Forces borne upon the hands of caregivers while manually transferring a patient

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Forces Borne Upon the Hands of Caregivers While Manually Transferring a Patient

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Abstract

This study investigated the forces borne through caregivers’ hands as they completed stand-pivot style transfers. Twenty-one licensed occupational and physical therapists each completed 12 transfers of various assistance levels. Assistance levels ranged from <25% to >75% of the patient’s body weight. One person, weighing approximately 145 lbs., served as the “patient” for all of the transfers. Results revealed that the average amount of force borne through the hands during a higher assistance level transfer was statistically different from a lower assistance level. No significant differences were found for the maximum amount of pull through the hands for any assistance level. Although not statistically different from each other, 39% of the transfers exceeded recommended guideline for manual transfers (35 lbs.). While the patient’s mass and required assistance increases, the exposure to musculoskeletal injury increases as well. Additional research is needed to identify the forces placed upon the body during manual handling.
Introduction

Several health related fields, including nursing, physical therapy, and occupational therapy have been cited as professions that will have “faster than average growth” between 2008 and 2018 (Bureau of Labor Statistics, 2009). Employment in the healthcare industry in general is expected to increase by 22 percent in the same amount of time. A major factor in industry growth will be the increased demand for health care services for older adults. A rapidly aging population, coupled with technological advances, better survival rates of medical procedures, and longer life expectancies contribute to this demand (Bureau of Labor Statistics, 2010). While the overall industry and the occupations within it look forward to continued growth in the future, the issue of musculoskeletal injury among many of its practitioners continues to exist as a major problem.

Hospital employees who have direct patient contact have been identified as being a high-risk group for job related injuries. One study of a university hospital found that inpatient nurses, nurses’ aides, radiology technicians, outpatient nurses, physical therapists, and occupational therapists were the groups most likely to report patient handling injuries (Pompeii, Lipscomb, Schoenfish, & Dement, 2009). Fragala and Bailey (2003) found that overexertion of personnel in nursing and personal care facilities contributed to injury rates that exceed four times the average across all industries. The Bureau of Labor Statistics (2009) reported that nursing aides, orderlies and attendants were the third most likely group of workers to require days away from work following occupational injuries. Owen (2003) asserts that one major contributor to injuries is a result of the changes in health care delivery services, including shorter hospital stays.
Shorter inpatient hospital stays result in more intense patient care in rehabilitation facilities and in the patient’s home.

While these injuries bring about physical suffering of the worker, there are also economic impacts. There are both direct and indirect costs when a work-related musculoskeletal injury occurs. The direct costs include what is covered by the worker’s health insurance as well as worker’s compensation. The indirect costs are those that are not covered by health insurance of the employee and cost the employer money. Indirect costs include lost productivity, replacement hire and training, overtime paid to workers who assume the injured worker’s responsibilities, and legal costs (Charney, 2004). A formula to estimate the number of dollars spent on injuries of health care workers has been developed and involves the following: direct costs multiplied by four (indirect costs) equals the total money spent on an injury (Charney, 2004).

Many of these musculoskeletal injuries pertain to the back. Cromie, Robertson, and Best (2000) found that among a survey of four hundred and eighty-eight responding physical therapists, 38.4% reported experiencing low back pain for three days or more as a result of job tasks. Dusseau, Rice, and Kopp Miller (2011) found that occupational therapy practitioners within the state of Ohio incurred an overall injury rate of approximately 5% regardless of clinical setting. Additionally, when considering clinical settings where manual handling of patients is required within the facility, the injury rate for occupational practitioners jumps to nearly 19%.

