2014

Predictors of time to return to work following a planned medical event: total knee replacement as an exemplar

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PREDICTORS OF TIME TO RETURN TO WORK FOLLOWING A PLANNED MEDICAL EVENT: TOTAL KNEE REPLACEMENT AS AN EXEMPLAR

by

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A thesis submitted in partial fulfillment
of the requirements for the Doctor of
Philosophy degree in Nursing
in the Graduate College of
The University of Iowa

August 2014

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Graduate College
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Iowa City, Iowa

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PH.D. THESIS

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To Tom, Colin & Drew

You get up every morning
From your alarm clock's warning
Take the 8:15 into the city

Randy Bachman
Takin’ Care of Business

ACKNOWLEDGMENTS

There are several people that I would like to acknowledge. First, my dissertation chair and advisor, Dr. Barbara Rakel, for consistently encouraging me to write, answering emails in the early morning hours, and your willingness to help from a couple of states away. Thanks for providing prompt, thorough feedback and follow-up phone calls for clarification. Most of all, thanks for always finding time in your schedule for me.

For my dissertation committee members: Dr. M. Kathleen Clark, Dr. Kennith Culp, Dr. Kathleen Sluka, Dr. Marianne Smith, and Dr. M. Bridget Zimmerman your feedback at my proposal and defense has elevated my work. I would also like to acknowledge: Dr. Kathleen Buckwalter for propelling me to finish; Cynthia Cooke for having a secret knock; Lisa Von Muenster for expert formatting skills; and my fellow TANK team members for collecting these data.

My best friend, Dr. Meghan McGonigal-Kenney, fostered my spirit during this dissertation. I appreciate our phone calls, java cooler runs, and your ability to remember my significant holidays and deadlines with cake. My parents, Jim and Andi, have always helped me reach my goals. Thanks for letting us move into your house with a newborn, watching the boys, getting groceries, washing clothes, <insert everything> and allowing me to have uninterrupted time to write. Thanks to Matt for being so good to my family and developing handy fixes. Many thanks to my sister, Shelli, for the motivational signs, Pinterest pins, and providing organization to end my cluttered ways. Both of you always make me laugh and make delicious baked goods; both were essential to me finishing.

My husband, Dr. Tom Blodgett, your unrelenting support is invaluable. I appreciate everything you sacrificed and how enthusiastically you listened to my ideas-

even in the middle of the night. Thank you for making sure I finish what I started. My boys, Colin and Drew, thank you for being little. Your kisses and hugs helped me focus on what really matters in my life and inspired me to finish.

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CHAPTER I

INTRODUCTION

Background and Significance

Work is an important component of the American sense of self. Work is a major determinant of one's salary, insurance coverage, living conditions, and many aspects of the worker's and his or her family's health status. On a larger scale, work-related statistics, such as unemployment rate, projected change in employment over time, and mean salary for a particular profession or occupation, have enormous implications for local, state, national, and global policy.

Several health-related disciplines, including medicine and nursing, have identified specialty practice areas dedicated to the health and safety of workers. Occupational health nurses form a small, but scientifically and politically active, subset of the nursing workforce. A top priority for occupational health nurses is the facilitation of timely, safe, and cost-effective return to work after a work absence (American Association of Occupational Health Nurses, 2012). Although work absence can occur for a variety of reasons, including injury, illness, and personal choice, an increasing number of workers are missing work due to planned medical events, which include any type of health-related procedure that is scheduled in advance and has a roughly pre-determined course of recovery. Because occupational health nurses have a unique perspective on health that blends occupational policy, epidemiology, nursing, law, and a variety of other realms of knowledge, and they are often responsible for case management in the workplace, occupational health nurses are in an ideal position to plan, implement, and evaluate interventions to reduce time to return to work (TRTW) after a planned medical event

(Pransky, Shaw, Loisel, Hong, & Desorcy, 2010; Shaw et al., 2010).

This introductory chapter describes the significance of TRTW following a planned medical event for the employee and employer, explain the rationale and conceptual underpinnings of the proposed study, and identify the proposed study aims and hypotheses.

Significance of Time to Return to Work Following Planned Medical Events

Planned medical events, such as elective surgeries, are frequently performed in adults and older adults who are in the workforce (Cullen, Hall, & Golosinskiy, 2009). Between 45% and 66% of those who have undergone a planned medical event were employed (or of working age) at the time of the procedure (Kuijer, de Beer, Houdijk, & Frings-Dresen, 2009). Preparation for a planned medical event includes an estimated time to return to work following the procedure. During recovery from a planned medical event the worker typically experiences a period of rehabilitation, learning about health management, and adaptation to his or her new functional capacity. However, time to return to work is highly variable and has been difficult for clinicians, policymakers, and researchers in a variety of disciplines to predict (Schultz & Edington, 2007); therefore, duration of TRTW following a planned medical event is an important, yet poorly understood, outcome.

When a medical event is planned, the worker and his or her employer can collaboratively identify a plan for the worker to return to work. This plan might include an expected duration of work absence, as well as the anticipated need for workplace modifications and work reassignment. At best, the worker will provide the employer with

the “estimated recovery time” or the routine time it takes a person to return to work following a similar surgery. This estimated recovery time has been found to be highly variable among health care providers, even when there are evidence-based return-to-work guidelines (Clayton & Verow, 2007a). *Actual recovery time* is based on personal factors and unforeseen complications that arise. For example, the actual TRTW following an inguinal hernia repair was two days longer than the expected TRTW and ranged from 2-60 days (Jones, Perkins, & Born, 2001). It is safe to assume that more extensive surgeries will have longer estimated recovery times and more variability in actual TRTW. In addition, actual TRTW may be based on workers’ workplace characteristics including the ability to function within their job and/or the accessibility of their workplace.

Understanding predictors of TRTW following a planned medical event will assist the worker and health care provider to more accurately predict how long it will take the employee to return to work and reduce the impact of work absences for employers and workers. This knowledge and ability to accurately plan the work absence has myriad benefits for the worker and employer, which are explained in the following sections.

Significance of Time to Return to Work for the Worker

Prolonged TRTW beyond what is presumed by the worker and employer leads to a number of occupational and health-related adverse effects for the worker. The more time a person remains off work, the higher the risk for ongoing work absence (Clay, Newstead, D'Elia, & McClure, 2010; Wadell, Sundelin, Henriksson-Larsen, & Lundgren, 2004). A delay in TRTW increases the likelihood that workers will not return to work at all. Since work is the most common source of income, health and life insurance, and retirement benefits for most Americans (Cho & Chan, 2013; de Vries, Reneman,

Groothoff, Geertzen, & Brouwer, 2012; Fronstin, 2012), reducing TRTW following a planned medical event is of critical economic importance for the worker and his or her family. To attract workers in some labor markets, employers are increasingly offering additional benefits to their employees, including tuition assistance, childcare assistance, and product or service discounts (Barnighausen & Bloom, 2009; Copeland, 2013; Jones, 2005; Peters, 2007). Because these types of benefits encourage financial transactions, the ability to work also has important implications for the local, national, and global economy.

Furthermore, working is physically beneficial to the worker (Joyce, Smith, Henderson, Greig, & Bambra, 2010; Kuijer et al., 2009). Controlling for age and a variety of other factors, Vitasalo et al. (2008) found that heart rate and systolic blood pressure are closer to the normal range in workers than in non-workers. In otherwise similar cohorts, workers reported significantly less fatigue than non-workers (Schuring, Mackenbach, Voorham, & Burdorf, 2011). Moreover, those with work-related health insurance benefits, which may be suspended or discontinued during prolonged work absence, are more likely to participate in routine health screening exams than those without these benefits (Phillips, Smith, Ahn, Ory, & Hochhalter, 2013). These findings have important implications for public health initiatives that focus on cardiovascular, cerebrovascular, and overall physical health. First, people with healthy cardiovascular function, which is partially determined using vital signs data, have lower risk for cardiovascular and cerebrovascular life-threatening events (e.g. myocardial infarction, cerebrovascular accident). Second, participation in routine health screening exams allows the worker to receive important information about health promotion and disease prevention, and

provides workers with access to health care services that may not be available to non-workers. Therefore, minimizing TRTW can have a significant impact on the worker's overall health status.

Beyond physical and fiscal incentives, employment has also been shown to provide psychological and social benefits to the employee. Employment is a vital component of personal identity, social status, life purpose, and daily structure in many cultures throughout the world (Bergvik, Sorlie, & Wynn, 2011; Black, Spetz, & Harrington, 2008; Wadell et al., 2004). The workplace provides opportunities for social interaction with coworkers, managers, and consumers, which increases job satisfaction (Pryce, Albertsen, & Nielsen, 2006; Pryce, 2006). Social support garnered through these workplace networks has significant protective effects on mental health (Stansfeld, Rael, Head, Shipley, & Marmot, 1997) and self-esteem (Kuijer et al., 2009).

When work absence is necessary, having the ability to plan ahead for the absence from and return to work can mitigate some of the challenges associated with not working. Accurate planning can allow the worker to coordinate the recovery phase around work responsibilities and expected work productivity gaps. For example, workers who can coordinate the planned medical event and subsequent recovery period around a known time in which their position is less demanding (e.g. secretaries, teachers) will suffer less of an impact from work absence because they would not have been working at that time, even without the planned medical event. In contrast, workers who are injured or become ill do not know when these injuries or illnesses will occur, and are therefore unable to anticipate work absences. Therefore, being able to anticipate work absence and predict TRTW after a planned medical event provides the worker and the employer with a

valuable opportunity to negotiate many of the logistical aspects of the work absence before the planned medical event occurs.

Employment seems to have an important and statistically significant protective effect on psychological, social, and physical health and the list of variables that may impact this relationship is vast. However, the scope of these variables that have been studied to date is limited. Regardless, the Occupational Safety and Health Administration have determined that a safe, healthy workplace, which is free of environmental hazards and psychological stressors, is likely to contribute to the overall health of its employees.

Significance of Time to Return to Work the Employer

Knowing the expected TRTW following a planned medical event can also benefit the employer. Employers reported a decreased profit margin, reduced productivity, and lower workplace morale when there is an unanticipated work absence or a delay in return to work (Wallace, 2009). Avoiding these costs is a high priority for employers, and being able to anticipate both the work absence and the TRTW can help the employer do so. Employers can adjust staff schedules, predict supplemental staffing needs, or adjust work assignments while the worker recovers from a planned medical event. This could lead to a more efficient use of corporate or workplace resources, as well as promote a relatively stable period of workplace adaptation during the workers absence.

Workplace departure of an employee, whether through voluntary resignation, termination, or retirement, is an expensive and inconvenient occurrence in the workplace. According to the United States Bureau of Labor, there were 47.2 million departures in 2011 (Bureau of Labor Statistics, 2012). Workplace departures create costs to the employer associated with replacing an employee. These include: advertising the job

opening, interviewing candidates, orientation of the replacement employee, temporarily decreased staffing ratios, and heightened vulnerability of relationships with consumers (Frank & Maddison, 2004). Costs to replace workers are estimated at 100% to 150% of the worker's annual salary (Phillips, 2005).

Absence from work due to a planned medical event can lead to employee-employer formal departure (Cowan, Makanji, Mudgal, Jupiter, & Ring, 2012; Leigh, 2011; Svendsen, Frost, & Jensen, 2012). Because predictors of the duration of absence from work following a planned medical event are poorly understood, the number of days missed from the workplace can be uncertain for both the employee and the employer. Furthermore, identifying predictors of an extended duration of work absence, and interventions implemented to negate them, then potentially devastating employee-employer departures may be avoidable.

The American College of Occupational and Environmental Medicine (Hymel et al., 2011) reported that an extended absence from work may be attributed to the employee's use of worker's compensation claims, short and long term disability, sick leave, paid time off, unpaid leave, use of Family Medical Leave Act (FMLA) protections, and death. Employers spend over $53 billion per year on workers' compensation claims alone (Leigh, 2011). Depending on the details of these benefits, qualified employees are provided the opportunity to convalesce following a planned medical event, usually for a delimited time, without fear of termination, wages, or seniority. In these cases, employees remaining at the workplace are required to increase their individual efficiency to compensate for the absent worker. If these individuals cannot adequately recover the lost productivity of the absent worker, the net productivity and financial stability of the

workplace suffer (Wallace, 2009). This can lead to a decline in workplace morale, resentment, anger, and separation of the remaining employees from the employer. Since extended employee absences are associated with increased workplace tensions that threaten productivity and profit margins, there is an increasing need to identify and reduce risk factors associated with these extended absences.

Summary of the Significance of TRTW

Prolonged work absence has detrimental effects on both the worker and the employer. Furthermore, if wages and benefits are suspended during work absence, there may be undesirable economic implications for the worker, their family members, and the local economy. In contrast to an unplanned medical event (e.g. illness or injury), a planned medical event allows the employee and employer to anticipate the dates of absence, which may mitigate some of the problems associated with the worker being absent from work. Moreover, research about interventions to reduce TRTW following a planned medical event is underdeveloped. While occupational health nurses and other health care professionals have clinical and scientific interests in promoting a prompt return to work following planned medical events, there has been a paucity of information to guide them in the implementation of evidence-based interventions to this end.

Rationale for the Study

The majority of return to work literature focuses on return to work following an unexpected illness or injury at work (Schultz, Stowell, Feuerstein, & Gatchel, 2007). The nature of an illness or injury is that it occurs spontaneously and without prior worker or employer knowledge of their occurrence and results in swift medical treatment. Since a planned medical event occurs according to a roughly pre-determined and non-emergent

timeline, the worker undergoing the planned medical event has the ability to arrange or negotiate post-event commitments before the planned medical event occurs. This is a key difference in return to work after a planned medical event research.

Theoretically, there are similarities between return to work following a planned medical event and following an injury and illness. In both cases, there is a disruption of work due to a medical incident, the worker recovers over a period of time and then returns to work; however, the similarities end there. If the unexpected illness or injury is work-related, return to work often involves workmen's compensation, lawsuits, liability issues, resentment toward employer/supervisor, and uncertainty in recovery process (Clay, Newstead, Watson, & McClure, 2010; Gilworth, Phil, Cert, Sansam, & Kent, 2009; Leigh, 2011; MacEachen, Clarke, Franche, Irvin, & Workplace-based Return to Work Literature Review Group, 2006; Patel, Greasley, & Watson, 2007). The U.S. Department of Labor Record requires meticulous record keeping for work related illness/injuries. In fact, the Occupational Safety and Health Administration (OSHA) reported there are over 4.1 million work related injury/illness that occur each year in the United States (OSHA, 2012). Therefore, the scope of this problem has warranted the appropriation of resources to address gaps in knowledge about facilitators of return to work following an unplanned medical event.

However, relatively fewer resources have been used to understand or address similar gaps in knowledge regarding return to work following a planned medical event. Since there is no required government documentation for planned medical events and little is known about the duration of time that is required to recover from planned medical events, the scope of this problem is largely unknown. Because planned and unplanned

medical events differ in ways that are not yet fully understood, our current understanding about return to work after a work-related injury or illness cannot be directly generalized to return to work after a planned medical event. The proposed study attempted to address some of the knowledge gaps about TRTW that are believed to be unique to planned medical events. Results from this study formed a much-needed basis for further study in this area, as well as provide clinicians and other stakeholders with preliminary evidence to support the implementation of interventions to promote the timely return to work after a planned medical event.

