			
1	14.799	8	.063			

The Hosmer and Lemeshow statistic or chi-square test (table 46) assumes the sampling adequacy, and it has a significant level of 0.063, indicating that it is not statistically significant, so the predictive model is a good fit and it adequately fits the data.

	Classification Table ^a				
			Predicted		
	_		Experienc	ed MSDs	Percentage
	Observed		No	Yes	Correct
Step 1	Experienced MSDs	No	14	16	46.7
		Yes	4	70	94.6
	Overall Percentage				80.8

Table 47 Classification table for pain model

a. The cut value is .500

Table 47 assesses the performance of the predictive model. The table indicates that the predictive model has predicted 70 caregivers to have musculoskeletal disorders out of 74 with 94.6% accuracy from the participants who actually experienced MSDs. On the other hand, the predictive model has predicted that 14 caregivers out of 30 do not have MSDs with 46.7% accuracy. This table shows that when including the independent variables (predictors) in the predictive model, the error rate has changed from the original model 71.2% to 80.8% from the predictive model.

								95% (EXF	
		В	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1 ^a	NoBodilyPain	-1.991	.649	9.406	1	.002	.137	.038	.487
	PainDiscomfort	565	.294	3.688	1	.055	.569	.320	1.012
	PainLast	009	.347	.001	1	.980	.991	.503	1.956
	PainAffectMood	.221	.554	.159	1	.690	1.247	.421	3.695
	PainAffectMoveAbility	.877	.718	1.492	1	.222	2.403	.588	9.812
	PainAffectSleep	.410	.509	.649	1	.420	1.507	.556	4.086
	PainAffectAnyWork	.911	.760	1.440	1	.016	2.488	.561	11.027
	PainAffectRecrActivs	-1.572	.655	5.760	1	.230	.208	.058	.750
	PainAffectEnjy	589	.619	.907	1	.341	.555	.165	1.865
	Constant	4.568	1.541	8.787	1	.003	96.370		

Table 48 Variables in the equation for pain model

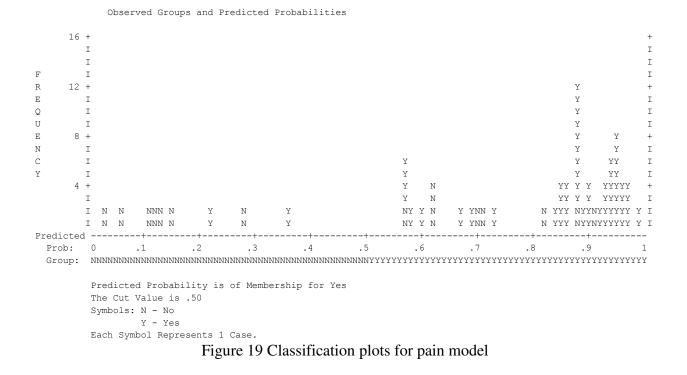
Variables in the Equation

a. Variable(s) entered on step 1: BodilyPain, PainDiscomfort, PainLast, PainAffectMood, PainAffectMoveAbility, PainAffectSleep, PainAffectAnyWork, PainAffectRecrActivs, PainAffectEnjy.

MSDs Predicted = 4.568 – 1.991 *(Having No Pain) + 0.911 *(Pain Affected Work)

Having No Pain: Increasing one unit of not having pain in caregivers corresponds with decreasing odds of having MSDs with a 0.137 size effect and 95% confidence interval (0.038, 0.487)

Pain Affected Work: One unit increase of pain that affected work/job/activity corresponds with increasing odds of having MSDs with 2.488 size effect and 95% confidence interval (0.561, 11.027)



4.11 Association of Psychology and Social Activities with Musculoskeletal Disorders

Table 49 Case processing summary for psychology and social activities model

Unweighted Cases	1	N	Percent
Selected Cases	Included in Analysis	104	100.0
	Missing Cases	0	.0
	Total	104	100.0
Unselected Cases		0	.0
Total		104	100.0

a. If weight is in effect, see classification table for the total number of cases.

The total participants who answered the survey were N=104 with no missing data or cases as it is shown in table 49.

Table 50 Dependent variable encoding for psychology and social activities model

Original Value	Internal Value
No	0
Yes	1

Dependent Variable Enc	oding
-------------------------------	-------

Table 50 shows how the procedure has handled the MSDs, the dichotomous dependent variable that is helping in interpreting the values of the parameter coefficients.

Code 0: Indicates that caregiver has not experienced musculoskeletal disorder

Code 1: Indicates that caregiver has experienced musculoskeletal disorder

				Predicte	d
			Experience	ed MSDs	Percentage
	Observed		No	Yes	Correct
Step 0	Experienced MSDs	No	0	30	.0
		Yes	0	74	100.0
	Overall Percentage				71.2

 Table 51 Classification table for psychology and social activities model

Classification Table^{a,b}

a. Constant is included in the model.

b. The cut value is .500

Table 51 shows that among participants (N=104), 74 caregivers have experienced MSDs which is 71.2% from total caregivers who participated in this study, and 30 of them have not experienced MSDs which is 28.8%. This table is important to show the results with only the constant counted in before the independent variables included into the predictive model. Then logistic regression compares this preliminary model with the predictive model to conclude whether the predictive model is more applicable and adequate. The table is proposes that without any knowledge about the variables, the model's estimate of a caregiver's chance of having MSDs would be correct 71.2% of the time.

	Ommbus rests of model coemclents				
_		Chi-square	df	Sig.	
Step 1	Step	58.693	12	.000	
	Block	58.693	12	.000	
	Model	58.693	12	.000	

Table 52 Omnibus tests of model coefficients for psychology and social activities model

Table 52 shows the Omnibus test which determines how well the model performs. The Chi- square test is testing the overall model's significance, if the original model is accurate, or whether or not the model will be more accurate if the independent variables (predictors) are included. This test has two hypotheses for the relation to the overall fit of the model:

Omnibus Tests of Model Coefficients

H0: The model is a good fitting model

H1: The model is not a good fitting model

Since Chi-Square = 58.693, and significance of p-value (0.000) with degree of freedom = 12, then the null hypothesis can be rejected which states that the initial model is a good fitting model.

Model Summary					
		Cox & Snell R	Nagelkerke R		
Step	-2 Log likelihood	Square	Square		
1	66.267ª	.431	.617		

Table 53 Model summary for psychology and social activities model

a. Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.

The model summary (table 53) shows the approximation of the R-square value as an alternative of the exact value. Based on Cox and Snell's R-Square, 43.1% of the variation is explained by the predictive model. Based on Nagelkerke's R-Square, 61.7% of the variation is explained by the predictive model, which indicates a reasonably strong relation between the independent variables and the prediction.

Table 54 Hosmer and Lemeshow test for psychology and social activities model

Hosmer and Lemeshow Test						
Step	Chi-square	df	Sig.			
1	17.710	8	.024			

The Hosmer and Lemeshow statistic or chi-square test (table 54) assumes the sampling adequacy, and it has a significant level of 0.024, indicating that it is statistically significant, so the predictive model is not a good fit and it is not adequately fits the data. Therefore, psychology and social activities factors only has no significant effect on musculoskeletal disorders.

			Predicted				
			Experienced MSDs Percentage				
	Observed		No	Yes	Correct		
Step 1	Experienced MSDs	No	20	10	66.7		
		Yes	4	70	94.6		
	Overall Percentage				86.5		

Table 55 Classification table for psychology and social activities model

Classification Table^a

a. The cut value is .500

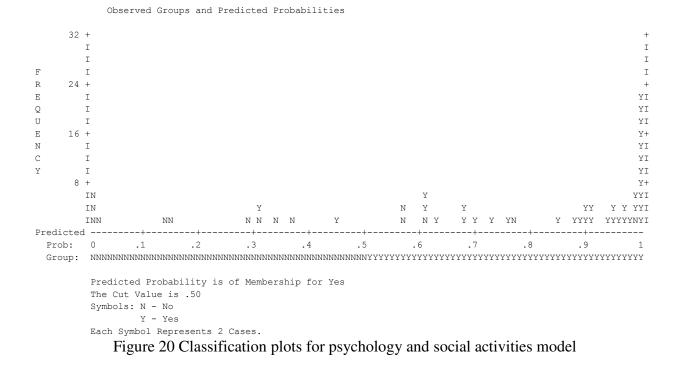
Table 55 assess the performance of the predictive model. The table indicates that the predictive model has predicted 70 caregivers to have musculoskeletal disorders out of 74 with 94.6% accuracy from the participants who actually experienced MSDs. On the other hand, the predictive model has predicted that 20 caregivers out of 30 did not have MSDs with 66.7% accuracy. This table shows that when including the independent variables (predictors) in the predictive model, the error rate has changed from the original model 71.2% to 86.5% from the predictive model.

	Variables in the Equation								
								95% (EXF	
		В	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1 ^a	SocialActivityEmotin	-1.141	.565	4.081	1	.043	.320	.106	.967
	SocialActvitlimitEmotin	.656	.501	1.711	1	.191	1.927	.721	5.149
	SocialActivites	292	.796	.134	1	.714	.747	.157	3.554
	Bothered	-1.775	.627	8.001	1	.005	.170	.050	.580
	FeelDown	2.032	.571	12.657	1	.000	7.632	2.491	23.384
	Restless	-1.973	.711	7.699	1	.006	.139	.034	.560
	Worried	1.948	.655	8.847	1	.003	7.016	1.943	25.330
	Cheerful	.255	.496	.265	1	.607	1.291	.488	3.414
	Isolated	2.251	.891	6.387	1	.011	9.497	1.657	54.416
	Нарру	312	.447	.487	1	.485	.732	.305	1.757
	Feeldepressed	-1.098	.627	3.067	1	.080	.333	.098	1.140
	Satisfaction	.583	.431	1.833	1	.176	1.791	.770	4.165
	Constant	-2.969	2.687	1.221	1	.269	.051		

Table 56 Variables in the equation for psychology and social activities model

Variables in the Equation

a. Variable(s) entered on step 1: SocialActivityEmotin, SocialActivitlimitEmotin, SocialActivites, Bothered, FeelDown, Restless, Worried, Cheerful, Isolated, Happy, Feeldepressed, Satisfaction.



4.12 Association of General Health with Musculoskeletal Disorders

Table 57 Case processing summary for general health model

Unweighted Cases	S ^a	Ν	Percent					
Selected Cases	Included in Analysis	104	100.0					
	Missing Cases	0	.0					
	Total	104	100.0					
Unselected Cases		0	.0					
Total		104	100.0					

Case Processing Summary

a. If weight is in effect, see classification table for the total number of cases.

The total participants who answered the survey were N=104 with no missing data or cases as it is shown in table 57.

Table 58 Dependent variable encoding for general health model

Dependent variable Encounty						
Original Value	Internal Value					
No	0					
Yes	1					

Table 58 shows how the procedure has handled the MSDs, the dichotomous dependent variable that is helping in interpreting the values of the parameter coefficients.

Code 0: Indicates that caregiver has not experienced musculoskeletal disorder

Code 1: Indicates that caregiver has experienced musculoskeletal disorder

			Predicted			
			Experience	ced MSDs	Percentage	
	Observed		No	Yes	Correct	
Step 0	Experienced MSDs	No	0	30	.0	
		Yes	0	74	100.0	
	Overall Percentage				71.2	

 Table 59 Classification table for general health model

Classification Table^{a,b}

a. Constant is included in the model.

b. The cut value is .500

Table 59 shows that among participants (N=104), 74 caregivers have experienced MSDs which is 71.2% from total caregivers who participated in this study, and 30 of them have not experienced MSDs which is 28.8%. This table is important to show the results with only the constant counted in before the independent variables included into the predictive model. Then logistics regression compares this preliminary model with the predictive model to conclude whether the predictive model is more applicable and adequate. The table proposes that without knowledge about the variables, an estimate of a caregiver's chance of having MSDs would be correct 71.2% of the time.