A survey of both physical therapists and occupational therapists found that the injury rates among the professions were not significantly different from each other (Darragh, Huddleston, and King, 2009). Respondents in the study indicated that occupational therapists and physical therapists suffered an average of 16.5 and 16.9 injuries per 100 workers, respectively, in 2006. Low back injuries had the largest percentage of all injuries. Within the
survey, 30% of injuries reported by occupational therapists pertained to the back, while physical therapists reported 33% of their work-related injuries involved the back. In the field of nursing, an epidemiological study found the annual prevalence of back injury among nurses is 40% to 50% of the workforce (Buckle, 1987). The Bureau of Labors Statistics reports “the rate of injury for nursing aides, orderlies, and attendants was 449 per 10,000 full time workers” (BLS, 2009, p.3). Also, these same workers required a median of five days to recover and return to work.

There is a significant component to each of these fields that includes manual patient handling. The connection between the manual handling of patients and the risk of low back disorder has been identified. One of the most dangerous patient handling tasks includes the manual transfer of a patient (Nelson & Baptiste, 2006). Radomski and Trombly Latham (2008) describe a transfer as the moving of a person’s body from one place to another. Transfers can be done independently by patients or dependently with the assistance of a caregiver, lift team, or a lift device. Lateral transfers involve the patient being transferred from one place to another in a supine position, while vertical transfers involve the patient beginning the transfer seated and moving to another surface (i.e. a toilet or wheelchair) (Nelson and Fragala, 2004).

When transferring a person, the patient can contribute to and assist in his or her own transfer from any level between total dependence and almost complete independence. In describing the levels of function according to independence, the terms minimal contact assistance, moderate assistance, maximal assistance, and total assistance are used to describe the amount of effort expended by both health professional and the patient (Uniform Data System for Medical Rehabilitation, 1990). Minimal contact assistance may require physical touching by the caregiver, and the patient expends at least 75% of the effort. Moderate assistance requires that the patient produce 50% - <75% of total effort. Maximal assistance transfers require that the
patient provides >25% - <50% of total effort. In total assistance transfers, the highest level, the patient contributes 25% or less of the total effort.

To understand forces upon one’s body when lifting or maneuvering a person or item, several models may be used. Common biomechanical models are either kinematic/kinetic or biodynamic. Kinematic/kinetic models use movement in space to calculate variables like velocity and acceleration. A motion analysis system as well as body segment analysis, force plates, hand force gauges, movement angles, and velocity of body contribute to these measurements. A limitation to kinematic models are the high number of unknown variables and large amount of assumptions inherent in these models. Biodynamic models use muscle activity, measured via electromyography, to measure muscle activity. Both of these models can be used to measure forces placed upon the body during tasks (Huston, 2009).

Marras, Davis, Kirking, and Bertsche (1999) found a significant risk of low back disorder when transferring patients with both one and two person techniques. Dalton (2005) describes how the structures within the spine react to forces resulting from gravity, ground reaction forces, and muscle contractions. Spinal compression results as intervertebral disks transmit forces to the surrounding (superior and inferior) vertebrae, causing pressure to be spread throughout the vertebral bodies, endplates, and zygapophyseal joints. Shear forces cause intervertebral disks to shift anteriorly, posteriorly, or laterally, in comparison to the vertebra directly inferior to the intervertebral disk. Shear forces can cause stress on the zygapophyseal joints as they resist the force. Marras and colleagues (1999) found that the commonly used one person hug transfer had 300 N to 400 N greater lateral shear forces and 1300 N to 1700 N greater compression forces upon the spine when compared to any of the two person technique transfers analyzed. While one-person transfer techniques were found to be the most dangerous, the authors conclude that
all the transfer methods studied, including two-person techniques, were close to or more than the recommended shear force limit of 890 N set forth by the National Institute for Occupational Safety and Health (NIOSH).

The National Institute for Occupational Safety and Health (1981) proposed a lifting equation and recommendations for manual lifting in the *Work Practices Guide for Manual Lifting*. In 1994, a revised lifting equation from NIOSH included a more comprehensive design, and incorporated more variation representative of the types of lifting done in the workplace. The Revised NIOSH Lifting Equation defines 23 kg (51 lbs.) as the *load constant*, or the maximum weight that can safely be lifted.

