

Review Article

Work-related musculoskeletal risks associated with nurses and nursing assistants handling overweight and obese patients: A literature review

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Abstract.

BACKGROUND: Nurses and nursing assistants are susceptible to work-related musculoskeletal disorders and injuries (WMSDs) due to the increase in overweight and obese patients they are handling on a daily basis.

OBJECTIVE: This study aimed to review work-related musculoskeletal hazards and risks associated with handling overweight and obese patients, and summarize the recommended interventions to mitigate musculoskeletal concerns among nurses and nursing assistants.

METHODS: Approximately 350 publications were initially screened and 22 refereed articles were used to synthesize for this study on the bases of inclusion/exclusion relevance and strength of evidence on overweight or obese patient handling.

RESULTS: Evidence suggested that the work-related musculoskeletal risks among nurses and nursing assistants included sprains/strains, low back pain, wrist, knee and shoulder injuries. The findings indicated that the WMSD risks increased when nurses and nursing assistants were manually moving or lifting patients, especially when the patients were overweight or obese. The recommended solutions included the lifting/transfer equipment and devices, ergonomic assessments and controls, no-lift policies, and training and education.

CONCLUSION: To alleviate the risk of musculoskeletal disorders and injuries among nurses and nursing assistants handling overweight or obese patients, additional research and development into what safe patient handling interventions suit this growing population needs to be addressed.

Keywords: Obese, patient handling, nurses, nursing assistants, musculoskeletal disorders, ergonomics

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1. Introduction

The healthcare industry is one of the nation's largest and fastest-growing industries and employs approximately 15 million workers [1]. Healthcare workers continually record some of the highest injury

rates in the US, costing the industry \$13.1 billion and more than 2 million lost workdays in 2011 [1]. One of significant challenges in healthcare is obesity. Nurses and nursing assistants are dealing with injuries and illnesses of their own due to the increase in overweight and obese patients they are handling on a daily basis. Obesity in the nation has reached epidemic proportions [2]. The population has reached an all-time record high with 64% of people being classified as overweight, and as many as 30% classified as obese [2]. There are several classification systems to define the criteria for obesity in adults [3]. These classification systems are the National Institute of Health (NIH), National Heart, Lung, and Blood Pressure (NHLB), and the North American Association for the study of Obesity (NAASO) [3]. With a body mass index (BMI) higher than 25 kg/m² a person is classified as being overweight [4]. The BMI is calculated from the individual's body weight and height. BMI is a consistent indicator of body fatness for most individuals and can be used as a screening tool to identify potential weight problems [5]. Obesity is having a BMI of 35.0-39.9, morbid obesity is having a BMI greater than or equal to 40.0 (BMI \geq 40.0) and super obesity is having a BMI greater than or equal to 50.0 (BMI \geq 50.0) [3].

Obesity can develop from many complex social and biological occurrences along with an individual's behaviors and choices [4]. In 2008, the medical costs linked with obesity were estimated at \$147 billion and the medical costs for obese individuals were \$1,429 higher than people of normal weight [5]. Obesity can be costly, not only to the individual, but also to the nurses and nursing assistants [3, 6]. The workers' compensation costs for the healthcare industry amount to nearly \$1 billion per year [1]. Hospitals, clinics, and nursing homes have to insure a different way to care for obese patients. Dealing with obese patients can present certain challenges in regard to lifting safety and the resources essential for mobility tasks. When addressing issues of mobility, there are many concerns regarding the patient and health care worker. The Bureau of Labor Statistics (BLS) [7] reported that employees in nursing and personal care facilities suffer over 200,000 work-related injuries and illnesses in a year. Patient handling is the transferring, repositioning and lifting of individuals receiving care. On a daily basis, nurses and nursing assistants are consistently handling more and more overweight and obese patients [8]. Employers understand the need to decrease work-related musculoskeletal dis-

orders (WMSDs) and injuries to nurses and nursing assistants in order to reduce costs [9, 10].