-		Chi-square	df	Sig.				
Step 1	Step	10.060	8	.261				
	Block	10.060	8	.261				
	Model	10.060	8	.261				

Table 60 Omnibus tests of model coefficients for general health model

Omnibus Tests of Model Coefficients

Table 60 shows the Omnibus test which determines how well the model performs. The Chi- square test is determines the overall model's significance, if the original model is accurate, or whether or not the model will be more accurate if the independent variables (predictors) are included. This test has two hypotheses for the relation to the overall fit of the model:

H0: The model is a good fitting model

H1: The model is not a good fitting model

Since Chi-Square = 10.060, and significance of p-value (0.261) with degree of freedom = 8, then the null hypothesis will be accepted, which states the initial model is a good fitting model and there is no need to add more variables.

Model Summary							
		Cox & Snell R	Nagelkerke R				
Step	-2 Log likelihood	Square	Square				
1	114.900ª	.092	.132				

Table 61 Model summary for general health model

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

The model summary (table 61) gives the approximation of the R-square value as an alternative of the exact value. Based on Cox and Snell's R-Square, 9.2% of the variation is explained by the predictive model. Based on Nagelkerke's R-Square, 13.2% of the variation is explained by the predictive model, which indicates a reasonably strong relation between the independent variables and the prediction.

Table 62 Hosmer and Lemeshow test for general health model

Hosmer and Lemeshow Test							
Step	Chi-square	df	Sig.				
1	7.081	8	.528				

The Hosmer and Lemeshow statistic or chi-square test (table 62) assumes the sampling adequacy, and it has a significant level of 0.528, indicating that it is not statistically significant, so the predictive model is a good fit and it is adequately fits the data.

			Predicted			
			Experience	Percentage		
	Observed		No	Yes	Correct	
Step 1	Experienced MSDs	No	4	26	13.3	
		Yes	2	72	97.3	
	Overall Percentage				73.1	

Table 63 Classification table for general health model

Classification Table^a

a. The cut value is .500

Table 63 assesses the performance of the predictive model. The table indicates that the predictive model has predicted 72 caregivers to have musculoskeletal disorders out of 74 with 97.3% accuracy from the participants who actually experienced MSDs. On the other hand, the predictive model has predicted that 4 caregivers out of 30 do not have MSDs with 13.3% accuracy. This table shows that when including the independent variables (predictors) in the predictive model, the error rate has changed from the original model 71.2% to 73.1% from the predictive model.

	variables in the Equation								
								95% C.I.fo	or EXP(B)
		В	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1 ^a	FeelSick	004	.239	.000	1	.987	.996	.623	1.592
	FeelGood	.113	.223	.255	1	.613	1.119	.723	1.733
	FeelBad	114	.090	1.590	1	.207	.893	.748	1.065
	PoorHealth	.097	.296	.108	1	.743	1.102	.616	1.970
	FeelHealthy	.035	.353	.010	1	.921	1.036	.518	2.070
	ExcellentHealth	.368	.366	1.009	1	.315	1.444	.705	2.959
	GetSickeasily	339	.267	1.609	1	.205	.713	.422	1.203
	WorseHealth	.378	.271	1.954	1	.162	1.460	.859	2.480
	Constant	446	1.565	.081	1	.775	.640		

Table 64 Variables in the equation for general health model

a. Variable(s) entered on step 1: FeelSick, FeelGood, FeelBad, PoorHealth, FeelHealthy, ExcellentHealth, GetSickeasily, WorseHealth.

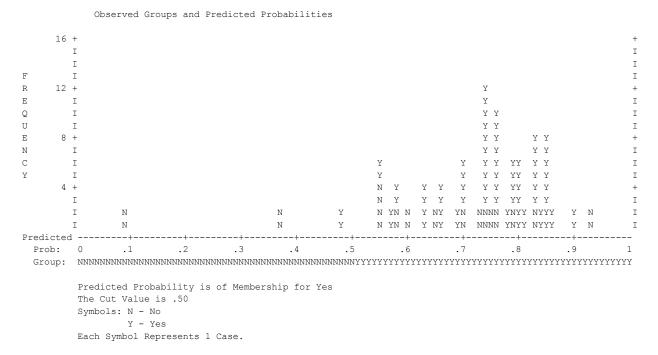


Figure 21 Classification plots for general health model

4.13 Association of Sleep with Musculoskeletal Disorders

Case Processing Summary						
Unweighted Cases	S ^a	Ν	Percent			
Selected Cases	Included in Analysis	104	100.0			
	Missing Cases	0	.0			
	Total	104	100.0			
Unselected Cases		0	.0			
Total		104	100.0			

Table 65 Case processing summary for sleep model

a. If weight is in effect, see classification table for the total number of cases.

The total participants who answered the survey were N=104 with no missing data or cases as it is shown in table 65.

Table 66 Dependent variable encoding for sleep

Original Value	Internal Value
No	0
Yes	1

Dependent	Variable	Encoding
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Table 66 shows how the procedure has handled the MSDs, the dichotomous dependent variable that is helping in interpreting the values of the parameter coefficients.

Code 0: Indicates that caregiver has not experienced musculoskeletal disorder

Code 1: Indicates that caregiver has experienced musculoskeletal disorder

			Predicted		
			Experienced MSDs		Percentage
	Observed		No	Yes	Correct
Step 0	Experienced MSDs	No	0	30	.0
		Yes	0	74	100.0
	Overall Percentage				71.2

Table 67 Classification table for sleep model

Classification Table^{a,b}

a. Constant is included in the model.

b. The cut value is .500

Table 67 indicates that among participants N=104, 74 caregivers have experienced MSDs which is 71.2% from total caregivers who participated in this study, and 30 of them have not experienced MSDs which is 28.8%. This table is important to show the results with only the constant counted in before the independent variables included into the predictive model. Then logistic regression compares this preliminary model with the predictive model to conclude whether the predictive model is more applicable and adequate. The table is proposes that without any knowledge about the variables, an estimate of a caregiver's chance of having MSDs, would be correct 71.2% of the time.

-		Chi-square	df	Sig.		
Step 1	Step	53.962	9	.000		
	Block	53.962	9	.000		
	Model	53.962	9	.000		

Table 68 Omnibus tests of model coefficients for sleep model

Table 68 shows the Omnibus test which determines how well the model performs. The Chi- square test determines the overall model's significance, if the original model is accurate, or whether or not the model will be more accurate if the independent variables (predictors) are included. This test has two hypotheses for the relation to the overall fit of the model:

Omnibus Tests of Model Coefficients

H0: The model is a good fitting model

H1: The model is not a good fitting model

Since Chi-Square = 53.962, and significance of p-value (0.000) with degree of freedom = 9, then the null hypothesis will be rejected which states that the initial model is a good fitting model.

Table 69 Model summary for sleep model

Model Summary					
Cox & Snell R Nagelkerke R					
Step	-2 Log likelihood	Square	Square		
1	70.998ª	.405	.579		

a. Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.

The model summary (table 69) shows the approximation of the R-square value, as an alternative of the exact value. Based on Cox and Snell's R-Square, 40.5% of the variation is explained by the predictive model. Based on Nagelkerke's R-Square, 57.9% of the variation is explained by the predictive model, which indicates a reasonably strong relation between the independent variables and the prediction.

Table 70 Hosmer and Lemeshow test for sleep model

Hosmer and Lemeshow Test					
Step	Chi-square	df	Sig.		
1	40.715	8	.000		

The Hosmer and Lemeshow statistic or chi-square test (table 70) assumes the sampling adequacy, and it has a significant level of 0.000, indicating that it is statistically significant, so the predictive model is not a good fit and it is not adequately fits the data. Therefore, psychology and social activities factors only have no significant effect on musculoskeletal disorders.

Classification Table ^a					
			Predicted		
			Experienced MSDs Percentage		
	Observed		No	Yes	Correct
Step 1	Experienced MSDs	No	20	10	66.7
		Yes	4	70	94.6
	Overall Percentage				86.5

Table 71 Classification table for sleep model

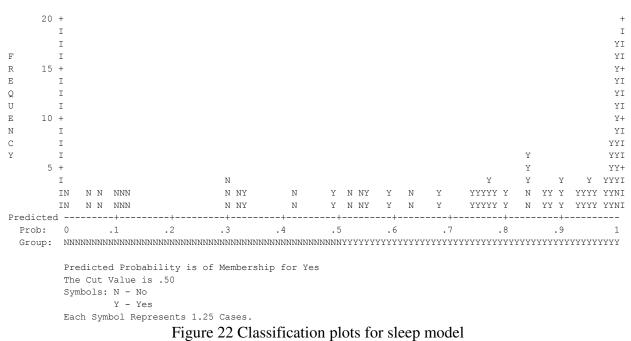
a. The cut value is .500

Table 71 assesses the performance of the predictive model. The table indicates that the predictive model has predicted 70 caregivers to have musculoskeletal disorders out of 74 with 94.6% accuracy from the participants who actually experienced MSDs. On the other hand, the predictive model has predicted that 20 caregivers out of 30 to have MSDs with 66.7% accuracy. This table shows that when including the independent variables (predictors) in the predictive model, the error rate has changed from the original model 71.2% to 86.5% from the predictive model.

	Variables in the Equation								
								95% C.I.fo	or EXP(B)
		В	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1 ^a	QuietSleep	649	.400	2.634	1	.105	.523	.239	1.144
	EnoughSleep	1.904	.456	17.411	1	.000	6.713	2.745	16.418
	WakeupBad	.652	.331	3.879	1	.049	1.920	1.003	3.676
	FeelSleepy	252	.449	.315	1	.575	.777	.323	1.874
	DiffFallAsleep	1.406	.549	6.557	1	.010	4.080	1.391	11.970
	FallingAsleep	890	.505	3.103	1	.078	.411	.153	1.105
	StayingUpDay	.664	.596	1.239	1	.266	1.942	.604	6.246
	Nap	709	.366	3.764	1	.052	.492	.240	1.007
	AmountofSleep	-1.097	.659	2.768	1	.096	.334	.092	1.216
	Constant	-6.353	1.882	11.396	1	.001	.002		

Table 72 Variables in the equation for sleep model

a. Variable(s) entered on step 1: QuietSleep, EnoughSleep, WakeupBad, FeelSleepy, DiffFallAsleep, FallingAsleep, StayingUpDay, Nap, AmountofSleep.



Observed Groups and Predicted Probabilities

4.14 <u>Predictive Model</u>

Variable Name	DV/IV	Valid Range	Variable Type
Having MSDs	DV	Yes <i>or</i> No	Character,
	DV	10507110	Categorical
Height	IV	> 0	Numeric,
Treight	1 1	2.0	Continuous
Weight	IV	> 0	Numeric,
weight	1 V	2.0	Continuous
Emotional Stress: Worry about	IV	Yes <i>or</i> No	Character,
health	10		Categorical
Heavy Physical Activities at	IV	Yes <i>or</i> No	Character,
Home	1 V		Categorical
Bend-Twist-Awkward Position	IV	Yes <i>or</i> No	Character,
	1 1	10507110	Categorical
Manual Handling	IV	Yes <i>or</i> No	Character,
ivianuar Handning	1 V	103 07 110	Categorical
		Usually 6-8 Hours	Character,
Amount of Sleep	IV	Sometimes 6-8 Hours	
		Less Than 6 or more than 8	Categorical

Table 73 Dependent and independent variables included in the predictive model

Variable Name	DV/IV	Valid Range	Variable Type
		Hour	
Repetitive Tasks	IV	No Problem Minimal to Moderate Problem Major Problem	Character, Categorical
Excessive Number of Patient	IV	No Problem Minimal to Moderate Problem Major Problem	Character, Categorical

Case Processing Summary					
Unweighted Cases	Ν	Percent			
Selected Cases	Included in Analysis	104	100.0		
	Missing Cases	0	.0		
	Total	104	100.0		
Unselected Cases		0	.0		
Total		104	100.0		

Table 74 Case processing summary for the predictive model

a. If weight is in effect, see classification table for the total number of cases.

The total participants who answered the survey were N= 104 with no missing data or cases as it is shown in table 74.

Table 75 Dependent variable encoding for the predictive model

Dependent variable Encoding								
Original Value	Internal Value							
No	0							
Yes	1							

Table 75 shows how the procedure has handled the MSDs, the dichotomous dependent variable that is helping in interpreting the values of the parameter coefficients.