Thomas Waters, an author of the *Applications Manual for the Revised NIOSH Lifting Equation*, proposed that the lifting equation should only be used under certain conditions for patient handling (Waters, 2007). These conditions include a cooperative patient, an estimation of the weight to be lifted, a “smooth and slow” lift, and the unlikelihood of the patient changing position during the transfer. Waters (2007) recommends that under ideal conditions, a caregiver should only lift 35 lbs. of a patient’s weight. The 35 lb. weight limit is chosen as a measure to protect healthcare workers. In the equation, the distance from the person being lifted to the caregiver’s body has been increased from 10 inches to 14.5 inches. Waters (2007) explains that this change in distance mimics a realistic working situation for the health care professional. The worker is not as physically close to the patient as other industry workers are to objects (i.e. boxes) to be lifted. These recommendations and lift guidelines are intended to increase worker safety and promote other means of lifting patients if the task is inappropriate by the standards set forth by NIOSH.
Algorithms are used to standardize the way that health care workers make decisions about transferring and repositioning patients (Nelson, 2003). Several algorithms are available for various patient populations as well as the position of the patient pre-transfer. Some factors within the algorithms include weight bearing status of the patient, patient strength, amount of patient assistance, cooperation, and the height and weight of patient. Algorithms guide health care practitioners to make safe decisions when risky handling tasks are present in the workplace.

With the costs of injury to both worker health and the health care system, there has been a safe patient handling movement to reduce the number of injuries among healthcare practitioners. The American Nurses Association (ANA) implemented its Handle With Care® campaign in 2003 to reduce the amount of musculoskeletal injuries to nurses nationwide. The campaign hinged on three main points. The first point stressed that manual handling is ultimately responsible for the prevalence of injury among nurses, the second encouraged the use of assistive equipment to transfer patients, and the third looked toward a future with greater patient care and less injury among the nursing population (de Castro, ANA, 2003).

Some of the approaches of this movement have included education such as body mechanics classes, training in safely lifting patients, and the use of back-belts (Nelson & Baptiste, 2006). However, Nelson and Baptiste report that the usage of several of these techniques are not evidence-based and do not reduce the incidence of musculoskeletal injury. They instead recommend the usage of lift teams, assistive devices to transfer patients, and no-lift policies.

Various types of devices can be used to aide health care professionals in transferring patients. Gait/transfer belts and sliding boards are low technology options which are useful for health care workers. Limitations of these options include non-use for bariatric, unpredictable, or
highly dependent patients (Nelson and Fragala, 2004). Mechanical lift devices can also assist health care workers in transferring patients by reducing strain upon one’s back. The most popular lifting device currently is the mechanical floor-based lift (Nelson and Fragala, 2004). Floor based lifts can be transported, while ceiling-based lifts are confined within the parameters of overhead ceiling tracks. Patients who are candidates for transfers with mechanical lifts are likely to have a high level of dependency. One precaution when using a mechanical lift with a sling is to identify and use the correct type of sling (i.e. fabric and size), taking into account the patient’s weight, condition, comfort level, and dependency (Alexander, 2005).

Even when using assistive equipment like patient lifting devices, there may still be a risk posed to health care practitioners. Rice, Woolley, and Waters (2009) found that using a floor-based lift required significantly more torque than using an overhead mounted patient lift. However, the forces were still within a suitable range for 90% of the female population based upon the parameters tabulated in the Snook Tables (Snook and Ciriello, 1991). The Snook Tables are a useful guide in determining the amount of the population that would be safe to perform certain tasks for various periods of time (Snook and Ciriello, 1991). The Snook Tables provide guidance on lifting and lowering tasks, push and pull tasks, and carrying. The NIOSH equation and the Snook Tables can be used in conjunction to determine amount of weight and number of times an object can be lifted without serious risk of injury to the worker.