The musculoskeletal risk factors have been identified and are associated with patient handling tasks such as transferring patients from the bed to wheelchair, repositioning patients in bed, transferring patients from the toilet to a chair, transferring from a chair to bed, transferring from a bathtub to chair, lifting a patient in bed, making a bed with a patient in it, and transferring from one bed to another [9, 11]. Researchers found that patient handling was conveyed as the primary discomfort in most of the body areas. The heavier the patients, the greater the exertion, maximum assistance needed and most exertion needed to complete the transfer [9]. The tasks that nurses and nursing assistants are expected to perform on a daily basis involves large amounts of weight, awkward postures, confined working environments, excessive manual forces, extended task duration, and high frequency/repetitions. Health care worker experiences a number of risk factors for musculoskeletal disorders in the workplace, such as back and shoulder injuries [12]. The frequency and severity of the contact to these risk factors differ, depending on the type of healthcare setting. To help in the reduction of musculoskeletal disorders and injuries workers need to be informed of the risks that can cause the MSD injuries.

However, very few studies have provided a systematic approach to review the work-related musculoskeletal risks associated with handling overweight and obese patients to the healthcare workers (e.g., nurses and nursing assistants). The purpose of the study was to review work-related musculoskeletal hazards and risks associated with handling overweight or obese patients, and summarize the recommended solutions to alleviate WMSD issues among nurses and nursing assistants.

2. Methods

A vast electronic search was initially conducted in EBSCO Host, Applied Science and Technology, CINAHL, General Science, Health, Science Direct, Medline (PubMed), Web of Science, and Google Scholar to retrieve research articles on nurses and nursing assistants who perform patient handling tasks on overweight and/or obese patients. There were several key search terms and phrases that were used: *health care workers, nurses, nursing assistants, patient handling, patient lifting, obese, overweight, bariatric, work-related musculoskeletal disorders, and ergonomics*.

2.1. Inclusion and exclusion criteria

The authors conducted an electronic search (covering the years 1980 to 2013) for relevant peer-reviewed articles published in English. The articles had to be related to patient handling and health care workers (nurses, nursing assistants). The research had to address patient's weight in some context, preferably overweight and obese patients. The initial electronic search identified 350 papers. Each abstract was assessed by the authors to determine eligibility. Higher priority was given to the study target audience characteristics related to overweight or obese patient handling, describing interventions for patient handling. Lower priority/excluded literature were the study did not meet specific criteria in terms of the quality and relevance of the research and reporting. To end with, the authors selected a total of 22 refereed articles to be summarized in this study (see Table 1).

3. Results

Work-related musculoskeletal disorders and injuries among nursing staff are a major concern due to the growing weight of the patient population. Nursing and nursing assistants are becoming injured due to frequent moving and lifting of patients, especially if they are obese or overweight [13]. Proper lift/transfer equipment and technology can reduce MSD injuries to nurses and nursing assistants [8]. Also ergonomic assessments and controls, no-lift policies, and ongoing research can decrease or eliminate musculoskeletal injuries.

Table 1 summarized the work-related musculoskeletal problems and the recommended solutions for the nurses and nursing assistants handling overweight or obese patients.

3.1. Work-related musculoskeletal challenges

The following describes the contributing risks and issues to the work-related musculoskeletal disorders and injuries encountered to the nurses and nursing assistants while handling overweight or obese patients in different job tasks.

3.1.1. WMSD risk factors associated with patient handling tasks

The recruitment and retention of nursing staff has become a significant problem, and the shortage of

its workforce has been intensified by occupational injuries and disabilities [14]. One of the challenges that nurses and nursing assistants encounter on a daily basis is overweight or obese patient handling tasks. Astonishingly, during one typical 8-hour shift a nurse can lift the cumulative weight of 1.8 tons [14, 15]. Potential high risk for WMSDs associated with patient handling tasks included: high force (overexertion), awkward postures (stooping, bending, and reaching), and repeated activities (lifting, transferring, and repositioning) [16, 17]. Also, research is reported the increased of the prevalence rates for hand/wrist pain among nurses and nursing assistants [18]. Another study by Menzel et al. [10] showed that there was a significant relationship between wrist and knee pain and the number of highest-risk patient handling tasks completed per hour of interacting with the load being lifted. There was also a significant relationship between the highest-risk tasks (i.e., manually transferring a patient from wheelchair/bathtub to toilet/ bed or from toilet/bed to wheelchair/bathtub, repositioning a patient and dressing a patient) performed per hour and the number of patients weighing 96 kg (212 lbs) or more, as well as an interaction variable to foresee frequency of knee pain [10].