Code 0: Indicates that caregiver has not experienced musculoskeletal disorder

Code 1: Indicates that caregiver has experienced musculoskeletal disorder

			Predicted								
			Experience	ed MSDs	Percentage						
	Observed		No	Yes	Correct						
Step 0	Experienced MSDs	No	0	30	.0						
		Yes	0	74	100.0						
	Overall Percentage				71.2						

 Table 76 Classification table for the predictive model

Classification Table^{a,b}

a. Constant is included in the model.

b. The cut value is .500

Table 76 shows that among participants (N=104), 74 caregivers have experienced MSDs which is 71.2% from total caregivers who participated in this study, and 30 of them have not experienced MSDs which is 28.8%. This table is important to show the results with only the constant counted in before the independent variables included into the predictive model. Then logistic regression compares this preliminary model with the predictive model to conclude whether the predictive model is more applicable and adequate. The table is proposes that without any knowledge about the variables, an estimate of a caregiver's chance of having MSDs would be correct 71.2% of the time.

	Omnibus Tests of Model Coefficients										
Chi-square df Sig.											
Step 1	Step	84.206	10	.000							
	Block	84.206	10	.000							
	Model	84.206	10	.000							

Table 77 Omnibus tests of model coefficients for the predictive model

SPSS Output 4 (table 77) shows the Omnibus test, which determines how well the model performs. The Chi-square test determines the overall model's significance, if the original model is accurate, or whether or not the model will be more accurate if the independent variables (predictors) are included.

This test has two hypotheses for the relation to the overall fit of the model:

H₀: The model is a good fitting model

H₁: The model is not a good fitting model

Since Chi-Square = 84.206, and significance of p-value < .000 with degree of freedom = 10, then the null hypothesis will be rejected, which states the initial model is a good fitting model.

Table 78 Model summary for the predictive model

Model Summary									
Cox & Snell R Nagelke									
Step	-2 Log likelihood	Square	Square						
1	40.754ª	.555	.794						

a. Estimation terminated at iteration number 8 because parameter estimates changed by less than .001.

The model summary (table 78) provides the approximation of the R-square value as an alternative of the exact value. Based on Cox and Snell's R-Square, 55.5% of the variation is explained by the predictive model. Based on Nagelkerke's R-Square, 79.4% of the variation is explained by the predictive model, which indicates a reasonably strong relation between the independent variables and the prediction.

Table 79 Hosmer and Lemeshow test for the predictive model

Hosmer and Lemeshow Test										
Step	Chi-square	df	Sig.							
1	13.236	8	.104							

The Hosmer and Lemeshow statistic or chi-square test (table 79) assumes the sampling adequacy, and it has a significant level of 0.104 and this indicates that it is not statistically significant, so the predictive model is a good fit and it is adequately fits the data.

			Predicted								
			Experience	ed MSDs	Percentage						
	Observed		No	Yes	Correct						
Step 1	Experienced MSDs	No	24	6	80.0						
		Yes	4	70	94.6						
	Overall Percentage				90.4						

Table 80 Classification table for the predictive model

Classification Table^a

a. The cut value is .500

Table 80 shown in SPSS output 7, helps in assessing the performance of the predictive model. The table indicates that the predictive model has predicted 70 caregivers to have musculoskeletal disorders out of 74 with 94.6% accuracy from the participants who actually experienced MSDs. On the other hand, the predictive model has predicted that 24 caregivers out of 30 do not have MSDs with 80.0% accuracy. This table is shows that when including the independent variables (predictors) in the predictive model, the error rate has changed from the original model 71.2% to 90.4% from the predictive model.

				-					
									C.I.for P(B)
		В	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step	ManualHandling	3.821	1.171	10.641	1	.001	45.635	4.596	453.149
1 ^a	BendTwistAwkwardPsitn	3.674	1.388	7.007	1	.008	39.420	2.596	598.686
	ExcessiveNoOfPatients	2.894	1.379	4.405	1	.036	18.063	1.211	269.383
	RepetitiveTasks	2.533	1.229	4.250	1	.039	12.590	1.133	139.901
	HvyPhysActivtiesatHome	1.305	.582	5.021	1	.025	3.688	1.178	11.549
	StressWorriedofHlth	.945	.368	6.604	1	.010	2.574	1.252	5.293
	AmountofSleep	-2.759	1.357	4.130	1	.042	.063	.004	.907
	Weight	.183	.089	4.223	1	.040	1.201	1.009	1.431
	Height	241	.072	11.232	1	.001	.786	.683	.905
	HandlingLiftingEqui	.406	.623	.425	1	.514	1.501	.443	5.084
	Constant	-27.104	12.112	5.007	1	.025	.000		

Table 81 Variables in the equation for the predictive model

Variables in the Equation

a. Variable(s) entered on step 1: ManualHandling, BendTwistAwkwardPsitn, ExcessiveNoOfPatients, RepetitiveTasks, HvyPhysActivtiesatHome, StressWorriedofHlth, AmountofSleep, Weight, Height, HandlingLiftingEqui.

It should be noted in table 81 that because MSDs are prevalent among nurses (more than 20%), the odds ratio is probable to be very high in some cases, even if the relative risk is low.

 $MSDs \quad Predicted = -27.104 + 3.821 \quad *(Manual Handling) + 3.674$ $*(Bending/Twisting/Awkward Position) + 2.894 \quad *(Excessive Number of Patients) + 2.533$ $*(Repetitive Task) + 1.305 \quad *(Perform Heavy Physical Activities at Home) + 0.945 \quad *(Emotional Stress: worry about health) - 2.759 \quad *(Amount of Sleep) + 0.183 \quad *(Weight) - 0.241 \quad *(Height)$

Manual Handling: Caregivers who perform manual handling have an increased odds of having MSDs with 45.635 size effect and 95% confidence interval (4.596, 453.149)

Bending/Twisting/Awkward Position: Increasing tasks that includes bending, twisting, or awkward position correspond with increasing odds of having MSDs with 39.420 size effect and 95% confidence interval (2.596, 598.686)

Excessive Number of Patients: Increasing the number of patients corresponded with increasing odds of having MSDs with 18.063 size effect and 95% confidence interval (1.211, 269.383)

Repetitive Task: Increasing values of repeating the same task over an over corresponded with increasing odds of having MSDs with 12.590 size effect and 95% confidence interval (1.133, 139.901)

Heavy Physical Activities at Home: Caregivers who perform heavy physical activities out of work have an increased odds of having MSDs with 3.688 size effect and 95% confidence interval (1.178, 11.549)

Emotional Stress (Worry about Health): Increasing value or the amount of caregivers who are having more stress and worries about their health and having injuries correspond with increasing odds of having MSDs with 2.574 size effect and 95% confidence interval (1.252, 5.293)

Amount of Sleep: Increasing the habit of having appropriate amount of sleep (6-8 hours) daily correspond with decreasing odds of having MSDs with 0.063 size effect and 95% confidence interval (0.004, 0.907)

Weight: Increasing one (1) kilogram (Kg) in caregivers' weight has an increased odds of having MSDs with 1.201 size effect and 95% confidence interval (1.009, 1.431)

Height: Increasing one (1) centimeters (cm) in caregivers' height correspond with decreasing odds of having MSDs with 0.786 size effect and 95% confidence interval (01.683, 0.905)

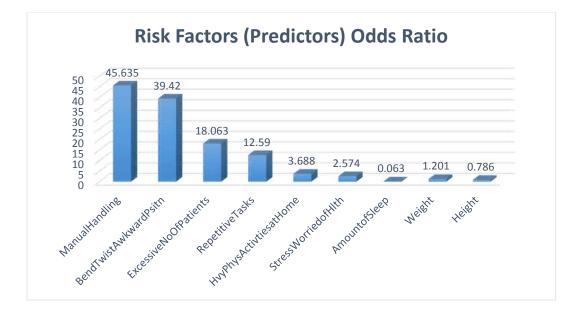


Figure 23 Risk Factors (Predictors) Odds Ratio

The equation of the final predictive model includes nine variables to predict MSDs, which are sorted according to their odds ratios in figure 23. The most significant risk factors in figure, according their effect handling the to size, were manual (45.635),bending/twisting/awkward positions (39.420), excessive number of patients (18.063), repetitive tasks (12.590), heavy physical activities at home (3.688), emotional stress (2.574), weight (1.201), height (.786), and amount of sleep (.063). Manual handling had the highest odds ratio, being 45.635 times more likely to influence MSDs than other factors.

32	2 +	+
	I	ΥI
	I	ΥI
F	I	ΥI
R 24	4 +	Y+
E	I	ΥI
Q	I	YI
U	I	YI
E 16	6 +	Y+
N	I	ΥI
С	I	YYI
Y	I	YYI
8	8 +N	YY+
	IN	Y YYYI
	IN N	Y YYYYI
	INNN N N N Y Y YNY N	Y YY Y YNYYYI
Predicte	ed++++++	+
Prob:		.9 1
Group		YYYYYYYYYYYYYY
	Predicted Probability is of Membership for Yes	
	The Cut Value is .50	
	Symbols: N - No	
	Y - Yes	
	Each Symbol Represents 2 Cases.	
	Figure 24 Classification plots for the predictive model	

Observed Groups and Predicted Probabilities

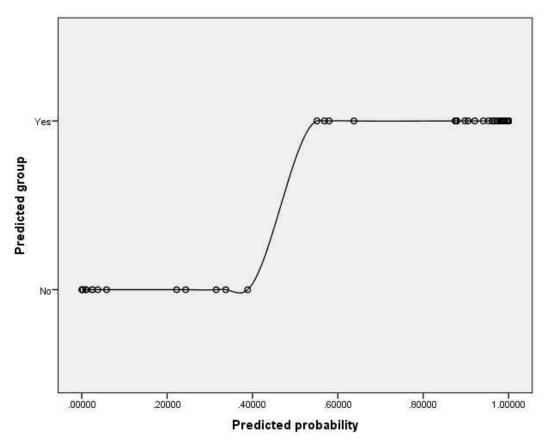


Figure 25 Predicted probability versus predicted group

Figure 25 shows how the model reflects a well-defined relationship based on the independent variable. Furthermore, independent variables (predictors) that have lower values correspond to the observations with zero for the defendant variable. On the other hand, Independent variables (predictors) that have larger values correspond well with the observations with a value of one on the defendant variable. Therefore, the logistic regression curve would have the ability to fit the data moderately well.

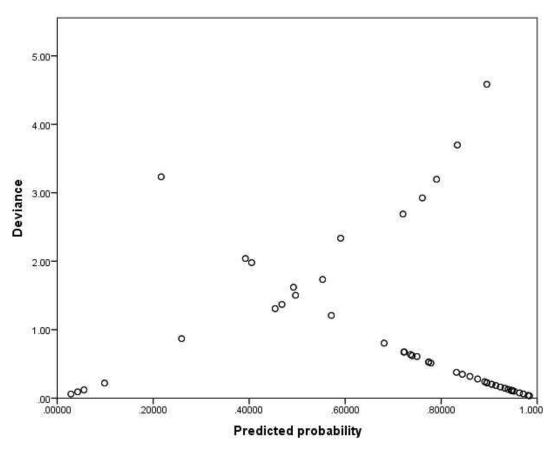


Figure 26 Change in Deviance versus Predicted probabilities

Figure 26 shows the change in deviance versus predicted probabilities and this figure helps to identify observations which are poorly fit by the model. The first curve which is extends from the lower left to the upper right represents $(0 / N_0)$ for having MSDs. The second curve which is extends from the lower right to the upper left represents $(1 / Y_{es})$ for having MSDs.