One study of a New York hospital found that purchasing several mechanical lifting devices as well as implementing a five step ergonomics program significantly reduced both the number of injuries to nursing aides as well as the cost associated with back injuries (O’Reilly Brophy, Achimore, and Moore-Dawson, 2001). The authors reported that average yearly cost of back injuries before the intervention was $201,100 and was reduced to $91,800 during the
intervention years. The mean of back injuries before the intervention was 30 per year and during the intervention decreased significantly to 21.5 back injuries per year.

While much of the literature focuses on nursing personnel, there is limited research on the effects of musculoskeletal disorders on the professions of occupational therapy and physical therapy. Occupational therapists and physical therapists transfer patients in order to “restore function and increase independence” (Darragh, Huddleston, and King, 2009, p. 351).

Specifically, occupational therapists use patient handling as a means to increase the mobility and occupational performance of a patient. Transfers can serve to increase the capability of a patient to transfer with decreasing levels of assistance, or even independently over time.

In the field of occupational therapy, conceptual frameworks provide overarching theories of occupation and a format to understand occupation and its interrelated components. In the Conceptual Framework of Therapeutic Occupation written by Nelson (1988), compensation is described as a substitute occupational performance to obtain a comparable impact upon the occupational form. Compensation can be used therapeutically in order to achieve future adaptations in the developmental structure of a patient. For example, after an occupational therapist transfers a client from a wheelchair to a shower, the patient has the ability to learn skills or gain strength (adaptation). The patient is also increasing occupational performance in a self-care occupation of daily living. The correct position of one’s body allows for the patient to interact with his or her occupational form (environment) in a meaningful and purposeful way. Positioning also provides access to materials and resources within the occupational form, providing opportunities to access and interact with his or her surroundings.

Transferring from one surface to another, or shifting one’s physical orientation, is often required to facilitate proper positioning for successful engagement in occupations. Occupational
therapists may be responsible for completing a number of transfers during therapeutic interventions. Manual handling of patients is presently taught to future health care providers, including occupational therapists. The Accreditation Council of Occupational Therapy Education (ACOTE) mandates that manual handling is incorporated in occupational therapy curricula for doctoral, master’s and occupational therapy assistant degree programs. In the section that provides guidance in intervention and implementation, Standard B.5.11. instructs institutions to provide training in functional mobility, which includes physical transfers (ACOTE, 2006).

Though the risks of manual handling and injury rates of health care workers have been identified, frequent manual transfers of patients by occupational therapists is a reality within the profession. The implications associated with injured occupational therapists are numerous. They are potentially unable to carry out job duties effectively, providing less than the optimum degree of care for the patient. Injured occupational therapists also create a burden upon their colleagues and the facility. Increased health care costs, staff shortages, frequent absenteeism, and discontinuous care for patients can also be consequences of work-related musculoskeletal disorders for occupational therapists.

While the risks linked with transferring of patients is well documented, the amount of load that occurs through the hands when manually transferring with minimal, moderate, maximum or total assist by the patient is relatively unknown. Therefore, the purpose of this study is to describe the load at the hands of the caregiver transferring a patient with varying levels of assistance to identify the amount of risk associated with each variation. Identification of these risks can further the body of research on this topic, increase safety of health care practitioners, and ultimately increase patient care. The hypothesis of this study will be that the
force borne through the hands of the caregiver during a manual transfer will increase as the level of assistance increases (e.g., minimum, moderate, maximum, and total assist) by the person being transferred.

Methods

Participants

Participants for this study included 21 healthy adults. Participants were excluded if they had a history of back injury or any condition that would affect ability to complete a pivot transfer. All participants were licensed in the state of Ohio as physical therapists, physical therapy assistants, occupational therapists, or certified occupational therapy assistants. Participants were recruited using word of mouth and flyers on The University of Toledo campus.