A conceptual problem that has plagued research on TRTW in both planned and unplanned medical events is the lack of a standardized method to define and measure TRTW. Substantial variation exists in how return to work is defined and measured, and this can have important implications for the validity of research results in both phenomena. Return to work has been defined as both the return to employment with income as well as the return to any sort of meaningful activity, such as hobbies, volunteerism, or household chores (Clay et al., 2010). This inconsistency is based on the myriad ways in which work is defined within the American culture. Furthermore, return to work has been measured as a dichotomous variable at various time points after work was stopped, as ordinal level data in which various ranges of time are provided from which the worker can select when he or she returned to work, or as continuous level data in which the worker identifies a time point in which he or she returned to work. Each of these variable types has advantages and disadvantages, as does the temporality with which return to work is measured (i.e. concurrent with the occurrence of returning to work versus retrospectively after return to work has already occurred). For example,

dichotomized data can be collected to determine if return to work has occurred at set time points during the study period (e.g. “yes” or “no” at 4 weeks, 8 weeks, etc.), or it can be collected to determine if return to work has occurred at all by the end of the study period. Although this strategy is least burdensome and less prone to recall bias than other types of recall data, it lacks adequate precision for use as a primary outcome variable. In contrast, continuous data can be collected in a variety of ways (e.g. direct question to worker or employer, inspection of “time card” for the first arrival at work after planned medical event) to determine, with great precision, when return to work has occurred. However, the most feasible approach of asking the worker to recall the exact date he or she returned to work has been shown to lack accuracy due to significant recall bias (Mobasheri, Gidwani, & Rosson, 2006; Peak et al., 2005; Tanavalee, Jaruwannapong, Yuktanandana, & Itiravivong, 2006). In contrast, using categorical data at the ordinal or interval level for measuring TRTW is a valid and reliable method to measure TRTW soon after a planned medical event (Tilbury et al., 2014). This method is less prone to recall bias than continuous data, and it can be used to collect data with greater precision than dichotomous data. Furthermore, using categorical data can yield greater statistical power than dichotomous data while preserving much of the clinical significance of continuous data. Therefore, categorical data provides a feasible and scientifically rigorous method to measure TRTW.

Conceptual Underpinnings for the Study

A major limitation of the existing return to work literature following illness/injury is the lack of a unifying, comprehensive framework to guide research (Schultz et al., 2007).Variables that influence return to work following a work related injury/illness may

be different (particularly in terms of liability and planning) than variables that influence return to work following a planned medical event. Even less is known about TRTW following a planned medical event. Therefore, a conceptual framework explaining the relationship between planned medical event and TRTW is essential in developing this area of research.

In Chapter 2, a conceptual framework that explains the relationships between the worker with a planned medical event and TRTW (Figure 1) is presented. While the purpose of the proposed study is not to test this conceptual framework, the framework provided a theory-driven direction to identify research aims, hypotheses, and appropriate data analysis procedures

Key variables that help explain TRTW are characteristics of the worker (demographic, psychosocial, preoperative physical function, workplace variables), the type of planned medical event, postoperative function and pain, and postoperative workplace modifications. Briefly, the extant literature supports a relationship between age (Jones, Burney, Peterson, & Christy, 2001; Lunel et al., 2003), sex (Nunley et al., 2011; Styron, Barsoum, Smyth, & Singer, 2011), race and ethnicity (Blinder et al., 2012), medical comorbidities (Luyckx, Luyckx, Donceel, & Debeer, 2011), mental health (Jones et al., 2001; Zieger, Schwarz, Konig, Harter, & Riedel-Heller, 2010), marital status (Sultan, Slova, Thiel, & Lepor, 2006), pain catastrophizing (Cowan et al., 2012), and level of physical exertion at work (Bains, Yarker, Amir, Wynn, & Munir, 2012; Styron et al., 2011; Sultan et al., 2006) influence TRTW following a variety of health-related events. Furthermore, preoperative physical function has been shown to predict postoperative physical function after a planned medical event (Rolfson et al., 2011;

Styron et al., 2011), which is directly associated with the worker's ability to perform work-related tasks.

Although most of these variables can be readily measured with adequate precision, accuracy, and psychometric properties, the exact nature of their relationships with TRTW after a planned medical event first needs to be clarified to yield clinically meaningful information. For example, the level of physical exertion at work is often measured by the type of occupation (e.g. blue collar versus white collar). While this vernacular reflects the societal belief about one's occupational duties, it does not quantify, or even accurately describe, the level of physical activity the worker exerts at the workplace. In contrast, worker self-report of physical activity at work produces a more accurate measurement of this particular TRTW predictor.

An accurate definition of planned medical events must also be employed to produce a conceptual framework with clinical and scientific utility. Furthermore, because many types of health-related procedures could qualify as planned medical events (e.g. inguinal hernia repair (Jones et al., 2001), uterine artery embolization (Hehenkamp, Volkers, Birnie, Reekers, & Ankum, 2006), hysterectomy (Hehenkamp et al., 2006), carpal tunnel release surgery (De Kesel, Donceel, & De Smet, 2008), subacromial decompression (Luyckx et al., 2011), open radical retropubic prostatectomy (Sultan et al., 2006), hip joint resurfacing (Malek, Hashmi, & Holland, 2011), and joint replacements (Lyall, Ireland, & El-Zebdeh, 2009; Mobasheri et al., 2006; Styron et al., 2011), an initial focus on only one type of planned medical event – total knee replacement – was used in this study. This approach ensured that variability in TRTW will be *de facto* connected to variability in the predictor variables, instead of to the type of procedure itself.

All planned medical events are followed by pain as a result of the normal inflammatory response to the tissue injury occurring during surgery, which typically contributes to some loss of physical function during the postoperative period. As pain subsides, physical function should improve over time, making return to work possible. In fact, higher postoperative pain has been shown to delay TRTW when compared to workers with less pain (Hehenkamp et al., 2006; Styron et al., 2011). Furthermore, higher physical function was a significant predictor of faster TRTW (Bohm, 2010; Donceel & Du Bois, 1999; Katz et al., 2005). However, the relationship between postoperative pain or postoperative physical function and TRTW, particularly when able to statistically control for the psychological and workplace activity described above, has not been examined.

The use of workplace modifications, as a potential moderator in explaining the relationship between postoperative pain and physical function and TRTW, was considered in this model. Workers with modified workplaces have faster TRTW when compared to workplaces without modifications (Clayton & Verow, 2007b; Cowan et al., 2012; Malek et al., 2011). Workers can use individual workplace modifications to reduce the impact of a loss in postoperative physical function, which may facilitate a faster return to work after the planned medical event. For example, a worker with bunion removal surgery may return to work faster if given an additional chair upon which he or she can elevate the affected foot to perform seated tasks. Other examples of workplace modifications that may reduce TRTW include flexible scheduling to allow more convenient physical therapy appointments and availability of parking spaces close to the workplace entrance to reduce walking strain. This study would be the first to examine the

role of workplace modifications as a moderating variable to reduce TRTW after a total knee replacement.

In summary, a conceptual framework that relates a variety of potential predictors of TRTW following a planned medical event was be used to guide the design of the proposed study. This framework included variables unique to the worker, the planned medical event, the workplace, and postoperative factors related to recovery and physical function. Although each of these potential predictors have been carefully selected based on a thorough review of the current literature involving several different types of unplanned and planned medical events, their significance has not yet been examined in relation to TRTW following a planned medical event.

Problem Statement

Predicting TRTW after a planned medical event has been a challenge for workers, employers, and clinicians. Identifying factors that predict TRTW after a planned medical event will provide these stakeholders with the ability to develop an individualized plan to facilitate a shorter duration of work absence or more accurately predict the TRTW for individual patients. Despite the enormous social and economic scope of this issue, researchers have been slow to examine this phenomenon, but have been relatively more productive in examining a comparable phenomenon following work-related injury or illness. Although similar in many ways, there are many important differences between planned medical events and illness or injury, many of which affect the generalizability of study findings from one to the other. Therefore, TRTW following a planned medical event should be explored as a separate, but related, line of scientific inquiry than TRTW following an injury or illness.

Purpose of the Study

The purpose of this study was to determine preoperative predictors of TRTW following a unilateral TKR. The following specific aims and hypotheses were tested:

Aim 1: To examine the individual contributions of age, sex, comorbid conditions, race, ethnicity, education, income, social support, depression, anxiety, pain catastrophizing, preoperative physical function and pain, preoperative workplace activities and modifications, postoperative physical function and pain, and postoperative workplace modifications on predicting TRTW in patients undergoing TKR.

Aim 2: Describe the normal practice of TRTW among employed working adults following a unilateral TKR, including: perceived appropriateness of time to return to work, workplace modifications, and hours worked per week.

This study tested the following hypotheses: that adults at preoperative visit that (1) are younger, (2) male sex, (3) few comorbid conditions, (4) Caucasian, (5) have higher annual income and education, (6) better social support, (7) absence of depression, (8) less anxiety, (9) less tendency to catastrophize pain, (10) better physical function, (11) less pain, (12) less physically demanding work-related tasks, and (13) have workplace modifications *will have faster TRTW* following a TKR than those who are older, female sex, have several comorbid conditions, have a diverse racial/ethnic background, have low annual income and education, worse social support, depression, higher anxiety, more tendency to catastrophize pain, poor physical function, more pain, more physically demanding work-related tasks, and no workplace modifications.

Assumptions

This study was based on the following assumptions:

1. Workers want to return to work after a planned medical event.
2. Employers want workers to return to work following a planned medical event.
3. Workers are able to access and actively participate in a postoperative rehabilitation program, which includes: physical therapy, stretching, and exercises.
4. Workers with higher preoperative physical function experience higher physical function after surgery.

Conceptual Definitions of Key Terms

Clear conceptual definitions are essential to advance the field of research in Time to Return to Work following a Planned Medical Event. Listed below are the pertinent definitions of key terms for this research study.

Worker—A person who works, either part-time or full-time, that earns an income. For this research, characteristics of the worker was defined in terms of demographic, psychological, preoperative pain and physical function, and workplace variables. Worker's demographic makeup included: age, sex, comorbid conditions, race, ethnicity, employment, and income.

Age—The chronological age between an event and the time of birth.

Sex—The biological orientation the patient reports.

Comorbid conditions—Pathological condition/s that have been shown to adversely affect health.

Race/Ethnicity—A particular social group/s based on a common culture and/or lineage.

Employment—The worker's occupation.

Education—The worker's level of schooling in primary, high school or college.

Income—The worker's financial earnings derived from their employment.

Psychosocial characteristics of a worker include: social support, depression, anxiety, pain and pain catastrophizing.

Social Support—The feelings of social connectedness that a worker may report.

Depression—A clinical diagnosis that is defined by presence of either (1) depressed mood (sadness, crying, feeling empty, hopeless) or (2) loss or interest or pleasure in nearly all things plus four additional symptoms; (3) weight loss or change in appetite; (4) insomnia or hypersomnia; (5) psychomotor agitation or retardation; (6) fatigue, loss of energy; (7) feelings of worthlessness or inappropriate guilt; (8) difficulty concentrating, indecisiveness; and (9) recurrent thoughts of death or suicidal ideation. The symptoms occur nearly every day and persist for at least a two week period of time, and cause clinically significant distress or impairment in daily function" (American Psychiatric Association, 2000).

Anxiety—A state of general apprehensive uneasiness, or fear, that a worker may report.

Pain Catastrophizing—a set of exaggerated and ruminating negative thoughts and feelings during actual or perceived painful experience that a worker may report (Lueng, 2012).

Preoperative Pain—Preoperative pain is defined as the worker's perception of an unpleasant sensory and emotional experience related with actual or potential tissue damage prior to the planned medical event (Merskey & Bogduk, 1994).

Preoperative Physical Function—The worker's preoperative physical function is defined as the physical ability of the worker to perform activities of daily living before the planned medical event.

The characteristics of the worker's preoperative workplace include: activity, modifications, and benefits at work.

Activity at Work—The general physical movement of the body during work.

Preoperative Workplace Modifications—Preoperative workplace modifications are defined as an adjustment in the worker's work environment or role that would facilitate the worker remaining at work prior to the planned medical event.

Benefits at work—Preoperative workplace benefits are factors that are additional benefits (beyond an income) that effect the worker's time off work (i.e. insurance, paid time off, disability insurance, etc.).

Planned Medical Event—A planned medical event is a scheduled procedure with estimated pre-determined and non-emergent timeline, and follows a predictable recovery time. A planned medical event may vary in level of surgical complexity and planned recovery times. For the purposes of this research, an example of a planned medical event is a total knee replacement surgery and the start of the work absence.

Postoperative Physical Function—Postoperative physical function is defined as the physical ability of the worker to perform routine activities after a planned medical event.

Postoperative Pain—Closely related to postoperative physical function, postoperative pain is defined as the worker's perception of an unpleasant sensory and emotional experience related with actual or potential tissue damage after a planned medical event (Merskey & Bogduk, 1994).

Time to Return to Work—In order to understand TRTW, one must first define return to work. Return to work has been defined as a final outcome after an impairment of function, i.e. status of working or not working (Schultz et al., 2007). Return to work is conceptualized as an employee re-entering the workforce after an absence for any amount of time (i.e. less than a full day per week up to 5 days or more a week). Furthermore, *time* to return to work (TRTW) has been defined as the duration, or length of time, of an inability to work secondary to functional limitation (Schultz et al., 2007).

Postoperative Workplace Modifications—Postoperative workplace modifications are defined as an adjustment in the worker's work environment or role after the planned medical event that would facilitate the worker returning to work.

Summary

In summary, understanding which factors influence TRTW following a planned medical event is important to multiple stakeholders. In this study, several variables were tested for their effects on TRTW following a particular type of planned medical event: total knee replacement. This work is the first attempt to examine variables in the physical, psychological, social, cultural, and workplace domains as predictors of TRTW in this population. The information garnered from the proposed study is necessary for clinicians to develop patient-centered plans to facilitate short work absences following a planned medical event.

In the subsequent chapter, critical appraisal of existing studies to guide the development of a conceptual framework for TRTW following a planned medical event. In chapter three, a secondary data analysis is proposed to better understand TRTW using a total knee replacement as a representative sample of a planned medical event.

CHAPTER II

REVIEW OF THE LITERATURE

Planned Medical Event

A planned medical event is a health-related procedure with estimated or known start and end times. This allows the person undergoing the planned medical event to arrange or negotiate post-event commitments before the event occurs. These events include a wide variety of procedures and health related life events, such as elective surgery (e.g. carpal tunnel release surgery, hysterectomy), invasive procedures (e.g. colonoscopy, hernia repair), and major surgery (e.g. total joint replacements, cardiac surgery, cancer removal surgery, lumbar disc surgery, organ or tissue transplant). Before the planned medical event occurs, the worker, employer, and healthcare provider can develop a plan to return to work in a timely manner.

In contrast, an unplanned medical event is one in which the event occurs suddenly or without warning. When an unplanned medical event occurs, the worker, employer, and clinician cannot coordinate a plan to return to work before the event occurs. Because unplanned medical events are typically more complex than planned medical events, they have received greater attention from the scientific and political communities. Compared to planned medical events, more is now understood regarding the experiences of those recovering from an unplanned medical event, as well as characteristics that facilitate a more rapid return to work. However, in exploring unplanned medical events, our understanding of return to work after a planned medical event has been relatively slow to develop. As the average age of the American population increases, and the overall health status of many Americans declines due to obesity, hypertension, and a variety of other

factors, workers with chronic health conditions are more commonly found in the workplace than they were in the past. Over time, workers with chronic health conditions, including coronary artery disease, diabetes mellitus, and osteoarthritis, may require some type of planned medical event to manage the complications of these conditions.

Because planned medical events are becoming more common among aging workers, the need for a greater understanding of characteristics that facilitate a more timely return to work after a planned medical event is more important than it has been in the past. Once known, clinicians can partner with workers, employers, and policymakers on strategies to more effectively coordinate the return to work after a planned medical event through optimization of patient-specific predictive factors, enhancement of postoperative work-related physical function, or more accurately predict TRTW so that appropriate plans can be made by both the employee and employer.