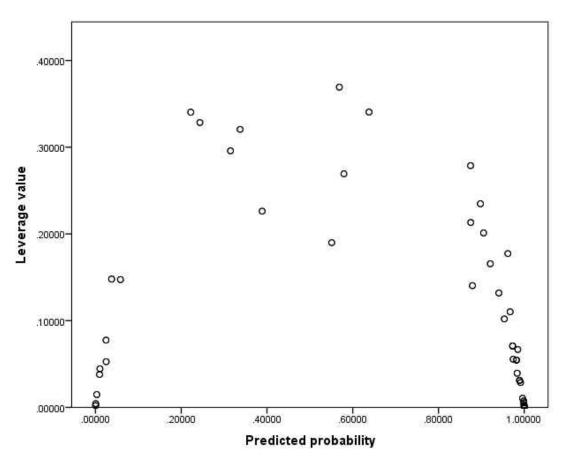


Figure 27 Leverage Value versus Predicted Probabilities

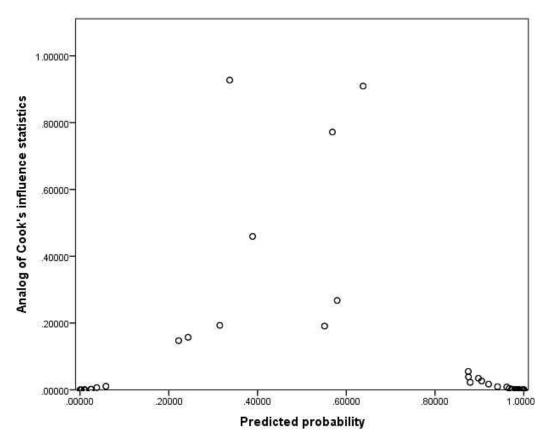


Figure 28 Cooks Influence versus Predicted Probabilities

4.15 Model Summary

A logistic regression analysis was conducted to predict Musculoskeletal Disorders (MSDs) among caregivers using Height, Hour per Week, Emotional Stress: worry about health, Perform Heavy Physical Activities at Home, Bending/Twisting/Awkward Position, Manual Handling, Amount of Sleep, Repetitive Task, and Excessive Number of Patients as a predictors. A test of the full model against a constant only model was statistically significant, which point out that the predictors as a set reliably distinguished between chance of having MSDs and not having MSDs (chi square = 84.206, p < .000 with degree of freedom = 10).

Nagelkerke's R-Square of 0.794 indicated a strong relationship between prediction and grouping. Prediction success overall is 90.4% (94.6 for having MSDs and 80.0 for not having MSDs). The Wald criterion indicated that only the following factors made a significant contribution to the prediction Manual Handling (p=.001 and odds ratio = 45.635, 95% CI [4.596, 453.149]), Bending/Twisting/Awkward Position (p=.008 and odds ratio = 39.420, 95% CI [2.596, 598.686]), Excessive Number of Patients (p=.036 and odds ratio = 18.063, 95% CI [1.211, 269.383]), Repetitive Task (p=.039 and odds ratio = 12.590, 95% CI [1.133, 139.901]), Perform Heavy Physical Activities at Home (p=.025 and odds ratio = 3.688, 95% CI [1.178, 11.549]), Emotional Stress: worry about health (p=.010 and odds ratio = 2.574, 95% CI [1.252, 5.293]), Amount of Sleep (p=.042 and odds ratio = .063, 95% CI [.004, .0907]), Weight (p=.040 and odds ratio = 1.201, 95% CI [1.009, 1.431]), Height (p=.001 and odds ratio = .786, 95% CI [.683, .905]). It was found that using a handling lifting equipment was not a significant predictor.

	Omnibus	Tests		Model Summary				Hosmer and Lemeshow test		
Model	Chi- Square		-2 Log Cox & Snell Nagelkerke R likelihood R Square Square		Chi- Square	df	sig	correct		
Demographic Data Strategies	40.971	.000	83.989	.326	.466	5.678	8	.683	80.8	
Ergonomic Practice	18.476	.002	106.484	.163	.233	14.906	6	.021	76.9	
Injury Prevention Strategies	17.306	.044	107.654	.153	.219	11.429	8	.179	71.2	
Physical Health	80.740	.000	42.219	.506	.789	10.527	8	.230	89.4	
Pain	41.864	.000	83.096	.331	.474	14.799	8	.063	80.8	
Psychology	58.693	.000	66.267	.431	.617	17.710	8	.024	86.5	
General Health	10.060	.261	114.900	.092	.132	7.081	8	.528	73.1	
Sleep	53.962	.000	70.998	.405	.579	40.715	8	.000	86.5	
Predictive Model	84.206	.000	40.754	.555	.794	13.236	8	.104	90.4	

Table 82 Model Comparison

Table 82 compares the predictive model which includes both work and non-work related factors to the individual models developed from the identified risk factor categories. The analysis indicates that the data can be better explained with the chosen predictive model and its factors, which has a better fit than the other models. The R-square value of the best fitting predictive model is .794 with the chosen risk factors. This model also has the least error associated with its estimations (90.4% correct) when compared to the other models.

4.16 Model Validation

ID	Experienced MSDs (Observed)	Manual Handling	Bend/Twist /Awkward Position	No. Of Patients	Repetitive Tasks	Heavy Physical Activities at Home	Stress Worry About Halth	Amount of Sleep	Height (Cm)	Weight (Kg)	Equipment s	Experienced MSDs (Observed)	Experienced MSDs (Predcted)	Difference Backward Model
1	Yes	1	1	1	1	4	7	0	156	60	4	Yes	Yes	0
2	Yes	1	1	1	1	4	7	0	156	60	4	Yes	Yes	0
3	Yes	0	1	1	1	6	7	0	163	80	3	Yes	Yes	0
4	No	1	1	1	0	2	3	0	182	100	2	No	No	0
5	Yes	0	1	1	0	2	5	0	170	80	2	Yes	No	1
6	Yes	1	1	1	0	4	10	1	165	75	4	Yes	Yes	0
7	Yes	1	1	1	1	4	10	1	164	75	2	Yes	Yes	0
8 9	Yes	1	0	1	0	4	3	0	160	53	3	Yes	Yes	0
	Yes	1	1	1	1	4	6	1	161	43	3	Yes	Yes	0
10	Yes	1	1	1	0	4	8	0	153	60	3	Yes	Yes	0
11	Yes	1	0	0	0	4	7	0	160	53	4	Yes	Yes	0
12	Yes	0	1	1	0	3	7	0	150	51	3	Yes	Yes	0
13	Yes	1	1	1	1	4	5	0	172	59	2	Yes	Yes	0
14	Yes	0	0	1	1	4	4	0	165	65	2	Yes	Yes	0
15	Yes	0	1	1	1	5	2	0	155	62	2	Yes	Yes	0
16	No	0	0	1	1	4	2	0	150	60	2	No	No	0
17	Yes	1	0	0	0	5	7	1	177	80	4	Yes	Yes	0
18	Yes	0	0	1	0	3	8	0	152	59	3	Yes	Yes	0
19	No	1	0	0	0	2	5	1	160	80	1	No	No	0
20	No	0	0	0	0	2	4	0	175	70	2	No	No	0
21	No	0	1	0	1	3	4	1	165	78	3	No	No	0
22	No	1	0	0	0	1	2	0	160	75	3	No	No	0
23	Yes	1	1	1	0	3	2	0	149	43	3	Yes	Yes	0
24	Yes	0	1	1	1	2	2	0	154	54	4	Yes	Yes	0
25	No	0	0	1	0	2	2	0	153	45	3	No	No	0
26	No	0	1	1	1	2	2	0	160	55	1	No	Yes	1
27	Yes	0	1	1	0	2	2	0	151	51	2	Yes	Yes	0
28	Yes	0	1	1	1	4	2	1	160	55	5	Yes	Yes	0
29	Yes	0	1	1	1	4	2	1	160	55	5	Yes	Yes	0
30	Yes	1	0	1	1	5	2	0	164	60	4	Yes	Yes	0
31	Yes	1	1	0	0	2	2	0	163	50	2	Yes	Yes	0
32	Yes	1	1	0	0	2	2	0	163	50	2	Yes	Yes	0
33	Yes	0	1	1	1	5	2	0	162	68	1	Yes	Yes	0
34	Yes	1	1	1	0	2	2	1	150	47	3	Yes	Yes	0
35	Yes	1	0	0	1	4	2	0	153	55	5	Yes	Yes	0
36	Yes	1	0	0	0	5	2	0	162	50	2	Yes	Yes	0
37	No	0	0	0	0	6	2	0	153	50	4	No	Yes	1
38	No	0	0	0	0	2	2	0	175	67	2	No	No	0
39	Yes	0	1	1	0	4	2	0	154	48	2	Yes	Yes	0
40	No	0	0	0	0	4	2	0	175	69	2	No	No	0
41	Yes	1	1	0	1	3	2	1	165	56	3	Yes	Yes	0
42	Yes	1	1	0	1	3	2	1	165	56	3	Yes	Yes	0
													Missed	3
1												Model Su	ccess Rate	92.86%

Figure 29 Model Validation

Forward logistic regression was used to validate the predictive model, involving 42 participants. This validation (figure 29) found that the model was accurate 92.86% of the time in predicting if a caregiver developed a MSD. There were three cases where the model gave inaccurate predictions, incorrectly predicting two cases of MSDs when caregivers did not have them, and failing to predict one MSD for a caregiver who had one. It was also found that the equipment handling variable excluded from the final model was not statistically significant, confirming that the presence of equipment is not helping caregivers by reducing their risk for MSDs (Rahal, 2005).

CHAPTER FIVE: CONCLUSION AND FUTURE RESEARCH

5.1 Introduction

Healthcare providers and caregivers are required to routinely perform high-risk tasks in their work environments, which can lead to physical injury. Due to the nature of their job, nurses routinely engage in tasks which involve lifting and handling patients, and working in awkward or extended positions, which can put them at risk for injuries and developing musculoskeletal disorders (MSDs). Because of these working conditions, musculoskeletal disorders are a leading problem among nurses who are involved with heavy workloads and physically demanding tasks such as patient handling or manual handling. Caregivers who must regularly handle patients are put at risk by complicating factors such as understaffing, patient size and weight, a lack of proper ergonomic equipment, a lack of body mechanics training, and others. As a result, many caregivers develop this type of injury, and it is prevalent among the types of work-related injuries in healthcare environments. The risks to caregivers in turn affects the overall quality in provider care, in an industry where quality is of utmost importance in all areas.

Furthermore, there are high costs associated with these injuries, which carry negative implications for caregivers and patients alike. In the short term, costs include compensation for injuries and treatment, as well as days spent away from work, while long term costs can include a loss in workplace productivity, a decrease in efficiency, and lower job satisfaction for nurses. Moreover, MSDs put nurses at risk for permanent and disabling injuries, which may result in

further losses in staffing due to recovery, rehabilitation, decreases in patient and caregivers satisfaction and overall quality of care.

It is important to understand and predict the risk factors that contribute to the development of MSDs among caregivers, in order to inform and empower policy making for both caregiver safety and patient safety alike. Decision makers have taken measures designed to prevent the development of MSDs in caregiver environments by implementing prevention policies aimed to introduce ergonomic lifting tools and effective training for caregivers. These measures have sought to directly reduce manual lifting done by nurses, as it has been identified by researchers as the leading cause to MSDs. However, challenges persist in implementing policies which are effective at preventing MSDs. Researchers have found that training provided to promote safe lifting techniques has not succeeded in targeting methods to reduce injuries.

Additionally, some providers do not have lifting equipment due to high costs, or do not have properly designed spaces to house such equipment. The most important risk factor for MSDs, manual handling, has yet to be thoroughly studied, and other non-work related risk factors are not frequently considered by major studies. Research efforts have fallen short of creating a comprehensive understanding of the impact of risk factors on MSDs. The shortcomings of current research and ineffective prevention policies highlight the need for a predictive model which considers both work and non-work risk factors which are associated with MSDs, in a way that acknowledges the multifactorial nature of the risk factors. This study found the correlation between both work and non-work related risk factors for MSDs, seeking to both assess what significant risk factors can be controlled through prevention policies, and develop insights which can guide those policies. With the ultimate goal of quality of care in mind, the developed framework sought to identify risk factors for MSDs, which in turn impacts quality factors such as job satisfaction, productivity, quality of life, and others. These risk factors were also designed according to the ergonomics injury triangle, which emphasizes frequency, posture, and force. The designed framework identifies six categories of risk factors for MSDs, which are identified from existing research, and include both work and non-work factors, which are organizational, work environment, caregiver characteristics, patient characteristics, psychological, and biomechanical factors. These factors were identified to acknowledge the influence that personal environments and characteristics have on a caregiver's risk for developing MSDs, in addition to workplace environmental factors.