Apparatus

A four camera Qualisys 3-dimensional motion capture system collected kinematic data at 240 HZ (Qualisys AB, Packhusgatan 6, S-411 13 Gothenburg, Sweden). Two force plates captured ground reaction forces. Also, two Imada digital push/pull gauges (model # DPS220, Imada, Northbrook, IL) collected force data at the hands. The force plates and the push/pull gauges were integrated with the Qualisys system using a Measurement Computing analog to digital card (model # PCI-DAS6402/16, Norton, MA). This force data both hands and force plates were collected at 960 Hz. A Philips computer camera (Philips Accessories and Computer Peripherals, North America, Ledgewood, NJ 07852, U.S.A.) collected video of the transfers. The force plates were embedded into a wooden platform. The wooden platform was 6 meters by 9 meters and constructed with supports approximately 46 cm on center. Two standard straight backed armless chairs with a seat height of approximately 47 cm were used for the transfers.
The chairs were oriented 45 degrees from each other and positioned directly in front of the two respective force plates.

Dependent Variables/ Statistical Analyses

Dependent variables for this study included mean hand pull force across the transfer and the maximum hand pull force during the transfer. Repeated measures analysis of variance was performed for each of these two dependent variables with a follow-up Tukey’s pairwise comparison when the results of the ANOVA were < .05.

Procedure

The procedure was approved by The University of Toledo Biomedical Institutional Review Board. Each participant acted as the “caregiver,” transferring the “patient” (researcher) a total of twelve times. The caregiver transferred the patient from one seat to the other, using a pivot transfer technique. There were four conditions total, involving weight bearing in each distinct level set forth by the Functional Independence Measure. Condition 1 trials are compromised of assistance that equaled ≤ 25% or less of the transferee’s weight. Condition 2 trial equaled >25% - ≤50% of the patient’s weight. Condition 3 equaled >50% - ≤75% of the patient’s weight. Condition 4 trials equaled > 75% of the patient’s weight. For example, a trial in which the transferee (weighing 140 lb) bore 40 lbs. through her feet during the transfer would be included in Condition 2 because that is 29% of the patient’s total weight.

The caregiver manually transferred the patient using a pivot transfer technique, while the patient graded her own contribution by watching a computer screen that indicated the correct range for that condition. Caregivers were given one practice transfer, and then subsequently performed twelve pivot transfers with various assistance levels. The assistance levels (Conditions 1 – 4) were randomized.
The pivot transfers were performed in a manner so that participants remained on their respective force plate. They donned several reflective markers, including on their wrists, elbows, shoulder, head, spine, hips, ankles and feet. Demographic data such as height, mass, age, gender, and ethnicity were recorded as well.

Results

Assignment of trials to specific conditions (Condition 1, Condition 2, Condition 3, and Condition 4) was completed post data collection. While efforts were made on part of the researcher (“patient”) to grade her weight according to the pre-selected condition, the accuracy of using the desired force proved to be formidably difficult. In order to assess the transfers authentically, they were categorized after the fact into four distinct categories. Specifically, the demarcation for condition assignment is based upon the percent of assistance given according to the researcher’s weight that day of data collection. Condition 1 trials were compromised of assistance that equaled $\leq 25\%$ or less of the patient’s (researcher’s) weight. Condition 2 trial equaled $>25\% - \leq 50\%$ of the patient’s weight. Condition 3 equaled $>50\% - \leq 75\%$ of the patient’s weight. Condition 4 trials equaled $> 75\%$ of the patient’s weight. See Table 1 for the transfer time and ground reaction force means and standard deviations across the four conditions.

Results from the repeated measures ANVOVA revealed statistical significance on the factor of average pull, $F(3,21) = 5.33, p=0.009$, with a small effect size of $f = 1.37$, but not for maximum pull, $F(3,21) = 2.929, p=0.064$ with a small effect size of $f = 1.01$. See Table 2 and Figure 1 for the means and standard deviation for this comparison. A post hoc Tukey’s pairwise comparison was performed on the average pull means across Condition 1, Condition 2, and Condition 3. Condition 4 was not included in this analysis because $n=1$ for that condition. The Tukey pairwise comparison revealed a significant difference between Condition 1 and Condition
3, \( p = .012 \). See Table 2 and Figure 1 for the means and standard deviations for this comparison. Posteriori analyses were done on the level of maximum pull at the hands of the caregiver.