This chapter provides an overview of the existing literature about return to work following a planned medical event and propose a conceptual framework to describe predictors of time to return to work.

Variables

This section discusses TRTW as an outcome following a planned medical event, compare and contrast strategies to measure TRTW, and describe independent variables that can be measured as predictors of TRTW.

Dependent Variable: Time to Return to Work

Measurement

TRTW have been measured in the following ways: 1) dichotomously as a yes/no variable at time of assessment; 2) continuously by recall of exact number of days/weeks

since surgery; and 3) categorically by recalling a time interval category. Each type of TRTW measurement is discussed in this section.

Dichotomous Variable

Return to work following a planned medical event has been measured as a dichotomous variable (i.e. yes/no response) by asking if the worker has returned to work at the time of assessment. This time of assessment is often arbitrary or determined by routine clinic visits following the event and ranges from as little as 2 weeks to as long as 10 years after a planned medical event (Bains et al., 2012; Davoodi, Sheikhvatan, Karimi, Hossein Ahmadi, & Sheikhfathollahi, 2010; Gimeno, Amick, Habeck, Ossmann, & Katz, 2005; Graver et al., 1998; Johnsson, Fornander, Rutqvist, & Olsson, 2010; Lubowitz, Ayala, & Appleby, 2008; Mallick, Clarke, Wilson, & Newey, 2009; Parot-Schinkel et al., 2011; Sultan et al., 2006; Svendsen et al., 2012; White-Williams, Wang, Rybarczyk, & Grady, 2011). This method measures whether or not someone returned to work at an arbitrary time point, not how long it took for the worker to return to work following a planned medical event. While this may be a convenient way to measure this variable, it is not specifically measuring time to return to work. Therefore this method lacks construct validity when measuring TRTW, and future research should forgo the use of arbitrary time points after a planned medical event to assess TRTW following planned medical events.

Continuous Variable

TRTW following a planned medical event has been measured by asking the worker to recall the exact date he/she returned to work after the event. TRTW is then calculated from the date of the planned medical event to the first day of work (i.e. number

of days/weeks). A continuous TRTW variable has a major statistical advantage of increasing power. However, there is a potential for a significant amount of recall bias especially when the exact TRTW was gathered several months (or years) after the medical event. Recall of an exact date of return to work has been collected at various time points as little as 3 months to as many as 10 years following a planned medical event (Atroshi, Johnsson, & Ornstein, 1998; Dietz, van der Vaart, van der Graaf, Heintz, & Schraffordt Koops, 2010; Donceel & Du Bois, 1999; Hansen, Dalsgaard, Meldgaard, & Larsen, 2009; Mobasheri et al., 2006; Sharp & Timmons, 2011; Soejima, Steptoe, Nozoe, & Tei, 1999). Variation in the length of follow-up time when collecting TRTW can influence the validity of the data (i.e. not remembering the exact date correctly) and influences the reliability of the data (i.e. variation in TRTW due to the different spans of time when the question is asked). This lack of accuracy in measurement of TRTW has been seen when examining data from joint replacements. For example, TRTW following THR has been determined to be an average of 6.5 weeks when asked 6 months after the surgery (Peak et al., 2005), 3 weeks when asked approximately 20 months following the event (Tanavalee et al., 2006), and 10.5 weeks when asked around 3 years following the event (Mobasheri et al., 2006). Median TRTW after total knee replacement was 8.9 weeks when asked 3 months following surgery (Styron et al., 2011) versus 12 weeks when asked around 41 months following surgery (Foote, Smith, Jonas, Greenwood, & Weale, 2010). When TRTW is measured closer to the planned medical event, the value is more accurate (Coolbrandt et al., 2011). In conclusion, TRTW measurement has a great deal of variability and is not accurate when measured years after the event. Future research should measure TRTW following a planned medical event as near as possible to

the actual return date (at 6 months vs. 3 years following surgery) to reduce recall bias and variability in this self-reported variable.

Categorical Variable

Research indicates using categorical data instead of continuous data is a valid and reliable way to measure highly variable self-reported data (i.e. body weight and dates of menstrual cycles) (Bachand, Cragin, & Reif, 2009; Han, Storr, & Trinkoff, 2012). While no studies have used this method to measure TRTW, using a categorical approach has been used in nursing research with much success. Nursing phenomena when measured as categorical variables with reliability, validity, and discriminatory power comparable to, or better than, measurement as continuous variables (Blum & Korner-Bitensky, 2008; Herr, Spratt, Mobily, & Richardson, 2004; Luffy & Grove, 2003; Phan et al., 2012; Tarrasch, Laudon, & Zisapel, 2003; Toledano & Pfaus, 2006) including pain, physical functional status, overall perceived health, quality of life, and patient satisfaction. Since psychometric properties of assessment tools that measure continuous data are not necessarily better than those that measure categorical data, the decision of which type of data to collect becomes a matter of feasibility and respondent preference.

Koskey, Sondergeld, Beltyukova, & Fox (2013) reported that research participants preferred categorical rating systems compared to continuous rating systems, indicating that use of a categorical rating system may lead to higher survey response rates. Therefore, a survey item with no more than 7 categorical time periods was used to assess TRTW following a planned medical event in the proposed study. Workers would be able to select their TRTW interval from a range of possibilities, such as: less than 5 weeks, at 6 weeks, 7 to 9 weeks, 10 to 12 weeks, 13 to 15 weeks, more than 16 weeks, or

have not returned to work. Therefore, TRTW collected shortly after actual return to work date and using a categorical range of possibilities for TRTW would provide more accurate and consistent data that will best reflect true TRTW. This allows future research to explore potential predictors of TRTW following a planned medical event such as TKR.

According to a recent systematic review, little is known about TRTW following a joint replacement (Kuijer et al., 2009). Of the three studies included in the review, only one study focused on the beneficial or limiting factors affecting time to return to work after a TKR. More recently, there have been three articles published (Foote et al., 2010; Lyall et al., 2009; Styron et al., 2011) looking at various predictors of TRTW following a TKR. Since little is known about TRTW following a TKR, this researcher broadened the search strategy to include TRTW following all planned medical events only TRTW is presented for planned medical events to provide an accurate description of variables that influence return to work.

Independent Variables: Characteristics of the Worker

Demographics

Age

There is mixed evidence among research studies regarding whether or not age is a potential predictor of TRTW. Age was not a predictor of TRTW inpatients under 60 years; 96% of patients < 60 years who were working prior to surgery returned to work by 10.5 weeks following a THR (Mobasheri et al., 2006) and 97.5% of patients < 60 years returned to work by 10 weeks after a TKR (Lyall et al., 2009). However, Lunel et al. (2003) found that patients over 50 years of age took longer to return to work than those under 50 years of age following a cardiac valvular surgery ($p < 0.02$). Likewise, when

participants over 60 years of age were included, Sultan (2006) found that the time to return to work following a prostatectomy decreased by 0.64 days for each one-year increase in age. These authors proposed that the older men in this sample returned to work faster than the younger men because older men are employed at jobs that require less physical activity, and are therefore less likely to require extended physical recovery. These surprising results built upon similar results by Jones et al., (2001) that found a slightly faster return to work (0.2 days) for each one-year increase in age among those recovering from inguinal hernia repair.

These findings support the hypotheses that age may not be a significant predictor of TRTW, and that older people who tend to work at less physically demanding jobs, which is less a function of age and more directly affected by activities at work, may return to work faster than younger workers who tend to have more physically demanding jobs.

Sex

There is also mixed evidence on whether or not sex is a predictor of TRTW following planned medical events. Women were more likely to have delayed TRTW following a carpal tunnel surgery (Carmona, Faucett, Blanc, & Yelin, 1998) (RR0.5 (95%CI 0.3-0.8); and THR (Nunley et al., 2011), p=0.0295; (Mobasheri et al., 2006); 25 weeks vs 12 weeks) then men. Moreover, women worked fewer hours (p=0.0001), and reported more difficulty than men performing work activities after a THR (Nunley et al., 2011).

However, Styron (2011) showed that women returned to work faster than men after TKR, though these results did not reach statistical significance. The authors

attributed this difference to women in their sample returning to less physically demanding jobs than men.

Given these contradictory findings, sex may not necessarily have a causal effect on TRTW following a planned medical event. Rather, differences in activities at work, which may or may not be sex-based, are ultimately responsible for TRTW.

Comorbid Conditions

Cormorbid conditions have some influence on TRTW following planned medical events. Longer TRTW was observed in obese individuals (i.e. those with higher body mass indexes) following arthroscopic subacromial decompression (Luyckx et al., 2011). Furthermore, patients that had a decrease in comorbid conditions following gastric bypass surgery were more likely to return to work ($p=0.001$) than those who did not have a reversal of comorbid conditions (Wagner, Fabry, & Thirlby, 2007). Based on this limited but consistent evidence, one can hypothesize that the more co-morbid conditions a patient has, the longer their TWTR. This unique relationship of comorbid conditions and TRTW needs to be further explored to determine the strength and magnitude of comorbid conditions on activity at work and TRTW.

Race/Ethnicity

The direct relationship between race, ethnicity, and TRTW following a planned medical event has not been explored. However, there is a possible interaction between race, ethnicity, type of employment and TRTW based on evidence that Latina women manual laborers were less likely than non-Latina women in other occupations to be working at 6 months and 18 months following breast cancer diagnosis (Blinder et al., 2012). The hypothesis that race and ethnicity are predictors of type of employment,

which may then influence TRTW following a planned medical event, may be helpful in designing future occupational health interventions targeted at racial sub-groups within specific occupations. Due to this potential interaction, the type of employment, rather than race and ethnicity, may be a more direct predictor of TRTW following a planned medical event.

Education/Income

Like race and ethnicity, education may be a predictor of TRTW following a planned medical event based on the relationship between educational level and activity at work. Furthermore, income may influence the urgency with which a worker returns to employment after a planned medical event. For example, workers with a low income may experience a stronger urge to return to work than someone with a high income because those with a low income often have less financial reserve than those with a high income. Since education is a major determinant of income, these two variables may interact to influence TRTW. Those with higher education tend to have non-laborer positions, which allows for greater flexibility in work related activities, and those with non-laborer positions tend to have a higher income. Jones et al. (2001) found that educational attainment, income, and occupation, when combined with other variables, accounted for 61% of the variation in actual time to return to work following a hernia repair surgery. Type of employment may be a stronger and more direct predictor of TRTW than education, though income may be an even more direct predictor of TRTW than either type of employment or educational level. Therefore, it is important to consider education, income as a direct predictor of TRTW following a planned medical event.

Psychosocial

Social Support

The degree of social support a person has may also influence the amount of time workers stay off work. Sultan et al. (2006) found that married men (i.e. higher social support) have faster TRTW than unmarried men following a radical retropubic prostatectomy. These authors suggested the rationale for this finding was due to the financial needs of the family. Because the American family, and therefore marital status, is defined in myriad ways (e.g. married with children, married without children, single with children, widowed with children, single without children, widowed without children, etc.), the relationship between marital status and TRTW after a planned medical event cannot be interpreted without also considering the adequacy of additional incomes and the number of dependents in the family.

One can hypothesize that the income of a married person with dependents is used to support one or more dependents, whereas the income of an unmarried person without dependents is allocated to himself or herself. Therefore, the unmarried person would essentially have a higher financial reserve than the married person because the unmarried person would not use his or her income to provide for his or her dependents. Following this logic, the married person would have more urgency to return to work and would therefore return to work faster than the unmarried person. In contrast, an unmarried person *with* dependents and only one income may have more urgency to return to work after a planned medical event than a married person *without* dependents (e.g. spouse provided a second income source). Therefore, marital status may be an important predictor of TRTW after a planned medical event.

Depression

Since return to work is at least partially dependent upon motivation, and motivation is often decreased in those with depression, it is reasonable to hypothesize that depression may delay TRTW following a planned medical event. Researchers have confirmed this hypothesis in patients who have had a variety of health events, including: disc herniation surgery (Donceel & Du Bois, 1999), acute coronary syndrome (Fukuoka et al., 2009), inguinal hernia repair (Jones et al., 2001), a mental health crisis (Nielsen et al., 2011), long-term sickness absence (Vlasveld et al., 2012), and cardiac transplantation (White-Williams et al., 2011). This has not been confirmed following TKR.

The prevalence of depression among working-age adults, as well as adolescents, who will soon be entering the workforce, has been increasing over the past several decades (Marcus & Olfson, 2010). If depression is found to be a predictor of TRTW following TKR, it would be important to develop effective interventions for depression management and to facilitate return to work in this population.

Anxiety

Anxiety is a potential predictor of TRTW following a planned medical event. Cowan et al. (2012) found high levels of anxiety were associated with delayed return to work after carpal tunnel release surgery for desk workers. In a recent systematic review, high levels of anxiety were found to delay TRTW in patients undergoing herniated disc surgery (Zieger et al., 2010). However, there is no evidence that high levels of anxiety interfere with motivation to return to work following a TKR.

Conversely, anxiety may also increase the likelihood for a worker to return to work quickly. For example, if a worker is worried about who is covering their job duties

while they are off of work (i.e. no one to fill in for them) they may be more anxious for their early return to work. High levels of anxiety, particularly after a planned medical event, may either impair or hasten the workers TRTW. Therefore, anxiety affects motivation to return to work and anxiety should be included as a potential predictor of TRTW following a planned medical event.

Pain Catastrophizing

Pain catastrophizing is another potential predictor of TRTW following a planned medical event. Cowan and colleagues (2012) found high pain catastrophizing was associated with return to modified duty among workers after carpal tunnel release, but not to return to full work. This research indicates the role of pain catastrophizing may influence the TRTW in the early period following a planned medical event when workplace modifications are necessary. For example, those with higher pain catastrophizing may be more likely to inhibit their movements after a planned medical event and delay recovery times. Therefore, having high pain catastrophizing would potentially delay TRTW following a TKR and should be included as a potential predictor.

Preoperative Factors

Preoperative Physical Function

Preoperative physical function, or baseline physical function, is a predictor of postoperative physical function (Rolfson et al., 2011; Styron et al., 2011). This relationship indicates that those workers with better preoperative physical function would have better postoperative function and likely return to work sooner than those with worse preoperative physical function following a planned medical event.

Better preoperative physical function has predicted return to work following planned medical events (Styron et al., 2011) but its influence on the amount of time it takes to return to work has not been studied. Therefore, disease-specific measurements of perceived preoperative physical function may be potential predictors of TRTW after a planned medical event and should be included in future research.

Preoperative Pain

Preoperative pain, or baseline pain, is a predictor of postoperative pain (Schneider, Bassi, & Ryan, 2011). Patients with more pain preoperatively had a slower TRTW at three months following TKR (Styron et al., 2011). Other studies have shown similar effects on pain and TRTW suggesting that these variables are correlated (Lydell, Grahn, Mansson, Baigi, & Marklund, 2009; Schneider, Bassi, & Ryan, 2011). One could hypothesize that preoperative pain directly influences the ability to physically perform a task. Those patients may modify the physical task, avoid the task, or ask for help in completing the physical task. Those patients with more pain preoperatively (will likely have more pain postoperatively) and will take longer to return to work following a planned medical event than those with less preoperative pain. Therefore, preoperative pain should be included as a potential predictor of TRTW following a planned medical event.