This framework involved the development of a logistic regression model to ultimately determine the relationship between the identified risk factors and the development of MSDs. The model analysis additionally determined which factors are significantly associated with the development of MSDs, and which ones are not significant. This framework takes into consideration under-studied risk factors which impact the outcomes for providers and their quality of care, in order to shed more light on the root causes of MSDs. The designed framework was supported by a data obtained from a survey of a Saudi Arabian hospital, where responding nurses provided 104 observations related to the identified risk factors.

The results from the logistic regression model show that there is a strong association among some of the studied risk factors and MSDs. Although some were not strongly associated with MSDs strictly by themselves, they were shown to contribute to MSDs when compounded by other factors. Demographic information, the first risk factor category, was found to be significantly associated with MSDs, and the significant risk factors were weight, height, and gender. Other factors such as age and experience were also included in the demographic information category, but were not found to be significant. While it is insightful to understand the association of a nurse's personal demographics with their development of MSDs, this factor is not immediately controllable by policy makers, and does not present a strong opportunity to alter the current methods for manual handling, nor should it be solely used as a key determinant for employers to assess prospective nurses.

No correlation was found between the ergonomic practices risk factor category and MSDs, meaning that if it is assumed that no knowledge on any other variable is available, the use of ergonomic practices is not a sufficient indicator for the chance of having MSDs. On the other hand, some strategies in the injury prevention category were found to be associated with the development of MSDs. It was found that not pausing regularly while performing a task increased the odds of a caregiver having a MSD, and it can be recommended for caregivers to take rests between activities. It was also found that adjusting the plinth/bed height to accommodate a change in posture correlated to a decrease in the odds of having a MSD.

The physical health risk factor category was strongly associated with the development of MSDs, which is comprised of several indicators. Caregivers who reported having bodily pain were likely to have MSDs, and caregivers who reported being satisfied with their physical ability were associated with lower rates of MSDs. Furthermore, being in a fixed position for a long period of time, whether sitting or standing, was found to increase the odds of having a MSD, and feeling fatigue was similarly found to increase these odds. Oppositely, caregivers who reported feeling energetic and satisfied with their overall health were found to have decreased chances of having MSDs. These findings suggest that confidence in physical well-being is important for caregivers in reducing risks for MSDs, while prolonged periods of working in a fixed position and fatigue are detrimental to their health. Caregivers should be offered the opportunity to stretch or change their position when they are in roles involving fixed positions for long periods of time to reduce the risk for MSDs. General fatigue, which was found to be a confounding factor in MSDs, carries other numerous impacts on the overall quality of care, and these results highlight the importance of avoiding fatigue.

Risk factors in the Pain category were also highly associated with MSDs, confirming that caregivers who don't feel pain are less likely to have MSDs. These results concur with the results from the physical health risk factors, and specifically found that pain which affected work activities corresponded to increased odds for having MSDs. Prevention policies could emphasize that caregivers should pause or stop when they feel pain or discomfort when engaging in lifting in their workplace. It was found that there was no association with psychology and social activity risk factors with MSDs, when considering different emotions felt by caregivers and their satisfaction. This risk factor category alone is not enough to predict MSDs without other variables, and is a category which would be difficult to influence through policy. Also, general health was not found be significantly associated with MSDs, when caregivers indicated feelings of being sick or healthy. While no association is indicated solely as a risk factor category, it cannot be concluded that general health does not play a role in the development of MSDs when considering other factors. Likewise, there was no significant correlation found between the amount of sleep for caregivers and MSDs. Variables in this risk factor category included caregivers' amount of sleep, feelings of being sleepy or falling asleep, tendencies to take naps, and others.

The predictive model was developed with a combination of risk factors which resulted in the best fitted model, such that the data could be well explained with it. The resulting model takes into consideration ten variables to predict MSDs. The equation for the predictive model included the following risk factors: manual handling, bending/twisting/awkward positions, excessive number of patients, repetitive tasks, heavy physical activities at home, emotional stress, amount of sleep, weight, and height. Figure 23 presented the odds ratio of each variable used to predict MSDs, and the model was found to reflect a well-defined relationship based on the independent variable.

The most significant risk factors in the figure, according to their importance, were manual handling (p=.001,odds ratio=45.635, 95% CI [4.596,453.149]), bending/twisting/awkward positions (p=.008, odds ratio=39.420, 95% CI [2.596, 598.686]), excessive number of patients (p=.036, odds ratio= 18.063, 95% CI [1.211, 269.383]), repetitive tasks (p=.039, odds ratio=12.590, 95% CI [1.133, 139.901]), heavy physical activities at home (p=0.025, odds ratio=3.688, 95% CI [1.178, 11.549]), emotional stress (p=0.010, odds ratio=2.574, 95% CI [1.252, 5.293]), amount of Sleep (p=.042, odds ratio = .063, 95% CI [.004, .0907]), weight (p=.040, odds ratio = 1.201, 95% CI [1.009, 1.431]), and height (p=.001, odds ratio = .786, 95% CI [.683, .905]). Manual handling was found to be the leading risk factor for developing MSDs, being 45.635 times more likely to influence MSDs than other factors. This result concurs with the findings of others who cite manual handling as the leading cause for MSDs. Some of these factors such as tasks carried out at home and emotional stress are also significant, however their size effect is minimal compared to other risk factors. All of the significant risk factors are important to address, and reflect opportunities for policy makers to reduce the occurrence of MSDs in the future.

It was also found that as a result of developing MSDs, 19% of caregivers switched to new areas within their career field, while 13% changed their career entirely due to MSDs. Among the sample population (N=104), 71% of participating caregivers (n=74) have experienced MSDs, and 93.3% (n=97) work more than 40 hours per week. It was further revealed that among the 71% of responding caregivers who had MSDs, only 26.9% received paid days away from work, indicating that many caregivers were not reporting their injuries.

The most affected body part for caregivers with MSDs was reported to be the lower back (46%, n=48), which concurs with the findings of other studies. Other most affected body areas included the knee (15.4%, n=16), shoulder (11.5%, n=12), wrist/hand (7.7%, n=8), neck (7.7%, n=8), hips/thighs (5.8%, n=6), upper back (3.8%, n=4), and elbow/forearm (1.9%, n=2). Responding caregivers also indicated that 55.8% did not receive any kind of ergonomic training in injury prevention. Some caregivers reported that they continued to move after feeling pain or becoming injured, and it was found that 71% of MSD pain in the sample population occurred gradually rather than suddenly. This means that MSDs carry early signs of development, and caregivers who report pain should be taken seriously by management in order to prevent MSDs. These early signs of MSDs further highlight the importance of stopping when physical activities become painful for caregivers, which is also concluded from the model.

Several recommendations can be made for reducing and eliminating MSDs, which must be implemented and enforced by policy makers. The primary focus for policy makers should be reducing any task which involves manual handling, which is a chief concern for caregivers. The results of this study echo those of other studies which highlight the significant role that manual handling plays in the development of MSDS.

Policy makers can limit the number of hours per week that caregivers have to work, which would attempt to limit their fatigue. Furthermore, policy makers can emphasize resting between lifting tasks, and stopping when caregivers begin feeling pain while carrying out a task. Other policy improvements could seek to redesign lifting tasks entirely to avoid movements identified as high risk factors. It is also important for policy makers and administrators to ensure that healthcare facilities are adequately staffed with physicians and nurses, while enforcing policies to ensure they are not overworked. While re-balancing current caregiver duties may prove impractical, future policies could be revised to consider basic physical ability standards for certain roles within different departments, to ensure that those in physically demanding roles are fit enough. Caregivers who are not satisfied with their physical ability or possess risk factors related to fitness could avoid lifting roles under such policies which would assure that others are available to assist.

In addition to ensuring caregivers' needs are met, policy makers can also work to more thoroughly to ensure they are informed of risks within their workplace. More policies could be implemented which seek to increase the awareness of workplace injuries, their consequences, and prevention techniques designed to minimize injury. Mandatory training on occupational injury prevention strategies and ergonomics would also benefit caregivers, since many reported that they did not receive training (55.8%). Training and awareness would help in ensuring caregivers do not continue to work when they feel pain or become injured, since it was found that 71% of caregivers with MSDs experienced early signs of gradually occurring pain.

Ultimately, the recommendations made by this study reflect opportunities for re-defining policies for preventing injury to caregivers in their workplace. While such policies can be defined with the perspectives gained from research, the importance of considering the challenges and pressure which caregivers face while working to follow the culture of safe ergonomic practices cannot be overstated. Nurses have asserted that although their workplaces promote safety, they place the needs of their patients above their own when they are involved in lifting activities while managing constraints such as limited spaces.

Policies cannot be made effective unless caregivers are supported with infrastructure such as working spaces which are designed for recommended ergonomic equipment, and facilities must maintain adequate levels of staffing so that caregivers are able to use safe lifting techniques, and do not have to resort to risky practices. Furthermore, it is important to strive for improvement within managing risks for caregivers in health professions so that they do not end up leaving their profession. Many providers are already experiencing shortages, and further shortages due to job dissatisfaction and health concerns among caregivers would only exacerbate the problem. New generations of caregivers should not feel deterred from entering the field of healthcare due to high risks for workplace injury.

This research contributes to the field of knowledge in human factors and ergonomics risk management by proposing a framework to identify risk factors for MSDs and producing a predictive model. It overcomes the shortcomings of previous models by correlating work and non-work related risk factors, and assessing the influence of these factors on the development of MSDs. Practitioners can use these results to support working condition changes for caregivers and implement prevention policies. This research also adds to the body of knowledge on quality of care, and presents researchers with opportunities for expanding approaches to identifying causes for MSDs.

5.2 Limitations and Future Research

This research considered non-work risk factors in addition to work related risk factors when determining the causes of MSDs through logistic regression, and in doing so overcame shortcomings of other research, while creating new challenges. The design of the study which collected data from nurses imposed some limitations on this research, and other limitations stemmed from the demographics of the site's caregiver population. With the introduction of six risk factor categories, there were many individual risk factors, and some overlapping factors resulted in collinearity, impacting the factors included in the final equation of the predictive model. Future studies could expand upon the findings of this research by redesigning the study and conducting more research on different risk factors.

With regard to demographic limitations, it was established in the literature that the average caregiver was middle-aged, however the demographic profile of the polled sample population differed from the average. Among the responding caregivers, 80% were between the ages of 20 and 30, which is not characteristic of the average demographic for caregivers. The sample population was also predominantly female (75%), and since there are slightly different risk factors for female caregivers, this means that the results are somewhat biased toward the perspective of their responses and characteristics. A further study could benefit from more variety in the demographic makeup of its sample population, where a better balance between gender and age could provide more accurate and applicable results.

The healthcare environment within the region of Saudi Arabia also imposed a limitation on collecting information about caregiver injuries. It is not a standard practice for hospitals in the region to maintain records of injuries among caregivers or compensation claims, meaning that the polled hospital did not have an available source of data for the history of injuries among its personnel. This made it necessary to obtain this information from caregivers, which was limited to the 104 available participants. Consequently, further analysis could be carried out within healthcare institutions which have more consistent bookkeeping of their history of caregiver injuries, providing an opportunity for a more extensive study.

This research found that pausing between lifting tasks was associated with decreased odds of having MSDs, which is an insight that can be elaborate on by further studies. Researchers could seek conduct research which proposes the frequency of these pauses and the time until they are needed, which would provide more information for the benefits of this practice as well as the implementation of policy regarding this risk factor.

Ergonomic tools, which have potential to aid caregivers during lifting activities, still have some developmental hurdles to overcome before they become more widely implemented and beneficial in injury reduction. To benefit the overall implementation of ergonomic practices and reduce MSDs, researchers could focus on the improvement of ergonomic lifting tools and equipment, to make them both easier to use and more accessible for environments with different space requirements. Research can also work to empower healthcare administrators in their goals of providing and designing effective training on how to use such ergonomic equipment, in order to integrate new equipment into existing environments. Finally, it is necessary to increase policy makers' awareness of ergonomic equipment, in order to gain increasing acceptance for the use of these tools in caregiver environments. Researchers can bring more attention to ergonomic equipment, if it could be proven to be effective in reducing injury occurrence, by studying the cost of the equipment versus the cost of injuries. It would be necessary to study in detail the direct and indirect costs of injuries associated with MSDs in order to make a proper comparison to the direct cost of ergonomic equipment, to determine if different types of equipment would ultimately be beneficial and financially significant enough to purchase.