A histogram of the 114 trials was created that depicts the level of force in pounds and its frequency of occurrence. See Figure 2. Forty-six percent of total transfers fell into the safer range of 0 – 30 lbs being lifted, 16% are noted to be of questionable safety at the 31 – 35 lbs., and 39% are in a definite unsafe range of 35 lbs. and higher (Waters, 2007). The total range of forces borne through the hand measured 2.97 lbs. to 75.5 lbs., with a mean of 32.4 lbs.

**Discussion**

The results of this study add to the body of research which aims to measure how much force is applied to areas of the body during manual patient handling tasks (Marras et al. 1999; Marras et al. 2006). While much of this research focuses on the lower back, upper back, and shoulders, no known study describes the level of force solely at a caregiver’s hands. Darragh, Huddleston, and King (2009) found that of therapists who had injured themselves in the last year, 30% of occupational therapists and 28% of physical therapists had incurred a work-related injury at the hands. The purpose of this study was to quantify the amount of force at the hands of the caregiver during a stand-pivot transfer of various assistance levels.

Significant results were found on the variable of force across the entire length of the transfer, ranging from 1.4 seconds to 4.6 seconds. The analyses reveal that the “lightest” condition (Condition 1) was significantly different from a “heavier” (Condition 3), in terms of weight borne through the hands of the participant during the transfer, with data collected 960 times per second (960 Hz). Examining these findings, a logical connection is found. As the level of assistance needed increased, so did the amount of force generated to complete the transfer. Because data were taken thousands of times across the entire length of the transfers,
this finding lends itself to an interesting concept. While one might be inclined to assume that the maximum amount of force generated could potentially be harmful, the sustained and modulating forces required across a transfer have the ability to produce potentially unsafe conditions. The engineering concept known as “creep,” mechanical loading which can lessen a structure’s ability to resist force over time, can be applied to occupational and physical therapy practice. Waters and Rockefeller (2010) suggest that even low amounts of static loading over a period of time can be harmful to tissues, weakening their ability to resist as forces acting upon them. This is especially true for occupational and physical therapists, as they maintain awkward static posturing while facilitating occupational engagement of their patients.

No significant results were found on the variable regarding the maximum level of hand force. While the analyses did not identify statistically significant differences between each of the conditions, there are important clinical implications for the level of force measured during trials. As previously mentioned, Waters (2007) identified a 35 lb. weight limit for caregivers to safely manually handling patients. In Condition 1, the mean value (46.5 lbs.) is well above the recommended limit. Approximately 30% of the trials in Condition 2 and 15% of trials in Condition 3 were above the recommended weight limit. In Condition 4 (the most assisted level), there appeared to be least amount of risk. Condition 4 consisted of one participant - assessment of this condition should be taken with caution. On the whole, it can be concluded that approximately 40% of all the transfers performed were above the recommended guideline for safe lifting. Although the $p$-value was relatively small for the maximum pull ANOVA ($p=.064$), the difference between conditions was not statistically significant. Participants were able to modulate the amount of mean force they applied throughout the transfer, but in terms of maximum force, the trend appeared to follow the same as what occurred in the mean hand force
measures across the trials. Considering the trend and the size of the $p$-value and the small effect size, there is a likelihood that a Type II error occurred with this analysis.