Characteristics of the Workplace

Benefits at Work

Worker benefits refer to a collection of non-income compensation options for beyond their income which includes, but not limited to: health insurance, vision insurance, prescription coverage, disability insurance, vacation time, and paid time off,

among others. Collecting data about utilization of these types of worker benefits seems to be a logical contributing factor but, to date, there is insufficient research to confirm their importance in TRTW following a planned medical event. Theoretically, benefit-eligible employees earn a certain number paid time off hours for every hour that they have worked. When planning for a medical event, the worker will often confirm the accumulated number of sick leave hours they have with their employer's human resource department and may choose to schedule the medical event to maximize utilization of paid time off hours for their recovery. Therefore, workplace benefits may be theoretically plausible to help explain TRTW following a planned medical event; however, little is known about these processes and exploration of these worker benefits is beyond the scope of this dissertation.

Activity at Work and Essential Job Functions

Activity at work, or the amount of general physical movement at work, is largely driven by the employee's essential job functions and has a strong and direct relationship with TRTW following a planned medical event. Manual labor requires a large amount of strenuous activity and may delay TRTW. For example, being a manual laborer delayed TRTW after curative treatment for colorectal cancer (Bains et al., 2012), subacromial decompression surgery (Luyckx et al., 2011), open radical retropubic prostatectomy (Sultan et al., 2006), carpal tunnel release surgery (De Kesel et al., 2008; Parot-Schinkel et al., 2011) inguinal hernia repair (Jones et al., 2001) and breast cancer removal surgery (Blinder et al., 2012). More physically demanding jobs were also predictive of a slower return to part-time work, three months following a TKR (Styron et al., 2011). In contrast, patients with desk-based jobs had faster TRTW than patients with non-desk based jobs

(an average 9.5 days vs. 29.5 days) following carpal tunnel release surgery (Cowan et al., 2012). It is clear that workers with physically demanding jobs, traditionally blue-collar or manual laborers, are likely to have delayed TRTW. Therefore, this variable should be included as a potential predictor of TRTW following a planned medical event.

Preoperative Workplace Modifications

Preoperative workplace modifications facilitate remaining at work while awaiting a planned medical event. The use of preoperative workplace modifications is based on the job requirements of the worker and the type of upcoming planned medical event. There are preoperative workplace modifications that can be achieved at little or no cost to help the worker remain at work prior to a planned medical event such as: parking closer to work, taking breaks to stretch/sit/stand, coming in later to work to allow for preoperative appointments, shorter workdays, and temporary job re-assignment. However, it is unknown if preoperative workplace modifications are utilized in workers with painful knee osteoarthritis while awaiting surgery for a TKR. More research is needed to identify specific types of preoperative modifications that are utilized and expand on the theoretical relationship between preoperative work modifications and TRTW following a planned medical event.

Employer

Employer Participation

Employers may have an important impact on the worker's TRTW after a planned medical event. The employer could decide to terminate a worker, modify job duties, or extend the TRTW after a planned medical if the worker cannot perform the essential job functions. Employer participation in TRTW following a planned medical event has not

been explored in the literature. However, because this dissertation focused on personal, but not work-related, predictors of TRTW following a planned medical event, exploring the contribution of employer participation to return-to-work is beyond the scope of this project.

Characteristics of the Planned Medical Event

Planned Medical Event

The type of planned medical event, or type of surgery, can have a large impact on TRTW. For example, patients returned to work significantly faster following a minor uterine artery embolization than a major hysterectomy (28.1 days vs. 63.4 days; $p<0.001$; (Hehenkamp et al., 2006). Likewise, patients having the more minor procedure of sacropsinous hysteropexy surgery returned to work significantly faster than patients having the major surgery of vaginal hysterectomy (43 vs. 66 days; $p=0.02$) (Dietz et al., 2010). The less invasive, laparoscopic-assisted vaginal hysterectomy patients had faster TRTW and significantly fewer complications than both total vaginal and abdominal hysterectomy patients (Lenihan, Kovanda, & Cammarano, 2004).

Differences in approach within surgical procedures performed for the same purpose also influence TRTW. Among joint replacements, the two-incision THR group had significantly faster TRTW than the mini-posterior THR approach (an average of 3 weeks vs. 7 weeks, respectively) (Tanavalee et al., 2006). The authors suggest that this difference in TRTW may be due to the fact that the mini-posterior approach had more restrictions in post-operative movement and the two-incision group did not have movement restrictions. In contrast, De Kesel et al. (2008) found that surgical factors were not related to TRTW after two types of carpal tunnel release surgery (open vs.

endoscopic). This may be due to a recall bias in the accuracy of TRTW since data collection occurred 2-17 months after the surgery. Therefore, the type of surgical procedure is an important variable to consider when determining predictors of TRTW and will likely influence the amount of time required for recovery before work is possible.

Postoperative Pain

Pain, especially pain experienced during recovery activities and/or functional tasks, has been shown to predict TRTW following planned medical events. For example, women undergoing uterine artery emobilization had significantly less pain during the first 24 hours after surgery and returned significantly sooner to work (28.1 days vs. 63.4 days; $p<0.001$) than hysterectomy patients (Hehenkamp et al., 2006). Patients with more pain preoperatively had a slower TRTW at three months following TKR (Styron et al., 2011). Other studies have shown similar effects on pain and TRTW suggesting that these variables are correlated (Lydell, Grahn, Mansson, Baigi, & Marklund, 2009; Schneider, Bassi, & Ryan, 2011). One could hypothesize that pain directly influences physical function and those patients with more pain postoperatively will take longer to return to work following a planned medical event.

Postoperative Physical Function

A change in physical function following the planned medical event also has a major and direct impact on TRTW following planned medical events. Physical function influences the ability to complete activities of daily living and improved physical function has been related to return to work. To date, studies have only evaluated the effect of physical function on whether or not an individual returns to work following a planned medical event, not the amount of time it takes to return to work. Higher physical

functioning following the planned medical event was a significant predictor of return to work after carpal tunnel release surgery (Katz et al., 2005), lumbar disc surgery (Donceel & Du Bois, 1999; R=0.221), and renal transplantation (Raiz & Monroe, 2007). Furthermore, higher perceived physical function was a predictor of whether or not a worker returned to work by three months after a TKR (on the WOMAC subscale) (Styron et al., 2011). The same is true for patients who return to work one year after total joint replacement, they reported better physical function than those who did not RTW (Bohm, 2010). In summary, better physical function predicts return to work following planned medical events but its influence on the amount of time it takes to return to work has not been studied. Therefore, disease-specific measurements of perceived physical function may be potential predictors of TRTW after a planned medical event and should be included in future research.

Postoperative Workplace Modifications

Theoretically, if a job requires certain physical tasks that the worker is unable to perform, any change at the workplace that makes these tasks manageable may shorten TRTW. Some evidence exists to support this theory; for example, workers with a modified workplace had faster TRTW compared to workers with normal work duty (mean 11.8 days versus 18.9 days) following carpal tunnel wrist surgery (Cowan et al., 2012). Temporary work restrictions are common before and after joint replacements and post-operative workplace modifications help make early TRTW possible; for example, 26% of patients following joint replacement (n=714) used workplace modifications to return to work faster (Nunley et al., 2011). Temporary workplace modifications have been used to return to work after hip resurfacing procedures (Clayton & Verow, 2007b;

Malek et al., 2011); however, actual TRTW with modifications was not reported. Presence of a handicap accessible workplace was also a predictor of return to work three months following a TKR (Styron et al., 2011). This is not surprising as the very nature of handicap accessibility is making the workplace universally accessible for everyone.

Unfortunately, little is known about what specific types of workplace modifications following a planned medical event were used to facilitate TRTW (Clayton & Verow, 2007b; Malek et al., 2011; Nunley et al., 2011; Styron et al., 2011) beyond the American Disability Association regulations. There are postoperative workplace modifications that can be achieved at little or no cost to help the recovering worker return to work after a planned medical event such as: parking closer to work, taking breaks to stretch/sit/stand, coming in later to work to allow for physical therapy appointments, shorter workdays, and temporary job re-assignment. Theoretically, the types of workplace modifications would be largely based on the type of planned medical event and the individual needs of the worker. For example, a desk-based worker recovering from a carpal tunnel release surgery will likely have modifications to computer based work-tasks; whereas, a desk-based worker had a TKR then modifications would need to be made to rest the affected leg (elevating the leg while working, shorter walking distances). Therefore, workplace modifications produces a mediating relationship between postoperative pain/physical function and TRTW after a planned medical event but more research is needed to identify specific types of modifications at work that workers have made and expand on the relationship between work modifications and TRTW following a planned medical event.

Perceived Appropriateness of TRTW

The worker's perception of whether or not they returned to work too quickly or too slowly is a potentially important factor for understanding why TRTW varies from worker to worker. The concerns underlying the perceptions, whether physical or psychosocial, may present risk factors beyond those present in this study and conceptual framework, and would serve to further enrich our understanding of potential barriers and timely return to work after a planned medical event.

Summary of Variables

In summary, several characteristics of the worker, workplace, and the planned medical event have been shown to affect TRTW. These characteristics were measured as variables that prevent or promote, either independently or interactively, TRTW. To identify appropriate measurement strategies, the conceptual basis for TRTW as it relates to these variables requires further examination.

Conceptual Frameworks

Research to date has focused on theoretical models for return to work as it relates to an injury/illness. It is theoretically important to utilize existing key concepts of return to work to develop a more comprehensive understanding of the components of TRTW following a planned medical event. In this section, these concepts and their relationships to TRTW were analyzed in the context of existing conceptual frameworks, and a new conceptual framework to relate these concepts to TRTW is proposed.

Existing Return to Work Conceptual Frameworks

There are six types of return to work models after an unplanned medical event that have been described in the literature, with underpinnings in biomedical,

psychological, forensic, ecological/case management, economic and biopsychosocial perspectives that are useful in understanding TRTW (Schultz et al., 2007). These models typically focus on a system, individual, or a system-individual interaction perspective to return to work. This is important because return to work after an illness or injury models focuses on understanding both the individual and systems involved and TRTW after a planned medical event takes a more scripted approach.

The conceptualization of return to work, both in research and practice, varies widely and depends on the return to work stakeholder (Franche & Krause, 2002; Krause, Frank, Dasinger, Sullivan, & Sinclair, 2001; Schultz et al., 2007; Sullivan, Rodgers, & Kirsch, 2001; Young, 2006). Key determinants of return to work after an injury/illness have been established as medical impairments (medical model), psychological factors (psychological model), objective proof of impairment (forensic model), return to work policy/practices (ecological/case management model), economic (economic model), and the interaction among medical, psychological, and system-based factors in return to work (biopsychosocial model) (Schultz et al., 2007). For example, physicians, nurses and physical therapists may be particularly interested in whether or not the worker can perform work-related functional tasks, while an employer, economist, or policymaker may be more interested in the duration of work absence, and therefore the loss in productivity. As a discipline with a holistic perspective of health, occupational health nurses also may be interested in these aspects of return to work, as well as the worker's level of satisfaction with return to work status, the impact of return to work status on social relationships, psychological well-being, and the extent to which the worker and employer work together to facilitate return to work (American Association of

Occupational Health Nurses, 2012). In the future, understanding variables that influence TRTW following a planned medical event is important to several stakeholder groups, including employees, employers, federal agencies, and occupational health specialty organizations.

TRTW following a planned medical event is an area of science that has received relatively little theoretical or conceptual consideration. Planned medical events occur, by definition, according to a roughly pre-determined and non-emergent timeline, whereas illness and injury generally occur spontaneously and without prior worker or employer knowledge of their occurrence. Therefore, key determinants of time to return to work after a planned medical event include: the type of planned medical event, physical function, workplace environment, and characteristics of the worker; rather than workmen's compensation, illness or injury issues, or any liability of the employer that would be associated with a work related illness or injury.

Proposed Framework

Based on a comprehensive review of the literature, a novel conceptual framework for TRTW after a planned medical event was developed (Figure 1). This model blends the ecological and biopsychosocial perspectives into one that is unique to occupational health nursing, and it further incorporates elements of epidemiology and health promotion to more comprehensively examine the factors that may predict TRTW following a planned medical event.

Prior to the planned medical event, several of the worker's demographic characteristics (age, sex, comorbid conditions, race/ethnicity, and education/income), psychosocial characteristics (social support, depression, anxiety, pain catastrophizing),

functional characteristics, (preoperative), and workplace characteristics (activity and benefits) may directly influence recovery after a planned medical event. For example, age, sex, comorbid conditions, race/ethnicity, and education/income may predispose a worker to certain opportunities for less (or more) physically active jobs prior to the planned medical event. A worker's psychosocial characteristics (social support, depression, anxiety, and pain catastrophizing) before the planned medical event may affect postoperative pain and physical function, through motivation to return to work immediately after the planned medical event. A worker's preoperative physical function will influence the postoperative physical function, as those who are more active before a planned medical event will likely be more active after a planned medical event. A worker's ability to complete prior workplace activities may be either directly related to postoperative physical function, or related indirectly with workplace modifications acting as a mediating variable. A worker with postoperative pain may have a transition period before returning to work in which pain interferes with physical function, but as it dissipates, physical function improves above that at baseline, and the worker can return to regular workplace activities. These examples illustrate the utility of a conceptual framework that has a nursing perspective over ones that have perspectives that are purely biomedical, epidemiological, or even biopsychosocial. Through blending these and other perspectives with values such as health promotion and functional enhancement, which are values inherent to the nursing profession, a more comprehensive conceptual framework can be used to understand predictors of TRTW following a planned medical event.

Application of the Proposed Conceptual Framework

In this section, total knee replacement surgery was used as an example of a planned medical event to illustrate the use of the proposed conceptual framework to examine predictors of TRTW following a planned medical event.

Description of a Total Knee Replacement

Total knee replacement surgeries are common in the United States, accounting for more than half of all joint replacement surgeries performed each year. Approximately 773,000 joint replacement surgeries are performed in the United States each year and roughly 500,000 are knee replacement surgeries (Losina et al., 2009; Mittleman et al., 2010). Furthermore, the number of knee replacement surgeries for women and men, ages 45 to 64, has more than doubled from 1997 to 2009 (AHRQ, 2011). Total knee replacement is an indicated treatment for degenerative diseases of the knee joint, such as osteoarthritis.

Osteoarthritis is a chronic, progressive inflammatory condition of synovial joints. In weight-bearing synovial joints, including the knee, articular cartilage and its surrounding extracellular matrix form a lining over bone that absorbs and cushions the force of bone-on-bone impact and reduces friction with joint movement. When these tissues are damaged due to repetitive and/or excessive pressure, their ability to regenerate is impaired, and they are no longer capable of adequately protecting bone tissue within the joint. Direct bone-on-bone contact results in extensive damage to the bone and surrounding tissues, including the formation of osteophytes, vascular congestion in the subchondral bone, periarticular muscle fatigue, joint effusion, and synovitis (Kumar, Abbas, Fausto, & Mitchell, 2007). Manifestations of osteoarthritis include joint pain,

stiffness, and impairment of joint function. This disease is managed with analgesic medications, physical therapy, non-pharmacologic pain reduction strategies (e.g. cold application, TENS), and lifestyle modifications (e.g. weight reduction). In those with severe joint pain or functional impairment, surgical joint replacement may be indicated.

Total knee replacement surgery involves the removal of unhealthy bone and soft tissue from the knee joint, and the replacement of these tissues with synthetic materials designed to mimic normal joint function. This procedure is, by definition, invasive, and it often requires mechanical displacement of healthy surrounding tissues in order to visualize and repair the unhealthy tissue. This leads to injury of skin, blood vessels, nerves, fascia, and various connective tissues (e.g. ligaments). The mechanically disruptive nature of all types of surgery results in some degree of soft tissue trauma and a localized inflammatory response. Post-operative inflammation may manifest as pain, edema, decreased function, erythema, and warmth (Meneghini & Hanssen, 2008). Although the inflammatory process is necessary for post-operative tissue repair, many of these signs and symptoms, in particular pain, can be distressing and may become a barrier to returning to work.