It has been established by several studies that the lower back is the body part most affected by MSDs, which is supported by the findings of this research (as indicated by 46% of caregivers). Further studies which analyze injuries could seek to determine why the lower back is the most affected body part, whether it be due to lifting policies, a lack of training, or caregivers' job design.

Lastly, future research could reproduce this study with an alternative tool to logistic regression. Acritical Neural Network (ANN) is one such tool which could analyze the data from this research, and might provide different results and understandings about the risk factors and their association with MSDs to some extent. ANN requires less formal statistical training, has the ability to implicitly detect complex nonlinear relationships (whereas logistic regression relies on causal relationships), and has the ability to detect all possible interactions between risk factors.

APPENDIX A RISK FACTORS IDENTIFIED FROM THE LITERATURE

Study	setting	Design	Sample size	Potential Risk factors
Holtermann 2013	Female healthcare workers in the eldercare services (Denmark)	Cohort Study, caregiver with lower back pain performing PH	1,544	Caregiver characteristics: age body mass index (BMI) current smokers seniority leisure time physical activity emotional demands role conflicts influence quality of leadership use of ergonomic device
Kim, Dropkin, Spaeth, Smith, & Moline, 2012	Caregivers who filed Workers' Compensation related to MSDs between (2003-2009) (USA)	Prospective cohort	3,452	Age Gender Union membership Scheduled shift Employment status Patient handling (Comparison)
Reme et al., 2014	Patient care workers (USA, Boston area)	Cross- Sectional Study	1,572	Demographic characteristics: gender race age marital status education Structural factors: job title Organizational practices: ergonomic practices people-oriented culture perceived staffing adequacy Psychosocial work environment: work load job control supervisor support co-worker support Psychological factors: burnout job satisfaction
Lee et al.,	Critical Care	Cross-	361	Personal factors:

Table 83 Potential Risk factors from literature	Table 83	Potential	Risk	factors	from	literature
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Study	setting	Design	Sample size	Potential Risk factors
2013	Nurses (USA)	Sectional Study		age gender race marital status body mass index (BMI) Workplace/employment factors: total years in nursing type of hospitals work setting type of unit work schedule work hours per shift Physical workload: No. Of patient lifts/transfers physical workload index Psychosocial factors: psychological demand job control job strain effort reward effort-reward imbalance ratio safety climate Lift team availability Lift equipment usage
Warming, Precht, Suadicani, & Ebbehøj, 2009	Caregiver from University Hospital in Copenhagen (Denmark)	Cross- Sectional Study	148	Gender Age Profession Years of patient handling Shift Psychosocial factors: time pressure stress conscience Physical factors: transfer tasks care tasks
Jellad et al., 2013	All Hospital's workers (Tunisia)	Cross- Sectional Study	433	Age Profession Years of service Body mass index (BMI) Gender

Study	setting	Design	Sample size	Potential Risk factors
				Tobacco consumption Lengthy standing Lengthy sitting Repetitive movement Postures Heavy load handling Climbing stairs Shifts Physical stress Mental stress
Pompeii et al., 2009	Workers at Duke University Medical Center (USA)	Prospective Cohort	861	Occupational group Gender Race Age Years employed at hospital
Lamy et al., 2014	Registered Nurses & Nursing Assistants (France)	Cross- Sectional and Longitudinal Study	1,801	Age Work unit specialty Shift Working hours Leisure time physical activity Tobacco consumption Body mass index (BMI) Work-unit-level psychosocial and organizational environment: support from nursing management staff adequate staffing organization encouraging the exchange of information regarding patient care interruptions during nursing tasks relationships with superiors ability to take holidays/ paid leave Biomechanical constraints: low/high physical exertion at work low/high constraints in direct patient handling low/high constraints in indirect patient handling low/high constraints in movements and postures Effort-reward perception Low/high over commitment
Schoenfisch	Medical Center	Cross-	585	Demographics/work characteristics:

Study	setting	Design	Sample size	Potential Risk factors
& Lipscomb, 2009	and Community Hospital (USA)	Sectional Study		Job title Age Years worked on current unit Years worked in nursing Patient handling injury No. of patient moves/assists performed per shift Work organization factor: Job Strain Decision latitude Job insecurity Total social support Psychological demand Physical demand Hazardous working conditions Job dissatisfaction Isometric load
Lee, Faucett, Gillen, Krause, & Landry, 2010	Nurses American Association of Critical Care Nurses (USA)	Cross- Sectional Study	361	Demographics characteristics: age body mass index (BMI) gender race Marital status Education Job characteristics: Years worked in nursing Hours worked per shift Hours worked per 2 weeks Total no. Of min. For breaks Type of unit Work status Job title Work schedule Workplace/organizational factors : Type of hospital Type of hospital setting Availability of lift devices/lift team Height-adjustable beds Safety climate Physical work factors: Number of patient handling per shift Physical workload index

Study	setting	Design	Sample size	Potential Risk factors
				Psychosocial work factors: Job strain Social support Effort-reward imbalance
Yasobant, 2014	Hospital in Chennai (India)	Cross- Sectional Study	140	AgeGenderBody mass index (BMI)Marital statusArea of practiceExperiencePhysical activityRecreational activitySmokingConsuming alcoholShiftJob rotationStressJob stress:Performing the same task over and overTreating an excessive No. of patient in onedayPerforming manual orthopedictechniquesNot enough rest break/pause during theworkdayWorking in awkward and crampedpositionWorking near/at your physical limitsReaching/working away from your bodyContinuing to work while injured or hurtLifting/transferring dependent patientsWorking with confused/agitate patientsCarrying/lifting/moving heavymaterial/equipmentUnanticipated sudden movement/fall bypatientAssessing patients during gait activitiesInadequate training on injury prevention

Study	setting	Design	Sample size	Potential Risk factors
(Tinubu, Mbada, Oyeyemi, & Fabunmi, 2010	Three Selected Hospitals in Ibadan (Nigeria)	Cross- Sectional Study		Age Height Weight Body mass index (BMI) Years of experience Hours per week Work stress: Working in the same positions for long periods Lifting or transferring dependent patients Bending or twisting your back in an awkward way Treating an excessive number of patients in one day Carrying, lifting, or moving heavy materials or equipment Performing manual orthopedic techniques Not enough rest breaks or pauses during the workday Work scheduling Working in awkward and cramped positions Continuing to work while injured or hurt Reaching or working away from your body Unanticipated sudden movement or fall by patient Inadequate training on injury prevention Working near or at your physical limits Working with confused or agitated patients Performing the same task over and over
Smith, Mihashi, Adachi, Koga, & Ishitake, 2006	Large Teaching Hospital (Japan)	Cross- Sectional Study	844	Assisting patients during gait activities Demographic characteristics: Age Drink alcohol Smoke tobacco Currently married Has Children Workplace factors: Career length Weekly work hours Manually handling patients

Study	setting	Design	Sample size	Potential Risk factors
				Often bending/twisting Hard physical work Psychosocial factors: Pre-menstrual tension High mental pressure Not enough staff Boring/tedious work Not enough support
Stubbs, 2009	Mental Healthcare Services (UK)			Patient characteristics Rapid work pace Repetitive motion patterns Heavy lifting Forceful exertions Non-neutral body postures Psychosocial factors: low mood poor support from supervisors stress high pressure of work poor job satisfaction low degree of work control

APPENDIX B EXPLANATION OF RESEARCH



EXPLANATION OF RESEARCH

Title of Project: Identifying Work Related and Non-work Related Risk Factors to Musculoskeletal Disorders among Saudi Arabian Nurses

Principal Investigator: Abdulelah Ali

Faculty Supervisor: Gene Lee

You are being invited to take part in a research study. Whether you take part is up to you.

The purposes of this research is to determine what factors contribute to musculoskeletal disorders injury (MSDs) resulted from patient handling task and prioritize those factors. Also, develop a predictive model in order to determine the association of the identified work related and non-work related risk factors with the musculoskeletal disorders in Saudi Arabian healthcare organizations.

This research will be conducted at one of Ministry of Health's hospitals in Saudi Arabia. A total of 100 participants (Caregivers) are needed to finish this study, and this is estimated to be done in the period of 2 weeks. The investigator will meet with the participants and collect the needed data and each survey will take less than an hour. The survey contains an introduction and description of the nature of the study.

The participants (caregivers) are going to be communicated before the actual survey will take a place and ask them to participate in the study. Each survey will be assigned to only one participant

at time. Each survey is expected to last less than one hour. It is expected to have 10 participants very working day for 2 weeks. This study targets caregiver who work full time in Saudi Arabian healthcare organizations.

You must be 18 years of age or older to take part in this research study.

Study contact for questions about the study or to report a problem: If you have questions, concerns, or complaints, please contact Abdulelah Ali, Graduate Student, Department of Industrial Engineering and Management Systems at (617) 480-4029 or by email at allosh84@knights.ucf.edu or Dr. Gene Lee, Faculty Supervisor, Department of Industrial Engineering and Management Systems at (407) 823-2308 or by email at glee@ucf.edu.

IRB contact about your rights in the study or to report a complaint: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901.

APPENDIX C STUDY IRB APPROVAL



University of Central Florida Institutional Review Board Office of Research & Commercialization 12201 Research Parkway, Suite 501 Orlando, Florida 32826-3246 Telephone: 407-823-2901 or 407-882-2276 www.research.ucf.edu/compliance/irb.html

Approval of Exempt Human Research

From: UCF Institutional Review Board #1 FWA00000351, IRB00001138

To: Abdulelah Ali

Date: November 18, 2015

Dear Researcher:

On 11/18/2015, the IRB approved the following activity as human participant research that is exempt from regulation:

Type of Review:	Exempt Determination
Project Title:	Identifying Work Related and Non-work Related Risk Factors to
	Musculoskeletal Disorders Among Saudi Arabian Nurses
Investigator:	Abdulelah Ali
IRB Number:	SBE-15-11723
Funding Agency:	
Grant Title:	
Research ID:	N/A

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

anne muratori 8

Signature applied by Joanne Muratori on 11/18/2015 04:51:53 PM EST

IRB Manager

Page 1 of 1

APPENDIX D SAUDI GERMAN HOSPITAL GROUP LETTER



عسير - ص.ب ٢٥٥٢ - خميس مشيط - الملكة العربية السعودية - تليفون : ٢٢٥٥٠٠٠ (١٠٠ خط) - فاكس: ٢٢٥٤٥٠٠ (٢٠١) Aseer - P.O. Box: 2553, Khamis Mushayt - Kingdom of Saudi Arabia - Tel. 966-17-2355000 (100 Lines) - Fax (017) Website: www.sghgroup.com -- Email: info.asr@sghgroup.net

APPENDIX E SURVEY

Survey on Work-Related Musculoskeletal Disorders among Saudi Arabian Nurses

* Required

1. 1. What is your age? *

(as at last birthday) Mark only one oval.

0	20 - 30
	20 00

C	\supset	30 - 40
C		40 - 50
C)	50 - 60

2. 2. What is your height? *

61	n.		1		
U	13	11			

 3. 3. What is your weight? * (Kg)

4. 4. What is your sex? * Mark only one oval.

> Male Female

\bigcirc	Female		

5. 5. What best describe your current area of practice? * Mark only one oval.

\bigcirc	Clinic
\bigcirc	Academic
\bigcirc	Public health
\bigcirc	Other:

6. 6. What is your rank/cadre? *

•	8. How many years of professional experience do you have? *
	9. Do you have a post basic nursing qualification? Mark only one oval.
	Yes No
	10. What is your work status in the last 12 months Mark only one oval.
	Full Time Part Time
•	11. Please indicate your work setting * Mark only one oval.
	Tertiary
	Secondary
	Primary
	Other:
2.	Primary

13. 13. Have you ever experienced work-related ache, pain, discomfort, or injury that lasted for more than three days (not within the previous 12 months) in your nursing career till date? *



14. 14. Have you ever experienced work-related ache, pain, discomfort, or injury in any part(s) of your body that lasted for more than three days in the last 12 months? * Mark only one oval.