3.1.2. Low back pain among nurses and nursing assistants

As a long recognized injury in the health care industry, low back pain (LBP) has been a major concern with respect to patient handling [19]. Researchers [20–23] examined different aspects of patient handling and lifting including the loads and how they act on the lumbar spine. Biomechanists have established that compression and shear loads on the lumbar spine during patient handling are high [19]. Previous studies have looked at realistic dynamic motion patient lifting. Marras et al. [22] used a biologically supported 3-D dynamic biomechanical model to assess various patient lifting and repositioning tasks performed by experienced and inexperienced caregivers. The weights used in the tasks were fairly light, but results showed that almost all the tasks exceeded either the spine compression or shear tolerance limits for safely lifting objects [22, 24]. Compression was normally lower when two caregivers performed the lift, but was still excessive in nature [22, 24]. Marras et al. [22] found that the spine compression forces at L5/S1 can simply exceed the 3400 N (Newton, which is a unit of force required to impart acceleration to mass). Also, Marras

Table 1
 Summary of work-related musculoskeletal issues and recommended solutions for the nurses and nursing assistants handling overweight or obese patients

Reference	Occupation	WMSD risks	Results	Suggested solutions
Bradway et al. [3]	Nursing assistants (obese nursing home residents)	Shoulder and back injuries (turning and lifting activities).	Need more research on obese nursing home residents	Ergonomic interventions, mechanical lifting, staff training and education
Chao & Henshaw [32]	Nurses and nursing assistants (nursing homes)	Musculoskeletal disorders/back injury	Guidelines for nursing homes and how ergonomics can help in the prevention of musculoskeletal disorders	Helps with identifying problems in nursing homes and implementing solutions to the problem
Daraiseh et al. [18]	Nursing	Dissatisfaction/satisfaction, energy state, exertion, musculoskeletal disorders	Working conditions of nurses considerably affect observed risk of injury, illness, psychosomatic outcomes and musculoskeletal symptoms	Higher quality of work life for health care workers and improved quality of care for patients
Dutta et al. [29]	Nurses and nursing assistants	MSDs/Low back injury	Biomechanical measurements and ground reaction forces and moments were taken to determine the forces on the caregiver during the lift maneuvering activity	Use overhead lifts
Galinsky et al. [26]	Nurses and nursing assistants (bariatric patients handling)	Repositioning obese patients, overexertion and awkward postures (lifting and moving bariatric patients)	The obesity epidemic, along with special medical and therapeutic concerns regarding bariatric patients, exacerbates healthcare workers' patient handling demands	Ergonomic interventions, mechanized patient lifts and other assistive devices
Humphreys [13]	Nurses (obese patients handling)	Back injuries (Frequent moving and lifting of obese patients)	As the number of Americans who are overweight and obese grows, the risk of lifting injuries to both patients and nurses increases. Occupational back and other musculoskeletal injuries are preventable	Ergonomic assessments and controls, no-lift policies, and ongoing research
Jung [8]	Nurses (obese patients handling-hospital setting)	Back injury and chronic back pain. (manually transporting or moving obese patients)	Nursing is a backbreaking job that has become harder as hospital staffs shrink and patients become heavier	Proper lifting equipment and devices
Keir & MacDonell [19]	Nurses and nursing assistants	Low back pain, MSDs	The study evaluated observe muscle activity patterns during patient handling tasks such as: manual transfers, and transfers using floor and ceiling lifts. The experienced patient handlers established approximately two times greater trapezius and latissimus dorsi activity than novices	The muscle activation pattern differences between the experience levels could improve training techniques to acquire better patient handling