Application of the Proposed Framework to Total Knee Replacement Surgery

Preoperative factors, such as age, sex, comorbid conditions, race, ethnicity, education, income, social support, depression, anxiety, pain catastrophizing, physical function, and workplace activities, have not been examined as predictors of TRTW following a TKR. Therefore, the extent to which these factors predict TRTW following a TKR is not known, although it is reasonable to expect that their relationship with TRTW

following a TKR is similar to TRTW following the planned medical events described in earlier sections of this chapter.

Because a total knee replacement is rarely performed urgently or emergently, most patients who undergo knee replacement surgery have the opportunity to plan in advance for work absence and post-operative rehabilitation needs. Therefore, TKR is an appropriate example of a planned medical event. During the TKR, a variety of surgical approaches can be used, and, in contrast to the THR and other surgeries described previously in this chapter, the surgical approach used during TKR can affect TRTW. (Foote et al., 2010) found that TRTW after patellofemoral joint replacement averaged 20 weeks (range 6-32 weeks) versus total knee replacement that averaged 12 weeks (range 4-52 weeks) and unicompartmental knee replacement that averaged 11 weeks (range 0-24 weeks) ($p=0.01$) (Foote et al., 2010). While these differences in TRTW may be due to variations in tissue damage sustained during the different surgical approaches, they may also be due to unmeasured variables during the preoperative or postoperative period or variations in the length of follow-up time in this study (in some cases up to 5 years postoperatively).

Although having the ability to plan ahead for a TKR can facilitate mutual understanding between the employee undergoing surgery and their employer about how and when post-operative return to work will occur, unforeseen physical, psychological, sociocultural, and financial factors during the postoperative period, as well as complications during the TKR procedure itself, may cause substantial changes in this plan. Nevertheless, these same unforeseen complications can occur during or following the other types of planned medical events described previously in this chapter, so it

would be reasonable to expect their impact on TRTW to be similar between TKR and other types of planned medical events.

Postoperative recovery from knee replacement surgery is a complex and somewhat unpredictable process. Similar to many other surgical procedures, the postoperative period focuses on the treatment of incisional pain, prevention of postoperative complications, and initiation of therapeutic exercises. As the patient transitions to later stages of rehabilitation, longer-term priorities are established, which may include returning to work, achieving a certain level of knee function, or maintaining knee pain below a certain level of intensity. While the healthcare provider typically provides the worker with recommendations about TRTW, research has found that these recommendations are often not followed (Clayton & Verow, 2007a).

The approximate TRTW following a TKR has been identified as 8 to 12 weeks (Foote et al., 2010; Lyall et al., 2009; Styron et al., 2011), although the samples in each study had a wide range, from 4 weeks to 52 weeks. The TRTW was similar with other types of health-related work absences, ranging from 2 weeks to greater than 12 weeks (Clayton & Verow, 2007b). While variation in reported TRTW following TKR may be attributable to error in measurement, recall bias, or other sources of nonrandom study bias, it is clear that more information using robust measurement strategies is necessary to predict TRTW following a TKR. Following a total hip replacement, workers returned to work significantly faster when they were allowed unrestricted movement compared to workers who were told to restrict movement (6.5 weeks and 9.5 weeks, respectively; $p<0.001$) (Peak et al., 2005). Furthermore, this plan can be highly variable depending on many factors, including postoperative complications, unrelieved pain, medical or

psychological comorbidities, and advice from healthcare providers, although this has only recently been addressed in the literature.

In summary, the variables and relationships described in the proposed conceptual framework are applicable to describe, explain, and predict TRTW following a TKR. While there may certainly be additional variables that are not depicted in the framework, it encompasses all known variables that have shown to be important predictors of TRTW in other types of planned medical events. Furthermore, its holistic perspective allows for future expansion based on research findings from a wide variety of disciplines, including nursing, medicine, public health, dentistry, and others. Therefore, this proposed framework was used to guide the design and analysis for the proposed dissertation project.

Conclusion

Time to return to work is a highly variable outcome following a planned medical event. Since prolonged work absence is known to result in declining physical health, physical function, mental health, and participation in social networks, extended work absence after a planned medical event, such as a TKR, should be reduced. Healthcare providers, particularly those in nursing, have an ethical obligation to promote health and well-being using evidence-based and patient-centered interventions whenever possible. Because so little is known about predictors of TRTW following a planned medical event, in part due to the absence of a satisfactory conceptual framework, designing and testing such interventions has been a very slow process. While much work has been done to understand predictors of TRTW following an unplanned medical event (e.g. workplace injury), far less is understood about this phenomenon in workers who have had the

opportunity to anticipate the occurrence of this medical event. In conclusion, more research using valid and reliable measures of personal and workplace characteristics, along with robust study designs, is needed to guide healthcare providers in planning effective, evidence-based, and patient-centered interventions to reduce TRTW following a planned medical event.

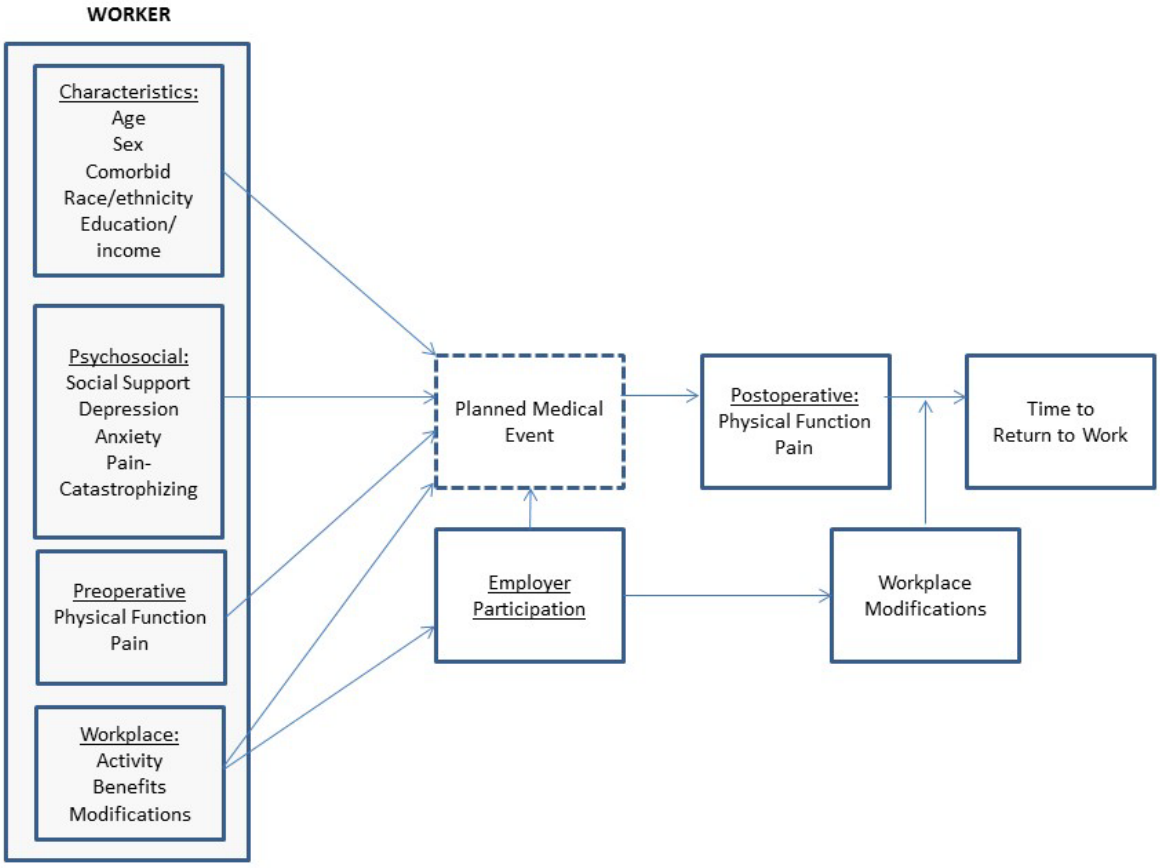

Figure 1. Time to Return to Work following a Planned Medical Event: Conceptual Framework

CHAPTER III

METHODOLOGY

Design

To determine preoperative predictors of time to return to work (TRTW) among working adults having a unilateral total knee replacement (TKR), this study is a secondary data analysis. Data for this analyses were collected as part of a larger randomized controlled trial testing the effectiveness of transcutaneous electrical nerve stimulation (TENS) on knee pain intensity and physical function (RO1 NR0098844: PI, Rakel) following unilateral TKR. These analyses identified significant predictors of TRTW at 6 months following a unilateral TKR, independent of treatment group assignment (controlling for TENS use) in the parent study. Based on their theoretical and empirical relationships to TRTW following a planned medical event described in the previous chapter, the following variables were tested as independent variables: age, sex, comorbid conditions, race, ethnicity, education, income, social support, depression, anxiety, pain catastrophizing, preoperative pain and physical function, and work activity.

This study tested the following hypotheses: adults at preoperative visit that (1) are younger, (2) male sex, (3) few comorbid conditions, (4) Caucasian, (5) have higher annual income and education, (6) better social support, (7) absence of depression, (8) less anxiety, (9) less tendency to catastrophize pain, (10) better physical function, (11) less pain, (12) less physically demanding work-related tasks, and (13) have workplace modifications *will have faster TRTW* following a TKR than those who are older, female sex, have several comorbid conditions, have a diverse racial/ethnic background, have low annual income and education, worse social support, depression, higher anxiety, more

tendency to catastrophize pain, poor physical function, more pain, more physically demanding work-related tasks, and no workplace modifications.

Setting

Two facilities were used for collection of data for the parent study. Site A was a large academic medical center in the Midwest, which performs 256 unilateral TKR procedures each year. Site B was a Veteran's Affairs Medical Center in the Midwest, which performs 70 unilateral TKR procedures each year. Patients are admitted to these institutions from across the state from urban, suburban, and rural areas. Moreover, Site A serves as a tertiary referral center for much of the Midwest, and many of its patients are referred due to complex health care needs that require advanced services, expertise, and resources.

Sample

At both sites, convenience sample composed of patients being examined in the pre-surgical evaluation clinics prior to TKR were recruited for participation in the parent study. Four orthopedic surgeons from these sites agreed to permit enrollment of their patients in the study. The following inclusion criteria were used in the parent study: (1) greater than 30 years of age, (2) presence of knee osteoarthritis, and (3) indicated for primary unilateral TKR at either site. An additional inclusion criterion for the proposed study is that participants from the parent study must have been working at least part-time at the time of study enrollment. Participants were excluded from the parent study if they had: (1) used a TENS unit (parent study intervention) within the last 5 years or had contraindications for TENS use (e.g. pacemaker, pregnant), (3) severe chronic uncontrolled pain unrelated to their knee osteoarthritis, (4) inability to correctly identify

sharp and dull stimuli on the surgical leg, (5) a cerebrovascular accident or other central nervous system disorder, (6) inability to ambulate independently (i.e. “wheelchair-bound”), (7) inability to follow directions, (8) inability to speak English (English did not need to be the primary language), or (9) inability to provide written informed consent to participate. For the secondary data analysis, participants in the parent study who were not working at the time of study enrollment were also excluded.

The sample recruited from these sites was restricted to middle-aged adult patients with osteoarthritis in one knee for whom TKR was surgically indicated. The surgeon collaborators on this project unanimously did not perform simultaneous bilateral TKR to avoid the need for total extended postoperative immobility and simultaneous healing of both lower extremities. Furthermore, the sample did not include younger adults (i.e. 30 years or younger) because osteoarthritis is not a typical finding in this younger population. Exclusion criteria (1) and (2) were implemented to enroll a sample that was neither familiar with nor were at increased risk for harm from the tested intervention in the parent study. Potential participants with severe chronic uncontrolled pain unrelated to their knee osteoarthritis were excluded from the parent study to avoid the possibility that other sources of pain besides the knee osteoarthritis or surgical recovery would influence study dependent variables. Exclusion criteria (4) and (5) were used in the parent study in an attempt to reduce the potential impact of sensory impairment, which reflects an underlying nerve or central nervous system pathology that could also influence the participant’s self-report of pain. Because physical function of the knee was partially measured through timed ambulation and other physical maneuvers, participants who were

unable to ambulate independently or follow directions were excluded from the parent study.

Sample Size

The study relied upon *post hoc* analyses of data collected for the parent study. The sample size of the parent study was N=355. Participants who indicated that they were working at baseline (prior to their surgery; n=134) were included in this study, and those who were not working at baseline (n=221) were excluded. Using the rule of thumb, ten participants per variable are necessary to get stable estimates of the regression coefficients (Harrell, Lee, Califf, Pryor, & Rosati, 1984; Harrell, Lee, & Mark, 1996; Van Belle, 2002). Peduzzi, Concato, Kemper, Holford and Feinstein (1996) found ten events (i.e. participants) per variable, or greater, ensured proper coverage for the confidence intervals. Therefore, this sample size provided enough model stability to test 12 independent predictors of TRTW following a TKR.

Operational Definition of Primary Study Variables

Dependent Variable

The primary dependent variable in the study was TRTW using seven time-points after TKR: (1) less than 5 weeks; (2) at 6 weeks; (3) 7 to 9 weeks; (4) 10 to 12 weeks; (5) 13 to 15 weeks; (6) greater than 16 weeks; or (7) has not returned to work. This study variable was collected in the parent study using a self-report questionnaire administered at the 6 month follow up appointment after the TKR occurred (see instrument in Appendix D).

Independent Variables

The Time to Return to Work after a Planned Medical Event conceptual framework (discussed in Chapter 2) provides the basis for examining the relationship between independent variables on TRTW in this proposed study. These independent variables included: age, sex, comorbid conditions, race/ethnicity, education/income, social support, depression, anxiety, pain catastrophizing, physical function, pain, workplace modifications, and work activity. In addition, data was collected about current occupation and plan to return to work (see instrument in Appendix C). Instruments were chosen based on reliability and validity, ease of administration, participant burden, and economic cost to the parent study. This section describes how each of these variables was measured.

Worker Characteristics

Age, sex, comorbid conditions, race/ethnicity, and education/income were measured using a questionnaire, combined with direct questioning of participants and using the electronic health record for verification, as needed. Participants were allowed to skip questions that they didn't want to answer. Age (in years) at the time of TKR surgery was used. Sex (male or female) at the time of TKR was used. Comorbid conditions were measured (either presence or absence) by direct questioning of the participants (see instrument in Appendix E), and the number of comorbid conditions was calculated as the sum of those conditions marked as "present". Race was assessed by seven National Institute of Health specified categories: American Indian/Alaskan Native, Asian, Native Hawaiian or other Pacific Islander, Black or African American, White, more than one race, and unknown or not reported. Ethnicity was assessed by three National Institute of

Health specified categories: Hispanic or Latino; Not Hispanic or Latino; and unknown (individuals not reporting ethnicity). The participant's highest level of education and income were assessed using mutually exclusive categories (see Table 1).

Social Support

Social support was measured using the Social Provisions Scale (SPS) (Cutrona & Russell, 1987). The 24-item SPS describes the extent to which various statements about 6 related concepts (attachment, social integration, reassurance of worth, reliable alliance, guidance, and opportunity for nurturance) reflect a person's current social network. High scores on each item indicate that the person is receiving the particular social provision. The item scores are added together to produce a global score of social provisions. The SPS has shown high internal consistency (α=0.92) and test-retest reliability (r = 0.75; (Cutrona & Russell, 1987). Using confirmatory factor analysis, (Cutrona & Russell, 1987), found that each subscale of the SPS had item loadings that were moderate to large in magnitude, ranging from 0.387 to 0.791, and were statistically significant. This indicates that each item has adequate construct validity to measure social support.