Marras (1999) and Waters (2007) described what is “safe” for practitioners to lift on a regular basis. Marras discusses this safe range in Newtons, namely providing evidence that greater than 6400N of compression or 1000N of lateral/anterior-posterior force will be harmful to most men and women. (Note, there are approximately 4.45N in one pound). In a similar fashion, Waters and NIOSH have put forth a guideline that states healthcare practitioners should manually lift no more than 35 lbs. of a person’s total body weight under ideal conditions. While the current study did not measure number of Newtons, it did record the pounds of force that were borne through the practitioner’s hands. Thirty nine percent of the total transfers performed during this study were above the NIOSH guideline of lifting 35 lbs. This finding suggests that a “patient” of relatively average weight and size, no balance and/or coordination deficits and with good cognition can pose a risk to healthcare providers. Because of the controlled nature of the design, one can extrapolate that transfers with real patients with actual deficits have the ability to place more force on a practitioner’s body.

The importance of this research and similar studies hinges on the safety and well-being of healthcare practitioners as they move and handle patients on a daily basis. Injury rates among healthcare workers due to patient handling have been well documented (BLS, 2010; Darragh, Huddleston, and King, 2009; Rice, Dusseau, and Kopp Miller, 2011). Injuries to healthcare practitioners can be monetarily costly to employer/employee, increase turnover rates, and decrease overall job and life satisfaction (Charney, 2004; Darragh & Campo, 2010). This study, as well as the many others that quantify forces, aim to provide guidance to healthcare practitioners. If a transfer is deemed unsafe due to a multitude of reasons (forces generated,
awkward posturing, environmental constraints, cognitive difficulties), there is a need to use clinical reasoning in conjunction with safe patient handling guidelines and equipment.

Safe patient handling and moving technologies have been developed to reduce the amount of force upon the caregiver’s body as they provide patient care. Various types of equipment are available for use, often grouped as either “low-technology” or “high-technology” devices. Low technology devices include gait belts, slide sheets, pivot platforms, standing aids, and traditional ambulation devices such as walkers, crutches, and canes. High technology devices include air-assisted lateral transfer devices, floor-based lifts, and ceiling-mounted lifts. While the use of patient handling technology does not eliminate the risk for the caregiver, many technologies decrease risk to an acceptable range for the majority of the population (Rice, Woolley, & Waters, 2009). Safe patient handling programs introduce policy and procedure at an organizational level. Programs include policy development, training, maintenance, and continued evaluation. While safe patient handling programs reduce the risk for work-related musculoskeletal disorders, they are not broadly put into practice and staff may be resistant to implementation (Collins, Wolf, Bell, & Evanoff, 2004; Zadvinskis & Salsbury, 2009).

The current culture in the areas of nursing, occupational therapy, and physical therapy is to manually handle patients in under a wide variety of ranges – from safe to unsafe – for both the practitioner and the patient. Within the rehabilitation community, safe patient handling and movement is widely seen as counterintuitive to rehabilitation, promoting dependency and immobility (Darragh, Campo, & Olson, 2009). A recent study compared stroke patients’ functional outcomes with and without the use of safe patient handling equipment. The authors found that the use of safe patient handling equipment did not inhibit the functional outcomes during the recovery process (Arnold, Radawiec, Campo, & Wright, 2011). There is a need for
similar studies, with a variety of patient populations and various patient outcome assessments, to further confirm these results. The current study furthers the body of evidence for safe patient handling literature that is rehabilitation specific, using solely rehabilitation professionals as participants and measuring forces that are especially pertinent to therapeutic practice.

As the base of evidence for safe patient handling grows, so does the legislation and mandates at the state level. Currently nine states have adopted “safe patient handling” legislation or resolutions. The State of Ohio currently has an interest-free long term loan program for skilled nursing facilities to purchase and train employees on safe patient handling equipment (ANA, 2011). Many of these states require facilities to develop and use an evidence-based practice safe patient handling policies and programs. The current study adds to the body of research which indicates that healthcare professionals are placing themselves and their patients at risk during repetitive manual handling.