Lapane & Resnik [25]	Nursing assistants (obese nursing home residents)	Back and shoulder injuries	Nurse's aides stressful activities do not necessarily lead to acute injuries, but can lead to cumulative trauma resulting in a debilitating injury or illness	Organizational and social work factors, staff training, and lifting equipment
Marras et al. [22]	Nurses and nursing assistants (hospital setting)	Low-back disorder	Assessed various patient lifting and repositioning tasks performed by both one and two (experienced and inexperienced) caregivers. Approximately all of the tasks exceeded either the spine compression or shear tolerance limits for performing a safe lift	Recommended the use of patient transfer devices as a low back pain risk intervention
McCoskey [9]	Nurses (obese patient handling in military health care facility)	Musculoskeletal injury risks, discomfort, physiological effects and productivity	Lateral transfers, especially repositioning, more frequently involves greater physical exertion and take longer to perform	A multifaceted ergonomic approach including engineering, administrative and behavioral controls could be essential
McGinley & Bunke [2]	Nurses (obese patients handling)	Encountering obese patients in nearly every area of the health care industry	There have been guidelines developed by nurses to be used in the field to prevent injuries and illnesses to staff and patients	Proactively establishing protocols, utilizing proper equipment, effective staff training, safe lifting policy and multidisciplinary teamwork and effective communication
Menzel et al. [10]	Nurses (handling heavier patients – veterans' hospital)	Manually transferring, repositioning and dressing patients (wrist and knee pain)	Significant association between wrist and knee pain and the number of highest-risk patient-handling tasks performed per hour of interrelating with the load being lifted	When patient handling equipment is in place, employers should remain alert for the possibility of WMSD risk shifting from the back to other body parts (e.g., knees and wrists) by scrutinizing injury and illness logs and be prepared to take exposure-reduction steps
Miller et al. [28]	Nurses and nursing assistants (multiple level care facility)	MSD risks and injury	Evaluated the effectiveness of portable ceiling lifts in a new multi-level care facility on the danger of patient handling injuries where the ratio of lifts to patient's beds is one to six	Use the ceiling lifts (incorporating ceiling lifts into the design of a new facility)
Muir & Archer-Heese [34]	Nurses(bariatric patients handling)	Sprains, strains and excessive spinal loading (lifting, reaching, repositioning)	Nurses want to offer care for bariatric patients, but methods, equipment and the environment do not accommodate this population	Operational procedure and policy, patient assessment tools, communication tools, algorithms and guidelines, space & environment consideration, equipment needs, staff training/education, ergonomic evaluation

(Continued)

Table 1
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Reference	Occupation	WMSD risks	Results	Suggested solutions
Nelson & Baptiste [14]	Nurses and nursing assistants (Hospital setting)	Patient's weight, transfer distances, confined environments, variable patient behavior, and awkward positions such as stooping, bending and reaching	Summarized current evidence for interventions designed to reduce caregiver injuries associated with patient handling tasks	Ergonomic assessment, patient handling equipment and devices, patient care protocols, not lift policies, patient lift teams and clinical tools, and training
Peterson et al. [11]	Nursing assistants	MSDs, Three different experimental training groups were used. A quiz and questionnaire was given to the participants in the training	Develop an ergonomics training program for selected nursing assistants at a state-run veterans' home to reduce musculoskeletal disorders	Significant improvement in understanding the principles of ergonomics and patient handling techniques. No considerable decline in musculoskeletal risk factors and one significant diminish in pain or discomfort or overall metal or physical health
Randall et al. [17]	Healthcare staff, nurses and nursing assistants (obese patients handling)	Manual handling, turning and repositioning the patient in bed	Registered nurses and nursing assistants accounted for 80% of the injuries related to bariatric patient handling	The E-OSHA 300 log provides a method to identify the frequency, severity, and nature of caregiver injury during mobilization of the obese
Tuohy-Main [15]	Nurses and nursing assistants/ Obese patient handling	Manual handling (mainly lifting) may cause the patients to experience many different injuries from being lifted	Being lifted may cause the patients to experience fear, pain, and damage to the shoulder, bruising of arms, loss of dignity during the lifting procedure, dependency on caregiver, skin tears and pressure area damage	Future research in this area is needed even though the level of predictive specificity of possible factors may prove insufficient given the complexity of manual handling activities
Waters et al. [12]	Nurses and nursing assistants	Musculoskeletal disorders (MSDs)/injury	Provided scientific evidence that substantial occupational risks for MSDs exist and summarized recommendations for reducing risk of MSDs	Effective interventions are available to diminish the risk for these workers
Waters [16]	General health care givers assistants	Low back pain	The Revised NIOSH Lifting Equation can be used to calculate a recommended weight limit for a limited range of patient handling tasks	15 kg maximum weight limit when performing patient-handling tasks. Assisted devices are to be used if the weight being lifted is to exceed this limit
Zhuang et al. [27]	Nursing assistants (nursing homes)	MSDs/low back injury	Reported a biomechanical evaluation of nine battery-powered lifts, a sliding board, a walking belt, and a baseline manual method for handling nursing home residents from a bed to a chair. The transfer method and residents weight influence a nursing assistant's low-back loading	Use the lifting devices (basket-sling, overhead, and stand-up lifts)