Depression

The Geriatric Depression Scale (GDS) is a five-item screening tool for depression in the older population in a self-report format of 'yes' or 'no.' Participants are classified as positive for depressive symptoms if they answer positive to two or more questions. The GDS has shown high sensitivity (0.925-0.94), specificity (0.77-0.81) and inter-rater reliability (0.84) (Hoyl et al., 1999; Mitchell, Bird, Rizzo, & Meader, 2010; Rinaldi et al., 2003). It is important to note that depression was not diagnosed in this study.

Participants were only screened for possible depression. If positive, further assessment would be needed to provide a diagnosis of depression.

Anxiety

The Trait Anxiety scale of the State Trait Anxiety Inventory (STAI Form Y-2) consists of twenty statements that assess how respondents generally respond to perceived threats in the environment rated on a 4-point scale ranging from “almost never” to “almost always” (Barnes, Harp, & Jung, 2002; Spielberger & Vagg, 1984; Spielberger, Gorsuch, & Lushene, 1970). In contrast, the State Anxiety Scale measures momentary anxiety. Because the proposed study focused on an end-point (return to work) that may occur up to several months, if ever, after a planned medical event, the Trait Anxiety Scale was be used. The STAI has moderate to strong correlations with other measures of anxiety (Depression Anxiety Stress Scale – Anxiety subscale 0.47; Beck Anxiety Inventory 0.68) and good test-retest reliability (STAI Trait 0.88) (Elwood, Wolitzky-Taylor, & Olatunji, 2011). Scores from the STAI can be directly interpreted: higher scores indicate higher anxiety. The STAI questionnaire has been used in studies with older adults following a joint replacement (Feeney, 2004) and can be completed in about 10 minutes.

Pain Catastrophizing

The Pain Catastrophizing Scale (PCS) is a 13-item scale that measures three sub-scales: rumination, magnification, and helplessness (Sullivan, Stanish, Waite, Sullivan, & Tripp, 1998). The PCS takes approximately 5 minutes to complete, and it utilizes a five-point Likert scale where 0 (not at all) and 4 (all the time) are used to indicate the participant’s thoughts or feelings when experiencing pain. After summing the responses,

the PCS total scores range from 0-52 and higher scores indicate more pain catastrophizing. The PCS has shown high internal consistency for adults (0.88-0.87) (Sullivan et al., 1998; Sullivan et al., 2001; Van Damme, Crombez, Bijttebier, Goubert, & Van Houdenhove, 2002; Osman et al., 2000), compared the PCS to variables that are theoretically similar to pain catastrophizing (e.g., negative affect, reported pain, interference with physical activities at work and during recreation), as well as those that are theoretically dissimilar to pain catastrophizing (e.g., positive affect) to establish convergent and divergent validity, respectively. The found that the PCS had moderate to strong and statistically significant convergent validity with negative affect ($r = 0.31$, $p<0.01$), pain ($r = 0.51$, $p<0.01$), and interference with physical activities ($r = 0.57$, $p<0.01$), and moderate but statistically significant divergent validity with positive affect ($r = -0.30$, $p<0.01$). While the sub-scales provide information about three specific aspects of pain catastrophizing, only a global measure of pain catastrophizing is necessary for the purposes of the proposed study for the following reasons. First, the concepts measured in the subscales of the Pain Catastrophizing Study (i.e. rumination, magnification, helplessness) are not necessarily thought to individually contribute to TRTW in a clinically meaningful way. Second, adding these three additional variables would reduce statistical power. Since the proposed study utilized a secondary data analysis approach, there is minimal opportunity to improve power through enhancement of study design or by increasing sample size.

Perceived Pain and Function

The Knee Injury Osteoarthritis Outcome Score (KOOS) questionnaire used as a self-reported measure of knee joint pain and physical function. This instrument takes

approximately 10 minutes to complete. It includes five sub-scales (pain, symptoms, activities of daily living, sport/recreation, and quality of life); however, only the pain sub-scale was used to measure pain and the activities of daily living sub-scale was used in the study as a measure of physical function to ensure an appropriately parsimonious regression model with adequate statistical power (see instrument in Appendix A). Furthermore, measuring pain on the KOOS has a stronger connection with pain during activity, similar to activity at work, than a simple measure of pain intensity on a visual analog scale (0-100). In these sub-scales of the KOOS questionnaire, responses were reported using a five-point Likert scale. Overall, the KOOS questionnaire has been validated against the WOMAC instrument in a sample of adults with knee osteoarthritis (Roos & Lohmander, 2003). Furthermore, Roos and Lohmander (2003) found that the KOOS activities of daily living and pain sub-scales shared a strong and statistically significant Spearman's correlation coefficient ($r = 0.62$, $p < 0.05$; $r = 0.48$, $p < 0.05$) with the WOMAC Physical Function sub-scale and bodily pain scale, respectively, indicating that the KOOS activities of daily living and pain sub-scales have adequate convergent validity. In patients with knee osteoarthritis the internal consistency and test-retest reliability for the KOOS activities of daily living and pain sub-scale were high ($\alpha = 0.78–0.97$, ICC = 0.84 – 0.97; $\alpha = 0.65–0.94$, ICC = 0.80-0.97, respectively; (Collins, Misra, Felson, Crossley, & Roos, 2011).

Workplace Activity

The participant's personal workplace activity was assessed using the work activity dimension of the Habitual Physical Activity Scale (Baecke, Burema, & Frijters, 1982). This instrument uses seven items with categorical responses to determine various

characteristics of the participant's workplace activities (see instrument in Appendix B). Tasks that require more activity at work receive more points. Reliability of this instrument has not been published (Helmerhorst, Brage, Warren, Besson, & Ekelund, 2012). Phillippaerts et al (1999) report a statistically significant correlation between this instrument and a biological measure of total activity expenditure (Pearson $r = 0.69$, $P < 0.001$) suggesting that convergent validity is intact. In older adults following a total hip replacement, this physical activity questionnaire was found to highly correlate with pedometer scores (ICC = 0.87; (Ono et al., 2007) also suggesting that this questionnaire has adequate convergent validity.

Workplace Modifications

The participants were asked if they had to modify their work environment or job duties to accommodate their knee pain via a questionnaire (see instrument in Appendix D) at their preoperative and 6 month postoperative visit. This self-report determined the presence or absence of workplace modifications. If workplace modifications were made, the participant was asked to list the type of modifications used in an open-ended format. A master's-prepared occupational health nurse with expertise in return to work developed the workplace questionnaire, which provided an initial effort at establishing content validity. The instrument was shared with a doctorally prepared occupational health advanced practice nurse who confirmed its face validity. The instrument was then piloted in a sample of five working adults for content validity, readability, and comprehension.

Data Collection Procedure

Patients with knee osteoarthritis were recruited for parent study participation during their outpatient appointment with the orthopedic surgeon. If the surgeon

determined the participant was a candidate for a total knee replacement, the research assistant (RA) approached the patient in the clinic exam room to explain the study purpose, to determine if the patient was interested in further details of the study, and to screen for other inclusion and exclusion criteria. If the patient met the inclusion criteria and if the exclusion criteria were absent, he or she was invited to sign the informed consent document. At the following pre-surgical evaluation appointment clinic visit, the participants was asked to complete the demographic questionnaire. At this appointment, the RA measured pre-operative study variables (depression, anxiety, social support, knee function, and information about the workplace environment). Following the TKR procedure, participants typically remained hospitalized 3 to 4 days.

Approximately 6 weeks after their TKR surgery, participants returned for to the orthopedic clinic for a routine postoperative follow-up visit. At this 6-week visit, the KOOS pain subscale and activity of daily living (ADL) was administered.

At the next visit, 6 months after their TKR surgery, participants returned to the orthopedic clinic. At this 6-month visit, the RA asked the participant when they returned to work using the categories listed above and completed data collection questionnaires: workplace activity and workplace modifications.

Data Entry and Analysis Procedures

Paper copies of all data collection forms were scanned using SNAP software and uploaded into a Microsoft Access database. The preoperative and postoperative workplace questionnaires were double data-entered by graduate RAs, manually checked with the hardcopies, and cleaned using range and consistency checks. Data were exported to Microsoft Excel and SPSS for data analysis.

Descriptive Statistics

Measures of central tendency were used to describe the sample characteristics. Nominal variables (i.e. sex, comorbid conditions, depression presence/absence, race, ethnicity, marital status, income, education, workplace modifications, and TRTW) were described using frequencies. Continuous variables (i.e. age, pain, anxiety level, self-reported workplace activity, social support) were described using means and standard deviation values. Visualization of the data plotted on a histogram were used to determine if the data follows a normal distribution (bell-curve pattern). The Shapiro-Wilk test was also performed for statistical evidence of normality (Razali & Wah, 2011). Data that are not normally distributed were grouped into categories based on distributions (e.g. medians and interquartile ranges).

Inferential Statistics and Analysis

Aim 1: To examine the individual contributions of age, sex, comorbid conditions, race, ethnicity, education, income, social support, depression, anxiety, pain catastrophizing, preoperative physical function and pain, preoperative workplace activities and modifications, postoperative physical function and pain, and postoperative workplace modifications on predicting TRTW in patients undergoing TKR.

Each independent variable was tested for differences between TRTW groups. Variables that showed a difference between TRTW groups ($p < 0.5$) were included in multivariate analysis.

Second, each independent variable was examined for collinearity with all other candidate independent variables using a test statistic appropriate for the type(s) of data being compared (e.g. Pearson's *r* when comparing continuous variables, Spearman's *rho*

when comparing categorical variables). Non-normally distributed continuous variables were tested using non-parametric methods. Independent variables that were highly correlated were compared to one another with regard to normality of their distribution within the sample, type of data (e.g. continuous vs. discrete), and completeness of data, and the variable with the most desirable statistical values were included in regression analyses.

Third, independent variables that were significantly associated ($p < 0.1$) with at least one category of the dependent variable were analyzed for significance using multinomial regression models (two models for each TRTW category of the dependent variable and one reference category). For all of the final regression models, the odds ratios, 95% confidence limits, *p*-values, and coefficients of determination (Nagelkerke's pseudo R-squared) were calculated. Each model was tested for goodness-of-fit to these data.

Aim 2: Describe the normal practice of TRTW following a TKR, including: perceived appropriateness of time to return to work, workplace modifications, and hours worked per week.

At the 6-month post-TKR research visit, workers were asked to provide a description of whether or not their TRTW duration was appropriate, if workplace modifications were used after TKR, and hours worked per week. A descriptive summary was performed of the perceived appropriateness of time to return to work and hours worked per week. Since workplace modifications varied widely, and participants were not able to provide more than a functional description of the workplace modification (e.g.

what they did, what it looks like, etc.), general explanations were presented based on the participant's description of the workplace modification.

Protection of Human Subjects

In the parent study, a description of the study procedures was submitted to the Institutional Review Board (IRB) at the University of Iowa for approval of the ethical treatment of human subjects. Additionally, the work questionnaire was added, and approved by the IRB, to the parent study for the purposes of this dissertation. The research participants were presented with verbal and written explanations of the study purpose, procedure, benefits, and risks, as well as a description of the process to maintain confidentiality. Participants were informed that participation in the study was voluntary, that participation in the parent study would require 3 hours of their time in addition to their regularly scheduled clinical appointments, and that there are risks associated with the treatment (TENS) groups. Participants were also instructed on how to contact the investigator with questions or concerns, and how to seek medication treatment if an adverse event occurred related to the study procedures. Each participant provided informed consent for study participation by signing an informed consent document. Additionally, this researcher submitted a Human Subject's Research Determination form to the IRB and it was determined the proposed study is not as human subjects' research (Appendix F).

Table 1. Potential Predictor Variables for Time to Return to Work

Variable Category	Variable	Measured by (scoring)	Reported as
Worker Characteristics	Age	18-99 years	Continuous
	Sex	Male, Female	Dichotomous
	Co-morbid conditions	Number of medical conditions present	Ratio
	Race	7 categories: American Indian/Alaskan Native, Asian, Native Hawaiian or other Pacific Islander, Black or African American, White, more than one race, and unknown or not reported	Nominal
	Ethnicity	3 categories: Hispanic or Latino, Not Hispanic or Latino, and unknown (individuals not reporting ethnicity).	Nominal
	Education	5 Categories: less than high school, graduated from high school, some college, graduated from college (specify major), and postgraduate school or degree (specify degree & major).	Ordinal
	Income	8 Categories: less than $10,000, $10,000-19,999, $20,000-39,999, $40,000-59,999, $60,000-79,999, $80,000-99,999, $100,000-119,999 and $200,000 or more.	Ordinal
Psychosocial	Social Support	Social Provisions Scale (SPS) 24-item, 4-point scale where 1 (strongly disagree) to 4 (strongly agree). Higher scores indicate higher social support	Continuous
	Depression	Geriatric Depression Scale (GDS) 5 items, a score of =/>2 indicates positive screen for depression	Nominal

Table 1. Continued

	Anxiety	Trait Anxiety (STAI) 20 questions: 4-point scale ranging from "almost never" to "almost always." Higher scores indicate higher anxiety.	Continuous
	Pain Catastrophizing	Pain Catastrophizing Scale. 13-item scale that measures three sub-scales: rumination, magnification, and helplessness (Sullivan, 1998). The PCS utilizes a five-point Likert scale where 0 (not at all) and 4 (all the time) is used to indicate the participant's thoughts or feelings when experiencing pain. After summing the responses, the PCS total scores range from 0-52 and higher scores indicate more pain catastrophizing.	Continuous
Physical Function and Pain	Perceived Physical Function	Knee Injury Osteoarthritis Outcome Score (KOOS): Activity of Daily Living sub-scale (17 items). It used a five-point Likert scale where 0 (No Problems) to 4 (Extreme Problems). The ADL sub-score was calculated between 0 and 100. Assessed preoperatively and 6 weeks postoperatively.	Continuous
	Perceived Pain	Knee Injury Osteoarthritis Outcome Score (KOOS): Pain sub-scale (9 items). It used a five-point Likert scale where 0 (No Problems) to 4 (Extreme Problems). The pain sub-score was calculated	Continuous

Table 1. Continued

		between 0 and 100. Assessed preoperatively and 6 weeks postoperatively	
Workplace Activity	Workplace Activity	*Baecke Activity Index.* Physical activity at work: 7 items, each with a Likert-type scale with varying response options: physical activity at work, the amount of time spent sitting, standing, walking, lifting, sweating, and tiredness at work. Some items are reverse-scored. Total score is the sum of individual item scores, which is divided by 7 to arrive at the average workplace activity score. Assessed preoperatively and 6 months postoperatively.	Continuous
Workplace Modifications	Workplace Modifications	Workplace modifications were assessed by: "Have you had to modify your work environment or job duties to accommodate your knee pain?" If yes, please specify why (open ended).Assessed preoperatively and 6 months postoperatively.	Nominal Descriptive
DEPENDENT VARIABLE:	Time to Return to Work	Time to Return to Work was measured by 7-time points: < 5 weeks after TKR, **at** 6 weeks after TKR, 7-9 weeks after TKR, 10-12 weeks after TKR, 13-15 weeks after TKR, > 16 weeks after TKR, & have not returned to work.	Ordinal

Table 1. Continued

		Assessed 6 months postoperatively.	
Planned Medical Event	Total Knee Replacement	Same for all study participants.	