C) Yes
C) No

 15. 15. If you answered 'Yes' to Question 14, please check all that apply * Check all that apply.

Neck
Shoulder
Upper back (thoracic)
Elbow/forearm
Low back (lumbar/sacral)
Wrist/hand
Thumb
Hips/Thighs
Knees
Ankles

- 16. 16. If you answered 'Yes' to Question 14, please indicate one most significant body location/site as stated in Question 15 where you have experienced work-related problems *
- 17. 17. When did you first experience this work-related problem? * Mark only one oval.
 - Before training as a nurse
 - As a student nurse
 - In the first five years after graduation
 - 5-15 years after graduation
 - >15 years after graduation
 - Don't know
- 18. 18. What was the onset of work-related problem like? * Mark only one oval.
 - Gradual
 - Sudden

As a result of an accident

19. 19. Have you ever treated yourself or sought treatment from any health professional as a result of work-related problem? *

Mark only one oval.

C)	Yes
C)	No

20. 20. Have you ever changed the area/specialty of nursing practice as a result of work-related problem? *

Mark only one oval.

\square)	Yes
_	S .	
)	No

21. 21. If you answered 'Yes' to Question 20, what did you change from? *

Please Indicate From / To

22. 22. Have you ever had training on ergonomics or how to prevent occupational Injury?

Mark only one oval.

C	\supset	Yes
C)	No

23. 23. Indicate how you may possibly reduce strain on your body when carrying out your nursing duties. *

Please tick all that apply. Check all that apply.

I will prefer to use adjustable bed/plinth

- I will prefer to use sliding board
- I will prefer to use lifting belt
- I will prefer to use splints
- None of the above
- Other:
- 24. 24. Have ever left the nursing profession to pursue another career as a result of workrelated disorders? *



- 25. 25. Have you ever had any job related injury? Mark only one oval.
 - ◯ Yes ◯ No

26. 26. If you answered 'Yes' to Question 25, Please describe your injury? *

27. 27. If you answered 'Yes' to Question 25, Did you get any compensation? * Mark only one oval.

C	\supset	Yes
C	\supset	No

28. 28. If you answered 'Yes' to Question 27, How much was the compensation amount?

l m	0	Δ	D
In	0	m	Γ.

29. 29. If you answered 'Yes' to Question 25, Did you get any paid days away from work (sick-leave)? *

Mark only one oval.

C		Yes
C	\supset	No

30. 30. If you answered 'Yes' to Question 29, How many days? *

31. Listed below are 17 conditions and tasks at work that could contribute to job-related problems. Please indicate, on a scale of 0 to 10, how much of a problem (if any) each item is for you by choosing the appropriate number." A score of 0 to 1 was equivalent to a job factor being "no problem," a score of 2 to 7 was rated as a "minimal to moderate problem," and a score of 8 to 10 indicated that a job factor was considered a "major problem. *

31. Performing the same task over and over Mark only one oval. No Major Problem Problem 32. 32. Treating an excessive number of patients in one day * Mark only one oval. No Major Problem Problem 33. 33. Performing manual orthopedic techniques * (Joint mobilizations, soft tissue mobilization) Mark only one oval. No Major Problem Problem 34. 34. Not enough rest breaks or pauses during the workday * Mark only one oval. No Major Problem Problem 35. 35. Working in awkward and cramped positions * Mark only one oval.

Major

Problem

No

Problem

37. Bending or twisting your back in an awkward way * Mark only one oval. 1 2 3 4 5 6 7 8 9 10 No Image: State of the state o		1	2	3	4	5	6	7	8	9	10	
Mark only one oval. 1 2 3 4 5 6 7 8 9 10 No Problem 0 0 0 0 0 0 Major 38. Working near or at your physical limits Mark only one oval. 1 2 3 4 5 6 7 8 9 10 1 2 3 4 5 6 7 8 9 10 Problem 0 0 0 0 0 0 Major Problem 0 0 0 0 0 0 Major 9 10 0 0 0 0 0 Major 9 1 2 3 4 5 6 7 8 9 10 No 0 0 0 0 0 0 0 Major Problem 1 2 3 4 5 6 7 8 9 10 No 0		\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	Major Probler
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Problem Problem 38. Working near or at your physical limits * Mark only one oval. 1 2 3 4 5 6 7 8 9 10 No 1 2 3 4 5 6 7 8 9 10 Problem 1 2 3 4 5 6 7 8 9 10 S9. Reaching or working away from your body * Mark only one oval. 1 2 3 4 5 6 7 8 9 10 Problem 1 2 3 4 5 6 7 8 9 10 Problem 1 2 3 4 5 6 7 8 9 10 Problem 1 2 3 4 5 6 7 8 9 10 No 1 2 3 4 5 6 7 8 9 10 Problem 1 2 3 <t< td=""><td></td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td></td></t<>		1	2	3	4	5	6	7	8	9	10	
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42. 42. Working with confused or agitated patients *

	1	2	3	4	5	6	7	8	9	10	
No Problem	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	Major Proble
43. Carryi (e.g., cont Mark only	inuous p	passive	20. 75 2 State 10			s or eq	uipmen	t*			
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44. Unant Mark only	Contraction of the second		n move	ment o	r fall by	patient					
	1	2	3	4	5	6	7	8	9	10	
No Problem	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	Major Proble
45. Assis Mark only			uring ga	it activ	ities *						
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No Problem	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	Major Proble
46. Work	schedul	ling *									
(Overtime Mark only			, length	of work	day)						
	1	2	3	4	5	6	7	8	9	10	
No Problem	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	\bigcirc	Major Proble
47. Inade Mark only	ACTION OF COM	()	on injur	y preve	ntion *						
	1	2	3	4	5	6	7	8	9	10	

48. The response to the following statements should reflect what you actually do in practice rather than what you would like to do or think you should do. In order to reduce the strain on my body when working

48. I get someone else to help me handle a heavy patient Mark only one oval.

Almost Always

- Sometimes
- Almost Never
- 49. 49. I modify patient's position/ my position *
 - Mark only one oval.
 - Almost Always Sometimes Almost Never
- 50. 50. I use a different part of my body in administering my nursing procedure * Mark only one oval.

- Almost Always
- Sometimes
- Almost Never
- 51. 51. I warm up and stretch before performing my nursing duties *

Mark only one oval.

- Almost Always
- Sometimes
- Almost Never
- 52. 52. I modify my nursing procedure in order to avoid stressing an injury * Mark only one oval.
 - Almost Always
 - Sometimes
 - Almost Never

53. 53. I pause regularly so I can stretch and change posture *

- Almost Always
- Sometimes
- Almost Never

54. 54. I adjust plinth/bed height so I can stretch and change posture *

Mark only one oval.

- Almost Always
 - Almost Never
- 55. 55. I select techniques/procedures that will not aggravate or provoke my discomfort * Mark only one oval.
 - Almost Always
 - Sometimes
 - Almost Never
- 56. 56. I stop a treatment if it causes or aggravate my discomfort *

Mark only one oval.

- Almost Always
- Sometimes
- Almost Never

57. 57. In general, would you say your health is: *

Mark only one oval.

Excellent

- Very good
- 🔵 Fair
-) Poor
- 58. 58. How much bodily pain have you generally had during the past 4 weeks? * Mark only one oval.

O Non

- Very mild
- O Mild
- Moderate
- Severe
- Very Severe

59. 59. During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups? *

Mark only one oval.



60. The following items are activities you might do during a typical day. Does your health limit you in these activities *

60. Vigorous activities, such as running lifting heavy objects, participating in strenuous sports

Mark only one oval.

Yes, Limited a lot

Yes, Limited a little

No, Not limited at all

61. 61. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf *

Mark only one oval.

Yes, Limited a lot

Yes, Limited a little

No, Not limited at all

62. 62. Lifting or carrying groceries *

Mark only one oval.

- Yes, Limited a lot
- Yes, Limited a little
- No, Not limited at all

63. 63. Climbing several flights of stairs *

Mark only one oval.

Yes,	Limited	a lot

Yes, Limited a little

No, Not limited at all

Mark d	only one oval.
\bigcirc	Yes, Limited a lot
\bigcirc	Yes, Limited a little
Ō	No, Not limited at all
	nding, kneeling or stooping *
	only one oval.
	Yes, Limited a lot
	Yes, Limited a little
\bigcirc	No, Not limited at all
	alking more than a kilometer *
\bigcirc	Yes, Limited a lot
\bigcirc	Yes, Limited a little
\bigcirc	No, Not limited at all
	alking several blocks * only one oval.
\bigcirc	Yes, Limited a lot
\bigcirc	Yes, Limited a little
$\overline{\bigcirc}$	No, Not limited at all
	alking one block * only one oval.
\bigcirc	Yes, Limited a lot
\bigcirc	Yes, Limited a little
\bigcirc	No, Not limited at all
	thing or dressing yourself * only one oval.
\frown	Ves Limited a lot

64. 64. Climbing one flight of stairs *

Yes, Limited a lot Yes, Limited a little

No, Not limited at all

- 70. 70. How satisfied are you with your physical ability to do what you want to do? * Mark only one oval.
 - Completely satisfied very satisfied Somewhat satisfied Somewhat dissatisfied Very dissatisfied
 - Completely dissatisfied
- 71. 71. When you travel around your community, does someone have to assist you because of your health? *

Mark only one oval.

- Yes, all of the time
- Yes, most of the time
- Yes, some of the time
- Yes, a little of the time
- No, none of the time
- 72. 72. Are you in bed or in a chair most or all of the day because of your health? * Mark only one oval.
 - Yes, every day
 - Yes, most day
 - Yes, some day
 - Yes, occasionally
 - No, never
- 73. 73. How often during the past 4 weeks Did you feel worn out? *

- All of the time
- Most of the Time
- A good bit of time
- Some of the time
- A little of the time
- Non of the time

74. 74. How often during the past 4 weeks Were you discouraged by your health problems? *

Mark only one oval.

- All of the time
- Most of the Time
- A good bit of time
- Some of the time
- A little of the time
- Non of the time

75. 75. How often during the past 4 weeks Did you have a lot of energy? *

Mark only one oval.

- All of the time
- Most of the Time
- A good bit of time
- Some of the time
- A little of the time
- Non of the time

76. 76. How often during the past 4 weeks Did you feel weighed down by your health problems? *

Mark only one oval.

- All of the time
- Most of the Time
- A good bit of time
- Some of the time
- A little of the time
- Non of the time

77. 77. How often during the past 4 weeks Did you feel full of energy? *

- Mark only one oval.
 - All of the time
 - Most of the Time
- A good bit of time
- Some of the time
- A little of the time
- Non of the time

- 78. 78. How often during the past 4 weeks Were you afraid because of your health? * Mark only one oval.
 - All of the time Most of the Time A good bit of time Some of the time A little of the time Non of the time
- 79. 79. How often during the past 4 weeks Did you have enough energy to do the things you wanted to do? *

Mark only one oval.

- All of the time
- Most of the Time
- A good bit of time
- Some of the time
- A little of the time
- Non of the time

80. 80. How often during the past 4 weeks Was your health a worry in your life? * Mark only one oval.

- All of the time
- Most of the Time
- A good bit of time
- Some of the time
- A little of the time
- Non of the time

81. 81. How often during the past 4 weeks Did you feel tired? *

- All of the time
- Most of the Time
- A good bit of time
- Some of the time
- A little of the time
- Non of the time

- 82. 82. How often during the past 4 weeks Were you frustrated about your health? * Mark only one oval.
 - All of the time Most of the Time A good bit of time Some of the time A little of the time Non of the time
- 83. 83. How often during the past 4 weeks Did you feel despair over your health problems? *

- All of the time
- Most of the Time
- A good bit of time
- Some of the time
- A little of the time
- Non of the time
- 84. 84. How often have you had any of the following symptoms during the past 4 weeks Stiffness, pain, swelling or soreness of muscles or joints? * Mark only one oval.



- 85. 85. How often have you had any of the following symptoms during the past 4 weeks Coughing that produced phlegm? * Mark only one oval.
 - Once or Twice
 - A few times
 - Fairly often
 - O Very often

86. 86. How often have you had any of the following symptoms during the past 4 weeks Backaches or lower back pains? * Mark only one oval.