et al. [24] noted that the anterior and posterior shear forces as well as the lateral shear forces approached or exceeded 1000 N when accomplishing these tasks regardless of whether the lift was performed by one or two health care workers. That is why the LBP incidences are so high among nurses and nursing assistants. The shear forces on the spine were often greater during the two person lifts [22, 24]. Patient handlers are exposed to far greater loads under typical transferring situations than observed in the study, therefore patient transfer devices were recommended to reduce spine loading [22, 24].

3.1.3. *Work-related musculoskeletal risks in the nursing home*

Nurses and nursing assistants are at high risk for work-related musculoskeletal disorders and injuries from handling obese patients in nursing home. Lapane and Resnik [25] addressed the issue of the obesity epidemic in the nursing home industry. They pointed out how critical it is to understand the issues related to caring for obese nursing home residents. These issues include difficulties relating to access to nursing homes, the structural preparedness of the nursing home to care for the obese patients and potential for staff injuries. Caring for obese patients is challenging to all providers in every setting, due to the special equipment needs, additional staff needed for assisting in routine tasks, extra time needed for safety precautions and added space for equipment and the patient. Nursing home workers have among the highest rates of back and shoulder injuries due to lifting [25]. Bradway et al. [3] also found that nursing assistants who were providing direct care to nursing home patients were just as likely to suffer work-related shoulder and back injuries no matter what the characteristics of the resident were, including obesity. They proposed the injury-prevention programs as a way to avoid or reduce staff and resident injuries thus insuring a safe work and care environment. Lapane and Resnik [25] found that nursing home workers have among the highest rates of back and shoulder injuries. Galinsky and Hudock [26] evaluated the research on the effectiveness of ergonomic interventions to reduce injury risks among nurses and nursing assistants who handle bariatric patients. Bariatric patients are more difficult to handle and require more repositioning to preclude impending medical emergencies such as: respiratory distress, impaired circulation, nerve damage, and cardiopulmonary decompensation [26].

3.2. *Work-related musculoskeletal injury prevention*

The following provides the guidelines to prevent work-related musculoskeletal disorders and injuries to nursing staff. The recommended solutions included: lifting/transport equipment technology (e.g., bariatric hospital bed, overhead/ceiling lifts), ergonomic assessments and controls, and training and education.

3.2.1. *Lifting/transport equipment and devices*

One of the biggest challenges lies in the transportation or simply moving an obese patient [8]. Instead of caregivers manually lifting obese patients, special equipment and devices are being implemented to prevent MSD injuries. There are benefits to the nursing staff and the patient when using the special equipment and devices. The patients feel safer and the nursing staff knows an injury was prevented. Hospitals are now obtaining special equipment to help with the growth of this obese population [8]. Zhuang, Stobbe, Hsiao, Collins and Hobbs [27] examined battery-powered lifts, a sliding board, a walking belt, and a baseline manual method for handling nursing home residents from a bed to a chair. The outcome of the study showed that the transfer method and resident's weight influence a nursing assistant's low-back loading. The basket-sling and overhead lift devices considerably diminished the nursing assistant's back-compressive forces during the preparation phase of the transfer. Also, the use of basket-sling, overhead, and stand-up lifts eliminated almost two-thirds of the exposure to the low-back stress as contrasted with the baseline manual method [27]. Marras, Knapik, and Ferguson [24] also looked at the potential intervention of patient lift systems and found that ceiling-based patient lifts would be considered safe since they imposed the lowest muscle activity and spine forces on the lumbar spine, while floor-based systems increased the anterior/posterior shear forces when attempting to turn floor-based patient lift device. Keir and MacDonell [19] also investigated the response of the trunk and shoulder musculature in novice and experienced patient handlers during manual transfers and transfers using the floor and ceiling lift. The study also found that the ceiling lifts would be considered safe since they imposed the lowest muscle activity and spine forces on the lumbar spine. The floor-based patient handling system had the capability to increase anterior and posterior shear forces to unacceptable levels during patient handling. Miller,