CHAPTER IV

RESULTS

Introduction

A total of 699 patients met inclusion criteria and were approached for the parent study; of these, 140 declined to participate (20%), and 242 patients (80%) were ineligible. Those who were ineligible were excluded using the following criteria: current TENS use (40%), a condition that precluded TENS use (18%), chronic pain condition (17%), stroke/central nervous system disease (11%), prisoner (7%) sensory impairment (5%) and permanently or indefinitely wheelchair bound (2%). There were 317 participants that met the criteria for the primary study. Of these participants in the parent study, a total of 132 (42%) met inclusion criteria (i.e. working at preoperative visit) and were included in this secondary data analysis.

Sample

The sample used for this secondary data analysis is described in Table 2. The mean age of participants was 58.5 ± 8 years, and the ages ranged from 40 years to 79 years. Females accounted for slightly more than half the sample (55%), were predominantly White (94.7%) and not Hispanic or Latino (97.7%). Most were married or living with a significant other (71.8%) and were employed full-time (66%). Exactly half of the sample had received at least some college education (50%), and slightly less than half had an annual income between $40,000 per year and $99,999 per year (46%). 124 (94%) of participants reported, on average, two diagnosed comorbid conditions in addition to knee osteoarthritis. The most common comorbid conditions included: hypertension (43.9%), obesity (37.9%), ulcer/stomach problems (15.9%), depression

(15.9%), low back pain (15.2%), diabetes (13.6%), cancer (0.1%), and smoker (0.09%). Two thirds of participants worked up to one or two days prior to their total knee replacement (67%). The remainder of participants stopped working between 3 and 98 days before their TKR surgery.

Most of the participants reported occupations in the Service Industry (48%) and Retail Trade (13%) when classified using the Standard Industry Classification Codes (Occupational Safety and Health Administration, 1987, Table 3, Figure 3). Within the occupations in the Service Industry Division, 39.3% worked the business sector and 26.2% worked in health services (Figure 4). Preoperatively, 60 participants (50%)of the sample) reported that they had modified their workplaces for reasons related to their knee osteoarthritis (Table 2) and reported either environmental and/or behavioral workplace modifications. Environmental preoperative workplace modifications included: changing their workstation to maintain contact with the floor, elevating the affected knee, using a golf cart to get around an athletic facility, using crutches, and using a pallet jack for lifting. Of the 60 participants that reported a preoperative workplace modification, the majority (86.7%) used behavioral workplace modifications to help cope with their osteoarthritis knee pain at the workplace such as: depending on others, taking breaks, having difficulty lifting, avoiding kneeling, decreased walking, avoiding uneven surfaces, avoiding stairs, and decreasing standing time (Table 4).

Postoperatively, 14 participants withdrew from the parent study due to participant burden, 9 participants were lost to follow-up, and 8 participants were excluded due to surgical complications or atypical recovery. This resulted in 101 participants who remained in the study and were used to determine predictors of TRTW following a TKR

(Figure 2). These participants were significantly more likely to be married or living with a significant other than those who withdrew, were lost to follow-up and excluded (χ^2 (1, N=124) = 9.26, p=0.002; Table 5).

Most participants had high social support (median 84.0, IQR 74-89), few screened positive for depression (17%), low trait anxiety (32.5mean 7.8sd), low pain catastrophizing (median 9, IQR 4-15). The participants had jobs where they reported mostly light somewhat mobile work activity at work (mean 2.18, 0.36sd) and had worked at their jobs for an average of 18.5 years (14sd). Participants with knee osteoarthritis reported a mean preoperative KOOS pain subscale score of 46.1 (16.9sd) and preoperative KOOS ADL subscale score of 56.2 (17.4sd) and showed improvement in 6 week KOOS pain subscale score (64.3 mean, 17.08sd) and 6 week KOOS ADL score (75.7 mean, 13.98sd).

Since the primary study was a RCT testing the effectiveness of a TENS unit on pain with movement, the TENS allocation groups (active, placebo, standard care) are described in Table 7. There was no significant difference between TENS treatment groups on TRTW (Chi-square =0.734) so adjusting for TENS treatment was not conducted.

Normality determinations for the continuous independent variables are listed in Table 6. All variables were normally distributed except for social support and pain catastrophizing. Therefore, non-parametric statistics were used when evaluating these variables.

Time to Return to Work Categories

Time to return to work (TRTW) was measured using a questionnaire administered 6 months following the knee replacement, as described in Chapter 3. The distribution of TRTW was examined visually via histogram, and this researcher determined, based on this distribution, that three TRTW categories would best fit the categorical data and was consistent with current surgeon recommendations that return to work usually occurs at 6 weeks following a TKR. The three time categories for TRTW are: less than 5 weeks (25 participants, 18.9%), at 6 weeks (30 participants, 22.7%), and greater than 7 weeks (46 participants, 29.5%) after a knee replacement (Table 2). This method of using the 3 TRTW categories was the optimal approach for estimation of the final regression model as this distribution maximized the number of TRTW categories used to measure the dependent variable, and thus the statistical power of the final regression model, while also having the maximum number of candidate independent variables for the final regression model.

Specific Aim 1—Predictors of TRTW

The first specific aim stated to examine the individual contributions of age, sex, comorbid conditions, race, ethnicity, education, income, social support, depression, anxiety, pain catastrophizing, preoperative physical function, preoperative pain, workplace activities, and workplace modifications on TRTW in patients undergoing TKR.

As mentioned above, TRTW was classified into three categories (“less than 5 weeks”, “at 6 weeks”, and “greater than 7 weeks”). Due to small sample size (in less than 5 weeks, n=25), a determination was made to include only independent variables that

were statistically different at the P <0.05 level, as potential candidate variables for the full model. The variables that were significantly different among the 3 TRTW categories were: annual income (chi-square, p=0.009), modify work prior to surgery (chi-square, p=0.023), 6 week pain (ANOVA, p=0.003), and 6 week physical function (ANOVA, p=0.002) and considered potential candidate variables (Table 2).

Each potential candidate variable was examined for collinearity with other independent variables using a test statistic appropriate for the type(s) of data being compared (e.g. Spearman's *rho* when comparing categorical variables, Table 8). Preoperative workplace modifications were significantly correlated with 6-week pain (Spearman's rho=-0.260, p=0.006), and 6-week pain was significantly correlated with 6-week physical function (Spearman's rho=0.766, p=0.000). Although the correlation between preoperative workplace modifications and 6-week pain was statistically significant, the correlation was relatively weak. Therefore, despite their collinearity, both of these independent variables were added into the multinomial regression models individually. In addition, although the correlation between 6-week postoperative pain and 6-week postoperative physical function was both strong and statistically significant, indicating high collinearity between these two variables, they may each account for variability in TRTW differently. Therefore, both of these independent variables were also added into the multinomial regression models individually (i.e. one set of models including pain, one set of models including physical function) and together (i.e. one set of models including both pain and physical function). Income was not correlated with other potential candidate variables (Table 8).

To summarize, three sets of multinomial regression models were constructed to predict TRTW. The first set of models (Model 1) included as independent variables: income, preoperative workplace modifications, and 6-week postoperative physical function. The second set of models (Model 2) included as independent variables: income, preoperative workplace modifications, and 6-week postoperative pain. The third set of models (Model 3) included as independent variables: income, preoperative workplace modifications, 6-week postoperative pain, and 6-week postoperative physical function. Joint contributions of independent variables, i.e. interaction terms, were not tested due to the power limitations based on the small sample size of TRTW category.

Participants with missing data were excluded in the analysis. Therefore, the final fitted models were based on n=81 ("less than 5 weeks" n=21, "at 6 weeks" n=29, and "greater than 7 weeks" n=31; Table 9; Table 10; Table 11). In Model 1 (Table 9), participants that returned to work in less than 5 weeks were less likely to have made preoperative workplace modifications than those returning to work at 6 weeks following a TKR (OR 0.131, 95% CI 0.032 – 0.539, $p = 0.005$) while holding income and postoperative physical function constant. Participants with poor postoperative physical function were more likely to return to work at greater than 7 weeks compared to those at 6 weeks (OR 0.952, 95% CI 0.910 – 0.995, $p = 0.031$) when holding income and work modifications constant in the model. The KOOS ADL sub-scale score, where lower scores mean poor physical function, were reported for participants that returned greater than 7 weeks (mean 71.9, 13.5sd) and for participants that returned at 6 weeks following a TKR (mean 78.6, 12.7sd). Annual income was not a significant predictor of TRTW following a TKR when including modifications to work and 6 week physical function at

less than 5 weeks or greater than 7 weeks following a TKR.

In Model 2 (Table 10), the use of workplace modifications was predictive of TRTW in less than 5 weeks versus at 6 weeks (OR 0.145, 95% CI 0.033 – 0.637, p = 0.011) when income and 6-week postoperative pain were held constant. The use of workplace modifications (OR 0.229, 95% CI 0.068 – 0.774, p = 0.018) and 6-week postoperative pain (OR 0.949, 95% CI 0.910 – 0.988, p= 0.012) were significant predictors of TRTW in greater than 7 weeks versus at 6 weeks when income was held constant.

In Model 3 (Table 11), the use of workplace modifications was predictive of TRTW in less than 5 weeks versus at 6 weeks (OR 0.135, 95% CI 0.030 – 0.616, p = 0.009) when income, 6-week postoperative pain, and 6-week postoperative physical function remained constant. The use of workplace modifications was also predictive of TRTW in greater than 7 weeks versus at 6 weeks (OR 0.252, 95% CI 0.073 – 0.869, p = 0.029) when income, 6-week postoperative pain, and 6-week postoperative physical function remained constant. The Nagelkerke pseudo R-squared values were 0.368, 0.386, and 0.393 for Models 1, 2, and 3, respectively.

Specific Aim 2—Practice of TRTW after TKR

The second aim was to describe the usual practice of TRTW among employed working adults following a unilateral TKR, including: perceived appropriateness of time to return to work, workplace modifications, and hours worked per week.

The majority (93.1%) of participants returned to their preoperative employment status after surgery. Of the participants who changed employment status 6 months after a TKR: three retired, three became unemployed, and one became a homemaker (Table 12).

This left a sample of n=94 to describe the normal practice of return to work following a TKR.

Perceived Appropriateness of TRTW

Overall, 82 (84.2%) participants responded that their TRTW was appropriate following a TKR. Only 11 (12%) participants thought the TRTW was not appropriate after a TKR. The majority of those who reported that the TRTW was not appropriate (n=6) did not return to work until greater than 7 weeks following their TKR. Participants who responded that TRTW greater than 7 weeks was inappropriate also reported that "sitting at work hurt my ability to flex my knee," they had "pain and stiffness", "swelling", and "should have went back to work part-time… was exhausted."

Hours Worked per Week

The majority of participants in all groups reported returning to the same number of work hours per week as they had worked before surgery but the percentage increased as the length of time increased (84% of those returning less than 5 weeks, 90% at 6 weeks, and 93.5% greater than 7 weeks).

A small group of participants in each TRTW category reported an increase (e.g. part-time to full-time) in their hours worked per week (Table 13). Among those returning to work in less than 5 weeks and at 6 weeks, six participants increased their work hours (from part-time to full-time). Among those returning to work in greater than 7 weeks, two participants increased their work hours. Few participants reduced their work hours (e.g. from full-time to part-time) 6 months after TKR surgery. Among those returning to work in less than 5 weeks and in greater than 7 weeks, only two participants reduced their work

hours from full time to part time. Among those returning to work in 6 weeks, no participants reduced their work hours.

Workplace Modifications

Among participants who returned to work in less than 5 weeks, eight (32%) participants used preoperative workplace modifications, three (12%) participants used a new postoperative workplace modification, and one participant used the same workplace modification at both time points. For those who returned at 6 weeks, 19 (63.3%) participants used preoperative workplace modifications, none used a new postoperative modification, and four (13.3%) participants used the same modifications for preoperative and postoperative TKR. Those who returned in greater than 7 weeks, 10 (50%) of participants used preoperative modifications, three (7.9%) participants used a new postoperative workplace modification and seven (18.4%) continued to use the same preoperative modification at postop. Details of postoperative workplace modifications are listed on Table 14.

Planned Return to Work and Occupations

At the preoperative visit, participants were asked about their plan to return to work following the TKR. For those who returned in less than 5 weeks, 22 (88%) participants had planned to return to work, while two (8%) did not plan to return to work and one (4%) indicated they might return to work. However, the participants that reported that they would not return or might return to work following a TKR remained at the same jobs at postop. Of those who returned at 6 weeks following a TKR, 27 (90%) reported that they had planned to return to work and two (6.9%) reported that they might return to work. Of those who reported they might return to work, one returned to the same job, and

one changed jobs (from a receptionist to a senior demand food planner in a food plant). Of those who returned to work at greater than 7 weeks, 41 (89%) reported that they planned to return to work and four (8.9%) reported that they might return to work. All those who returned at greater than 7 weeks who reported that they might return to work remained at the same jobs. However, one participant who planned to return to work had changed jobs at their 6-month visit (from a patient educator at a grocery store to sales).