Never Once or Twice A few times Fairly often Very often

87. 87. How often have you had any of the following symptoms during the past 4 weeks Nausea (upset stomach)? *

Mark only one oval.

Never Once or Twice A few times Fairly often Very often

88. 88. How often have you had any of the following symptoms during the past 4 weeks Acid indigestion, heartburn, or feeling bloated after meals? * Mark only one oval.

Never
 Once or Twice

A few times

Fairly often

Very often

89. 89. How often have you had any of the following symptoms during the past 4 weeks Nausea (upset stomach)? *

- Never
- Once or Twice
- A few times
- Fairly often
- Very often

90. 90. How often have you had any of the following symptoms during the past 4 weeks Heavy feelings in arms and legs? * Mark only one oval.

Never
Once or Twice
A few times
Fairly often
Very often

91. 91. How often have you had any of the following symptoms during the past 4 weeks Headaches or head pains? *

Mark only one oval.

Never Once or Twice A few times Fairly often Very often

92. 92. How often have you had any of the following symptoms during the past 4 weeks Lump in throat? *

Mark only one oval.

Never
 Once or Twice
 A few times
 Fairly often

- Very often
- 93. 93. Did you experience any bodily pain in the past 4 weeks? * Mark only one oval.
 - Yes
 - ─ No
- 94. 94. During the past 4 weeks, how often have you had pain or discomfort? *

- Once or twice
- A few times
- Fairly often
- very often
- Almost every day

- 95. 95. When you had pain during the past 4 weeks, how long did it usually last? * Mark only one oval.
 - A few minutes
 - Several minutes to an hour
 - Several hours
 - A day or two
 - More than two days
- 96. 96. During the past 4 weeks, how much did pain interfere with Your mood? * Mark only one oval.
 - Not at all
 A little bit
 Moderately
 Quite a bit
 Extremely
- 97. 97. During the past 4 weeks, how much did pain interfere with Your ability to walk or move around? *

- Not at all
- A little bit
- Moderately
- Quite a bit
- Extremely
- 98. 98. During the past 4 weeks, how much did pain interfere with Your sleep? * Mark only one oval.
 - Not at all
 - A little bit
 - Moderately
 - O Quite a bit
 - Extremely

99. 99. During the past 4 weeks, how much did pain interfere with Your normal work (including both work outside the home and house-work)? * Mark only one oval.



100. 100. During the past 4 weeks, how much did pain interfere with Your recreational activities? *

Mark only one oval.



101. 101. During the past 4 weeks, how much did pain interfere with Your enjoyment of life? *

Mark only one oval.

Not at all A little bit Moderately Quite a bit Extremely

102. 102. Please select the one number that best describes your pain on the AVERAGE over the past 4 weeks. *



103. 103. Please select the one number that best describes your pain on the AT ITS WORST over the past 4 weeks. *

Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
No Pain	\bigcirc	Too much Pain									

104. 104. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health Took frequent rests when doing work or other activities? *

Mark only one oval.

C)	Yes
C	\supset	No

105. 105. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health Cut down the amount of time you spent on work or other activities? * Mark only one oval.

C)	Yes
C	5	No

106. 106. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health Accomplished less than you would like? *

Mark only one oval.



107. 107. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health Didn't do work or other activities as carefully as usual? * Mark only one oval.

C)	Yes
C)	No

108. 108. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health Were limited in the kind of work or other activities? *



109. 109. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health Had difficulty performing the work or other activities? *

(for example, it took extra effort) Mark only one oval.

C	Yes
C	No

110. 110. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health Required special assistance (the assistance of others or special devices) to perform these activities? *

Mark only one oval.

\bigcirc	Yes
\bigcirc	No

111. 111. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious) Cut down the amount of time you spent on work or other activities? *

Mark only one oval.



112. 112. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious) Accomplished less than you would like? *

Mark only one oval.



113. 113. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious) Didn't do work or other activities as carefully as usual?

Mark only one oval.

C)	Yes
C)	No

114. 114. Does your health keep you from working around the house? * Mark only one oval.



115. 115. Does your health keep you from working at a paying job? * Mark only one oval.



116. 116. How happy, satisfied, or pleased have you been with your personal life during the past month? *

Mark only one oval.

Extremely happy, could not have been more satisfied or pleased

Very happy most of the time

Generally satisfied, pleased

- Sometimes fairly satisfied, sometimes fairly unhappy
- Generally dissatisfied, unhappy
- Very dissatisfied, unhappy most of the time

117. 117. During the past month, how often did you feel there were people you were close to? *

Mark only one oval.



118. 118. During the past month, how often has feeling depressed interfered with what you usually do? *

Mark only one oval.

Always
Very often
Fairly often
Sometimes
Almost never
Never

119. 119. How much of the time, during the past month, did you have difficulty reasoning and solving problems; for example, making plans, making decisions, learning new things? *

Mark only one oval.

- All of the time
 - Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time
- 120. 120. During the past month, how much of the time have you generally enjoyed the things you do? *

Mark only one oval.

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time
- 121. 121. How much of the time, during the past month, has your daily life been full of things that were interesting to you? *

Mark only one oval.

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time
- 122. 122. During the past month, how much of the time have you felt loved and wanted? *

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

123. 123. How much of the time, during the past month, have you been a very nervous person? *

Mark only one oval.

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time
- 124. 124. During the past month, how much of the time did you have difficulty doing activities involving concentration and thinking? *

Mark only one oval.

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

125. 125. During the past month, how much of the time did you feel depressed? *

Mark only one oval.

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

126. 126. During the past month, how much of the time have you felt tense or "highstrung"? *

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

127. 127. During the past month, how much of the time have you been in firm control of your behavior, thoughts, emotions, feelings? *

Mark only one oval.

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time
- 128. 128. During the past month, how much of the time did you become confused and start several actions at a time? *

Mark only one oval.

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time
- 129. 129. During the past month, how much of the time did you feel that you had nothing to look forward to? *

Mark only one oval.

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

130. 130. How much of the time, during the past month, have you felt calm and peaceful? *

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

- 131. 131. How much of the time, during the past month, have you felt emotionally stable? * Mark only one oval.
 - All of the time Most of the time A good bit of the time Some of the time A little of the time
 - None of the time
- 132. 132. How much of the time, during the past month, have you felt downhearted and blue? *

Mark only one oval.

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

133. 133. How often have you felt like crying during the past month? * Mark only one oval.

Always
Very often
Fairly often
Sometimes
Almost never
Never

134. 134. How much of the time, during the past month, did you feel left out? *

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

135. 135. During the past month, how often did you feel that others would be better off if you were dead? *

Mark only one oval.



136. 136. During the past month, how much of the time did you forget, for example, things that happened recently, where you put things, appointments? *

Mark only one oval.

- All of the time Most of the time A good bit of the time Some of the time A little of the time None of the time
- 137. 137. During the past month, how much of the time did you feel that your love relationships, loving and being loved, were full and complete? * Mark only one oval.

All of the time

- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

138. 138. How much have you been bothered by nervousness, or your "nerves," during the past month? *

Mark only one oval.

Extremely so, to the point where I could not take care of things

Very much bothered

- Bothered quite a bit
- Bothered some, enough to notice
- Bothered just a little
- Not bothered at all

139. 139. During the past month, how much of the time has living been a wonderful adventure for you? *

Mark only one oval.

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time
- 140. 140. How much of the time, during the past month, have you felt so down in the dumps that nothing could cheer you up? *

Mark only one oval.

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

141. 141. During the past month, did you ever think about taking your own life? *

Mark only one oval.

- Yes, constantly Yes, very often Yes, fairly often Yes, a couple of times Yes, once No, never
- 142. 142. During the past month, how much of the time have you felt restless, fidgety, or impatient? *

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

143. 143. During the past month, how much of the time have you been moody or brooded about things? *

Mark only one oval.

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time
- 144. 144. During the past month, how often did you get rattled, upset, or flustered? * Mark only one oval.
 - Always
 Very often
 Fairly often
 Sometimes
 Almost never
 Never
- 145. 145. How much of the time, during the past month, did you have trouble keeping your attention on any activity for long? * Mark only one oval.

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- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

146. 146. During the past month, how much of the time have you been anxious or worried?

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

- 147. 147. During the past month, how much of the time have you been a happy person? * Mark only one oval.
 - All of the time Most of the time A good bit of the time Some of the time A little of the time None of the time
- 148. 148. How often during the past month did you find yourself having difficulty trying to calm down? *

Mark only one oval.
Always
Very often
Fairly often
Sometimes
Almost never
Never

149. 149. During the past month, how much of the time have you been in low or very low spirits? *

Mark only one oval.

All of the time

- A good bit of the time
- Some of the time
- A little of the time
- None of the time

150. 150. How much of the time, during the past month, have you felt cheerful, lighthearted? *

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

151. 151. During the past month, how depressed (at its worst) have you felt? *

Mark only one oval.

- Extremely depressed Very depressed Quite depressed Somewhat depressed A little depressed Not depressed at all
- 152. 152. How much of the time, during the past month, did you react slowly to things that were said or done? *

Mark only one oval.

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time
- 153. 153. During the past month, how often did you feel isolated from others? * Mark only one oval.
 - Always
 Very often
 Fairly often
 Sometimes
 Almost never
 Never
- 154. 154. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)? *

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

155. 155. Compared to your usual level of social activity, has your social activity during the past 6 months decreased, stayed the same, or increased because of a change in your physical or emotional condition? *

Mark only one oval.

- Much less socially active than before
- Somewhat less socially active than before
- About as socially active as before
- Somewhat more socially active than before
- Much more socially active than before
- 156. 156. Compared to others your age, are your social activities more or less limited because of your physical health or emotional problems? *

Mark only one oval.

- Much more limited than others
- Somewhat more limited than others
- About the same as others
- Somewhat less limited than others
- Much less limited than others

157. 157. I am somewhat ill *

Mark only one oval.

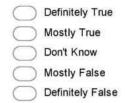
- Definitely True
- Mostly True
- Don't Know
- Mostly False
- Definitely False

158. 158. I feel about as good now as I ever have *

- O Definitely True
- Mostly True
- O Don't Know
- Mostly False
- Definitely False

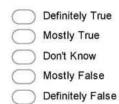
159. 159. I have been feeling bad lately *

Mark only one oval.



160. 160. I am in poor health *

Mark only one oval.



161. 161. I am as healthy as anybody I know*

Mark only one oval.

- Definitely True
 Mostly True
- O Don't Know
- Mostly False
- Definitely False

162. 162. My health is excellent *

- Definitely True
- Mostly True
- O Don't Know
- Mostly False
- Definitely False

- 163. 163. I seem to get sick a little easier than other people *
 - Mark only one oval.



164. 164. I expect my health to get worse *

Mark only one oval.



- 165. 165. How often during the past 4 weeks did you Feel that your sleep was not quiet (moving restlessly, feeling tense, speaking, etc., while sleeping? * Mark only one oval.
 - All of the time
 - Most of the time
 - A good bit of the time
 - Some of the time
 - A little of the time
 - None of the time
- 166. 166. How often during the past 4 weeks did you Get enough sleep to feel rested upon waking in the morning? *

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

167. 167. How often during the past 4 weeks did you Awaken short of breath or with a headache? *

Mark only one oval.

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

168. 168. How often during the past 4 weeks did you Feel drowsy or sleepy during the day?

Mark only one oval.

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

169. 169. How often during the past 4 weeks Did you have trouble falling asleep? *

Mark only one oval.

- All of the time
 Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time
- 170. 170. How often during the past 4 weeks Awaken during your sleep time and have trouble falling asleep again? *

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

- 171. 171. How often during the past 4 weeks Have trouble staying awake during the day? *
 - Mark only one oval.
 - All of the time
 - Most of the time
 - A good bit of the time
 - Some of the time
 - A little of the time
 - None of the time
- 172. 172. How often during the past 4 weeks Take naps (5 minutes or longer) during the

day? * Mark only one oval.

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

173. 173. How often during the past 4 weeks Get the amount of sleep you needed? * Mark only one oval.

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

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