Engst, Tate, and Yassi [28] also looked at replacing manual patient handling techniques with ceiling lifts in a long term facility, and discovered that the nursing staff observed were at significantly less risk of injury when utilizing the portable ceiling lifts than compared to the manual methods [28]. Dutta, Holliday, Gorski, Baharvandy, and Fernie [29] investigated the differences in peak external hand forces and external moments produced by the L5/S1 joint of the low back due to manipulating loaded floor-based and overhead-mounted patient lifting devices. Their study outcomes showed that overhead lifts lead to significantly lower back loads than floor lifts. The study suggested that overhead lifts ought to be used whenever possible to diminish the risk of back injury to caregivers [29].

3.2.2. *Ergonomic interventions*

Occupational Safety and Health Administration (OSHA) [30] suggested that ergonomic programs are essential for the health and safety of health care workers. In the study done by McCoskey [9] ergonomic components such as engineering, administration, and behavioral controls may be required to keep workers safe. Given the difficulty of this high-risk, high volume, high-cost issue of safe patient handling, multifaceted programs are more likely to be effective than any particular intervention [31]. A multifaceted ergonomic approach including engineering, administration, and behavioral controls are essential in reducing musculoskeletal injuries and illnesses [9]. Ergonomic interventions that can help reduce or eliminate musculoskeletal injuries and disorders are: the use of specialized patient handling equipment and devices (lifts), patient care ergonomic assessments, no lift policies, patient lift teams, clinical tools (algorithms) training and education on proper lifting equipment and devices, unit-based peer leaders, implementing effective ergonomics programs, adjusting environment, and implementing procedures and policies [14, 32]. When evaluating the task of lifting, no one factor can define a safe lift [16]. The National Institute for Occupational Safety and Health (NIOSH) issued the Revised NIOSH Lifting Equation in 1994. The Revised NIOSH Lifting Equation is an ergonomic assessment tool that can be utilized to calculate the recommended weight limit for two-handed manual-lifting tasks [16]. The equation can be used to calculate a recommended weight limit for a limited range of patient handling tasks, in which the patient is cooperative and unlikely to move suddenly during the task [16]. Healthcare worker handling patients on a day to day basis would find that the

Revised NIOSH Lifting Equation is too complex and time consuming to allocate for efficient use in clinical settings [16]. The recommended max weight yield for the revised equation is 15 kg (35lbs) for use in patient handling tasks. Assistive devices should be used to lift when the weight to be lifted exceeds the 15 kg (35lbs) [16]. In the practical hospital setting, patient-handling musculoskeletal injuries could decline at a hospital due to not only the policy/lift equipment but also institutional-level changes (e.g., a shift in the responsibility of lost work day costs from the hospital to nursing unit managers, and a requirement that work-related injuries be reported within 24 hours) [33].

3.2.3. *Training/education and no-lift policies*

Obese patients clearly present special challenges for nurses and nursing assistants especially in terms of lifting safety and resource requirements to accomplish all mobility tasks. The American Nurses Association (ANA) published a position statement that called for engineering controls, no-lift policies, and additional research [13]. Occupational back and other musculoskeletal injuries are preventable, however changes in the workplace need to occur in order to prevent injuries and insure safe lifting of patients [13]. Training of nurses and nursing assistants on patient handling in nursing homes is a major component stressed by OSHA [30] to lessen and prevent occupationally related musculoskeletal illnesses and injuries [11]. The ergonomic patient handling program should include teaching/educating the nurses and nursing assistants for the good work practices and how to use engineering controls to reduce the incidence of musculoskeletal disorders [11]. The ergonomics training components should consist of pre-training data, given three months before training, that included a questionnaire about general information, questions about determining the stress of the top twenty perceived risk factors, to evaluate pain and discomfort levels, evaluating parts of the body, and to respond to a general health survey [11]. The nursing staff's work conditions and environments should be evaluated before training to determine information that should be included in the sessions [11]. As research has shown back and other musculoskeletal injuries related to nursing tasks of lifting and moving patients still continue to occur, thus providing that proper body mechanics might not be the solution to the problem [13]. Additionally, Randall, Pories, Pearson, and Drake [17] proposed a tracking indicator on the Occupational Safety and Health Administration 300 logs to identify the frequency, severity, and nature

of caregiver injury during mobilization of the obese (bariatric) patient [17].