There were several limitations to this study that were encountered during data collection and post data collection. The motion lab provided a non-naturalistic setting to perform stand-pivot transfers. Because licensed therapists were subjects, no “transfer training” was completed prior to data collection. Each subject transferred the researcher in a slightly different way, including differences in posture, grip, and speed. Most notably, some therapists used a knee blocking technique, while others did not. Because there was an additional point of contact between the body of the subject and the body of the researcher during knee blocking transfers, there could be a supplementary transfer of force. In addition, the apparatus to measure the forces at the hands was also non-naturalistic in nature, with the therapist’s hands place approximately six inches from the gait belt - instead of holding the gait belt as during a traditional transfer. A limited sample size also leads to difficulty when generalizing findings to a larger population.
Other limitations include errors in instrumentation and data collection. Several subjects were not included in data analyses, as there were instrumentation errors in the force plates and hand gauges. As discussed previously, human error was also a limitation to this study. The researcher’s inability to effectively grade her weight during data collection led to demarcation of conditions after data was collected, which was not as intended in the original procedure and protocol.

The area of safe patient handling is in need of future research measuring the forces upon various body parts of healthcare practitioners during manual handling. The current study should be repeated with a greater control of variables and a more standardized protocol. Because grading weight was difficult for the researcher to accomplish effectively, this component should be altered. Suggestions for replication include a highly trained and proficient “patient” or a standard amount of weight to be lifted while measuring forces at the hands.

There is also a need to study different types of transfers that healthcare practitioners encounter on a regular basis. These include lateral transfers (e.g., bed to stretcher), where the patient is positioned supine for the transfer. There is an exceptionally high risk for unsafe anterior-posterior shear lateral forces during these types of transfers. Other types of transfers that would be especially pertinent to therapists include transfers that would be encountered in a typical therapy setting, such as a bed to commode or wheelchair to chair transfer. The addition of occupational forms that are common in therapeutic practice could provide added value from an occupational or physical therapist’s perspective.

The purpose of this study was to objectively quantify the amount of force borne through the hands during a manual patient transfer, a task that many occupational and physical therapists perform often as an essential function of their career. Results of the study found that forces
borne through the hands during lower and higher assistance levels were significantly different from each other. Additionally, this research found that a portion (39%) of total transfers were above the standard limit deemed as safe. While the patient’s mass and the amount of required assistance increases, the exposure to musculoskeletal injury increases as well. Prior research endeavors and the current study lend support to concept that forces acting on the body can place healthcare practitioners at risk for work-related musculoskeletal disorders.
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References


Table 1

Means and Standard Deviations of Variables across Conditions (Bertec Force Plate)

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</tr>
<tr>
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<td>1</td>
<td>31.09</td>
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<tr>
<td><strong>Max Patient GRF</strong></td>
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<td>3</td>
<td>207.68</td>
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<td>140.17</td>
<td>18.86</td>
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<td>7</td>
<td>137.70</td>
<td>15.91</td>
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<tr>
<td>4</td>
<td>1</td>
<td>89.73</td>
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</tbody>
</table>

*Note*: GRF = ground reaction forces.
Table 2

*Means and Standard Deviations across Conditions (Hand Force Gauges)*

<table>
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<th>Force in Pounds</th>
<th>n</th>
<th>M</th>
<th>SD</th>
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</thead>
<tbody>
<tr>
<td>Mean Pull</td>
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<td>1</td>
<td>3</td>
<td>8.72</td>
<td>1.72</td>
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<tr>
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<td>10</td>
<td>5.50</td>
<td>2.94</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
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<td>1.90</td>
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<tr>
<td>4</td>
<td>1</td>
<td>.61</td>
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<tr>
<td>Maximum Pull</td>
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<td></td>
<td></td>
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<td>3</td>
<td>46.53</td>
<td>13.51</td>
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<td>30.33</td>
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<tr>
<td>4</td>
<td>1</td>
<td>13.58</td>
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</tr>
</tbody>
</table>
Figure 1. Means and standard deviations of mean pull at hands and maximum pull at hands.

Note: $n=1$ for Condition 4.
Figure 2. Histogram of the peak forces borne at the hands during the pivot trials. $n=114$ trials.