4. Discussion

The literature reviewed in this study indicated that risk of WMSD injuries can be increased when nurses and nursing assistants were manually (frequent) handling overweight or obese patients. The contributing MSD risk factors associated with the patient handling tasks could include: high force (overexertion), transfer distances, confined environments, variable patient behavior, and awkward body postures such as stooping, bending and reaching. The recommended interventions included properly unitizing lifting/transfer equipment and devices, no-lift policies, ergonomic assessments and controls, and training and education. However, a result of study by Menzel et al. [10] indicated that the following variables had no predictive effect on musculoskeletal discomfort frequency or severity: patient-to-nurse ratio, patient classification rating (dependency level), or the availability of patient-handling equipment. One should note that, although the usage of lifting equipment and technology can reduce the risk of back pain, there seemed more prevalence rates for wrist and knee pains among the nurses and nursing assistants [10, 18]. When applying the patient lifting equipment (manipulating slings or manually pumping), it is important to pay attention to the possibility of WMSD stress shifting from the back to other body parts such as hands/wrists and knees [10]. Based on a critical assessment of the research on overweight and obese patient handling, it is evident that many gaps exist with respect to this growing problem. Over the past 20 years, there has been an intense growth in obesity in the US and the rates are consistently staying high [5]. With more than one-third of the US adults (36%) and about 17% (12.5 million) of children are obese and the number continue to rise [5]. Since the growth of the population is not slowing down and either is the rate of overweight and obese people more needs to be done to accommodate the problem. Many studies address the issues of musculoskeletal injuries in handling and lifting patients. Nurses and nursing assistants are at higher risk for injury due to the types of tasks they are required to perform. Nurses and nursing assistants are lifting human bodies and most of the people doing the lifting are women workers. The workers are lifting patients that are more than their own body weight. The study done by Waters [16] looked at when it is safe to manually lift a patient.

The revised NIOSH Lifting Equation yields a recommended maximum weight limit of 15 kg for the use in patient handling tasks. This study would suggest that an overweight or obese patient should not manually be lifted. However, there were no studies done on overweight or obese patient and any type of ceiling lift or lift in general. For instance, Marras et al. [24] found that ceiling lift would be considered safe to use with lifting patients since they imposed the lowest muscle activity and spine forces on the lumbar spine. This study was done with a standard ceiling lift and the patients were not obese. There is a compelling need for research to be done on the most appropriate equipment and devices that should be used with overweight and obese patients. Studies need to be done to evaluate the effectiveness of: bariatric lifts, tilt beds, reinforced trapezes, bariatric beds, reinforced toilets, wider exam tables, recliners, shower chairs, wheel chairs and walkers. The studies need assess whether the equipment used has an impact on reducing injuries in health care workers. Additional research is necessary to learn more about how ergonomics can aid nurses and nursing assistants in what interventions are the most effective when lifting overweight and obese patients.

5. Conclusion

This review study synthesized the recent literature on work-related musculoskeletal disorders and injuries among nursing staff (nurses and nursing assistants) and summarized the interventions to lessen or eliminate musculoskeletal risks associated with handling overweight or obese patients. The findings indicated that the WMSDs in the back, wrists, knees and shoulders have been increased when nurses and nursing assistants handling overweight or obese patients. Moreover, nurses and nursing assistants manually lifting obese patient in the nursing home had among the highest rates of back and shoulder musculoskeletal injuries. It was highlighted that a combination of ergonomic patient handling interventions seemed to be a better approach along with the properly utilizing lifting/transfer equipment and devices. A multifaceted approach to the safe patient handling should be executed with interventions that provide the most evidence including: use of proper handling equipment, patient care ergonomic assessment protocols, no-lift policies, and training and education. A further research and development is warranted to integrate obese patient lift equipment like ceiling lifts into the design considerations

during remodeling or new construction of health care facility. All in all, the findings from this study can provide some valuable insights and further directions to improve safety patient handling for both overweight/obese patients and health care workers.

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