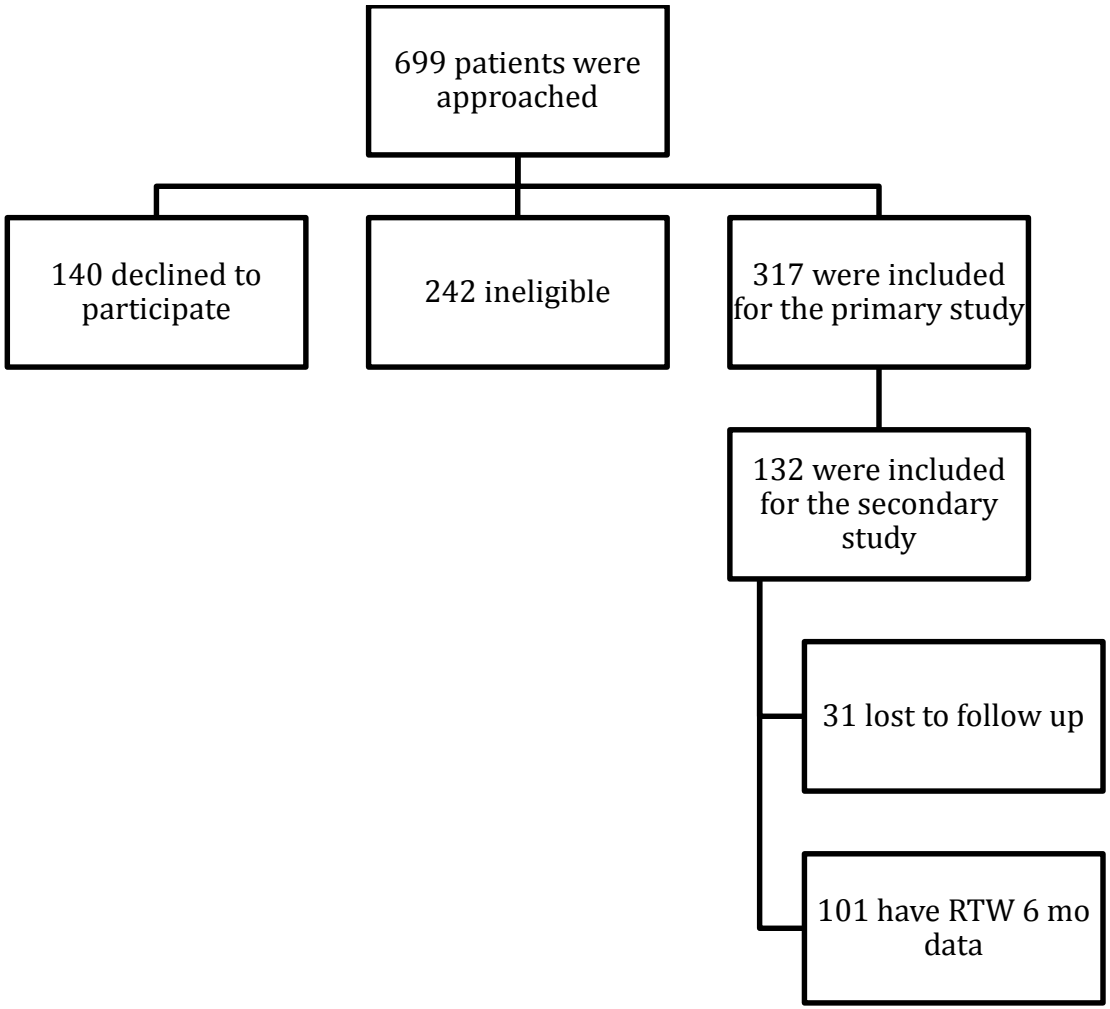

Figure 2. Participants in Secondary Study

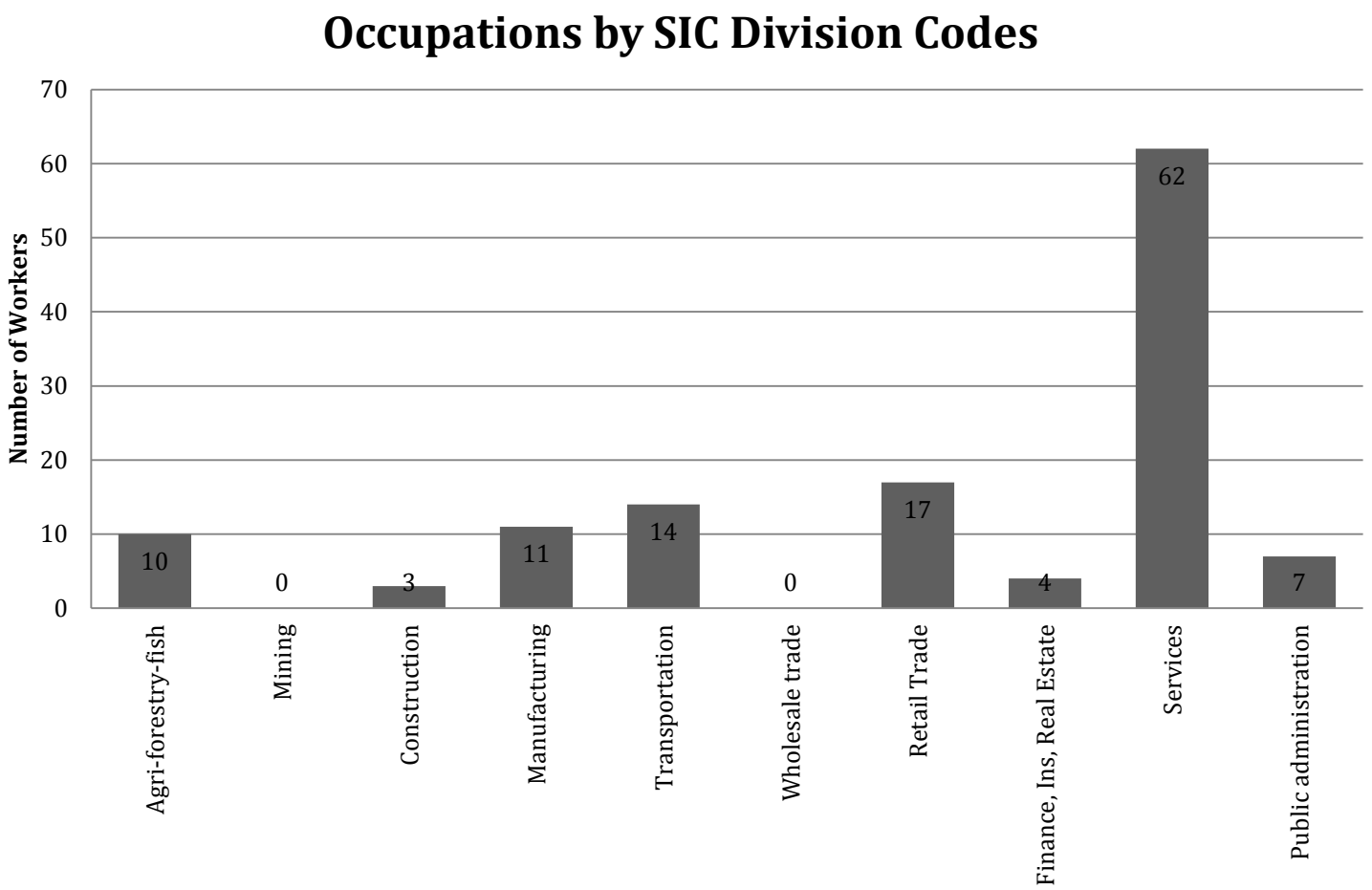

Figure 3. Occupations by OSHA's SIC Division Codes

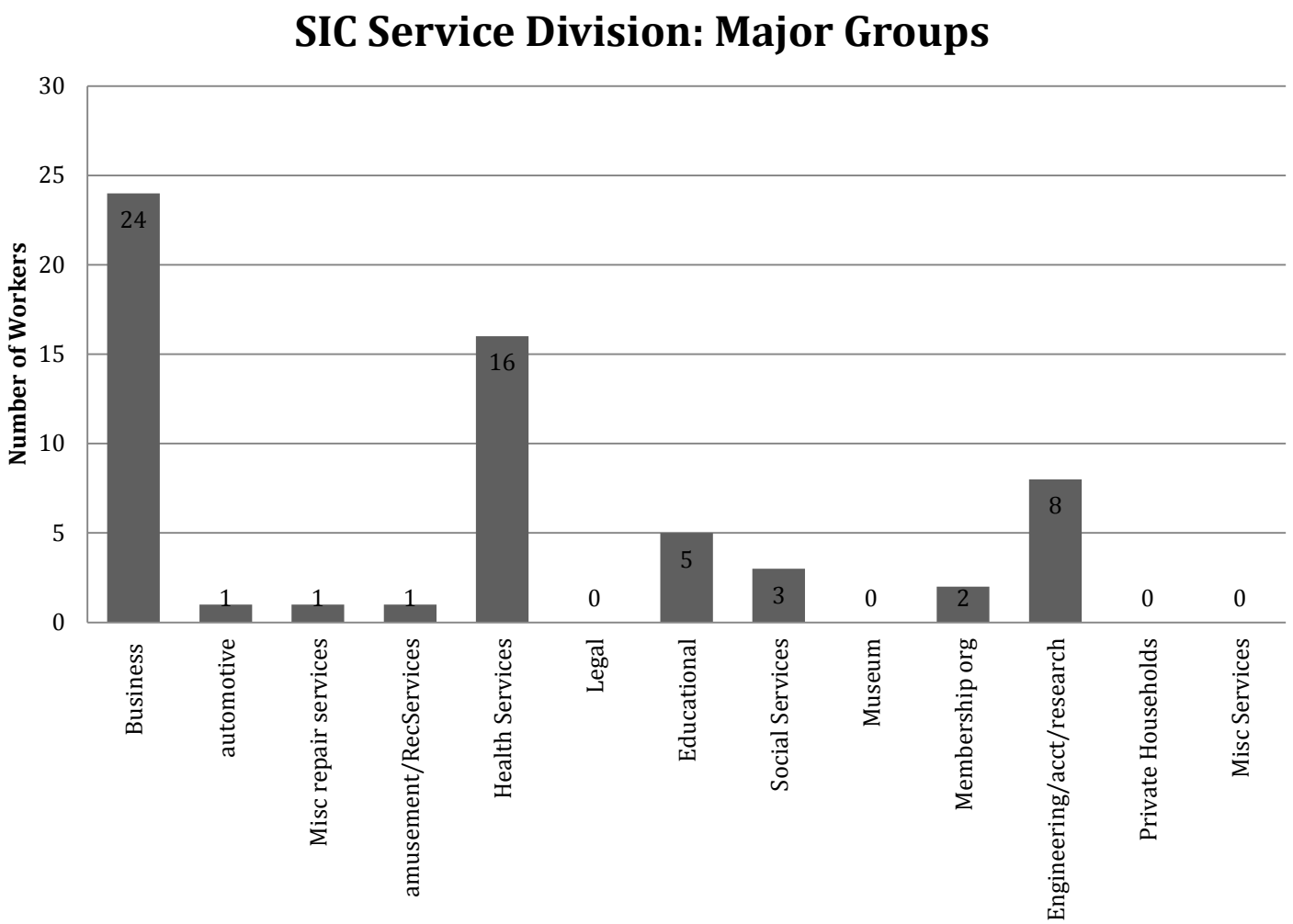

Figure 4. Description of SIC Service Division by Major Group

Table 2. Demographics and Potential Predictor Variables

Predictor Variables	TRTW <5 wks n=25	TRTW at 6 wks n=30	TRTW >7 wks n=46	Total n=132	p-value
Age	58.5±7.8	56.2±6.5	58.5± 8.1	58.5±8.0	0.492
Sex (female)	52%	67%	56.5%	55.3%	0.373
Comorbid conditions	n=24, 1.5±1.5	n=28, 2.2±1.6	2.1 ± 1.6	n=124, 2±1.5	0.132
Race (white)	100%	90%	93.5%	94.7%	0.575
Ethnicity (not Hispanic or Latino)	100%	93.3%	97.8%	97.7%	0.359
Annual Income	n=24	n=30	n=40	n=124	0.009[1]
$0-39,999	5(20.8%)	10(33.3%)	10 (25%)	39(31.5%)	
$40,000-99,999	6(25%)	15(50%)	24(40%)	57 (46%)	
$100,000 and greater	10(41.7%)	4(13.3%)	4 (10%)	21 (17%)	
Decline to answer	3(12.5%)	1(3.3%)	2 (5%)	7 (5.6%)	
Education	n=24		n=40	n=124	0.355
High School	5(20.8%)	6(20%)	16 (40%)	41 (33.1%)	
Grad College/Some College	13(54.2%)	18(60%)	20 (50%)	62 (50%)	
Post-Grad School	6(25%)	6(20%)	4 (10%)	21 (17%)	
Marital Status (Married or living with SO)	24(87.5%)	30(73.3%)	34(85%)	71.8%	0.493
Social Support (SPS, 0-96)	n=23 83.2±9.4	n=29 82.1±8.1	82.3±9.1	82.1±8.9	0.787
Depression (GDS, yes)	4%	10%	16.3%	17 (13.2%)	0.224
Anxiety (STAI, 0-80)	n=23 30.4±8.1	32.3±7.1	32.6±7.9	n=129 32.5±7.8	0.478
Pain Catastrophizing (PCS, 0-52)	n=23 7.3±7.7	10.9±5.8	10.3±8.3	n=127 10.1±8.1	0.075
Pain (KOOS, 0-100)	n=23, 49.4±17.8	43.7±15.1	46.5±18.1	n=125,46.1±16.9	0.476
Physical Function (KOOS, 0-100)	n=21 60.6±17.2	53.9±16.5	55.7±17.7	n=123 56.2±17.4	0.394

Table 2. Continued

Activity at Work (Baecke, 0-5)	2.68±0.7	2.68±0.66	2.9±0.63	2.18±0.36	0.099
Hours per week (Full-time)	17(68%)	24(80%)	25(62.5%)	87 (66%)	0.098
Years at current work status?	21.8±14.9, 20.5(8.5-30.75)	17.4±13.24 16(4.25-29.75)	15.6±13.9 10(3-25)	18.5±14 15(6-30)	0.344
Modify work prior to surgery (yes)	8 (32%)	20 (69%)	22 (47.4%)	50%	0.023[2]
Last day of work prior to surgery (1-2 days)	18(78.3%)	19(76%)	27(64.3%)	82(67%)	0.477
Plan to return to work? (yes)	22(88%)	27(90%)	41(91%)	116(89%)	0.218
Time at job (years)	21.83±14.97	17.40±13.24	16.32±14.11	18.12±14.09	0.561
6 week Pain	72.2±16.4	67.6±13.2	60.2±16.7	n=113,64.3±17.08, 63.9 (52-75)	0.003[3]
6 week Physical Function	81.2±13.97	78.6±12.7	71.9±13.5	n=111,75.7±13.98, 75 (64.7-85.3)	0.002[4]

Mean ±SD, n (%), or median (IQR)

[1] X^2 (4, n=82) =13.430, p=0.009 [2] X^2 (2, n=92) =7.518, p=0.023 [3] F(2, 90)=6.083, p=0.003 [4] F(2, 89)=6.469, p=0.002

Table 3. Preoperative Occupations Organized by Standard Industry Classification Codes

Standard Industry Classification Codes				
Division	**Major Group**	**Industry Group**	**Occupations listed at Prior to Surgery (n=128)**	**Postoperative Jobs (n=94)**
A: Agriculture, Forestry, And Fishing	01: Agricultural Production Crops	011 Cash Grains	farmer farmer farming farming farmer	 farming farmer
	02: Agriculture production livestock and animal specialties	0241 Dairy Farms	dairy farmer	dairy farmer
	07: Agricultural Services	074: Veterinary Services 0782 Lawn and Garden Services	Veterinary Technician Take care of birds and small animals at a chain pet store. Ground keeper riverside golf course Park custodian/Cemetery caretaker.	 Take care of birds and small animals at a chain pet store. Ground keeper riverside golf course Park custodian/Cemetery caretaker.
	08: Forestry			
	09: Fishing, hunting, and trapping			
B: Mining	10: Metal Mining			
	12: Coal Mining			
	13: Oil And Gas Extraction			

Table 3. Continued

	14: Mining And Quarrying Of Nonmetallic Minerals, Except Fuels			
C: Construction	15: Building Construction General Contractors And Operative Builders	Unable to classify further.	Construction	Construction
	16: Heavy Construction Other Than Building Construction Contractors			
	17: Construction Special Trade Contractors	1751 Carpentry Work	Building Contractor-carpenter Carpenter	
D: Manufacturing		Unable to classify further.	Equipment operator (motor grader) Manufacturing ERD senior machinist press operator PLBg-HTg-Mech Contractor Mechanic, Laborer	Equipment operator (motor grader) Manufacturing Mechanic, Laborer
	20: Food And Kindred Products	204: Grain Mill Products.	2043: Cereal Breakfast Foods	**Senior demand food planner in food plant (was receptionist)**

Table 3. Continued

	21: Tobacco Products			
	22: Textile Mill Products			
	23: Apparel And Other Finished Products Made From Fabrics And Similar Materials			
	24: Lumber And Wood Products, Except Furniture			
	25: Furniture And Fixtures			
	26: Paper And Allied Products			
	27: Printing, Publishing, And Allied Industries	8999 Services, Not Elsewhere Classified Unable to classify further.	self-employed - desktop publishing Manager printing	self-employed - desktop publishing Manager printing
	28: Chemicals And Allied Products			
	29: Petroleum Refining And Related Industries			
	30: Rubber And Miscellaneous Plastics Products	308: Miscellaneous Plastics Products	Plant manager for a plastic blow-molding facility	Plant manager for a plastic blow-molding facility

Table 3. Continued

	31: Leather And Leather Products			
	32: Stone, Clay, Glass, And Concrete Products	3271 Concrete Block and Brick	Concrete construction	
	33: Primary Metal Industries			
	34: Fabricated Metal Products, Except Machinery And Transportation Equipment			
	35: Industrial And Commercial Machinery And Computer Equipment	3585 Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment	On the line at a large manufacturing company	On the line at a large manufacturing company
	36: Electronic And Other Electrical Equipment And Components, Except Computer Equipment			
	37: Transportation Equipment			

Table 3. Continued

	38: Measuring, Analyzing, And Controlling Instruments; Photographic, Medical And Optical Goods; Watches And Clocks			
	39: Miscellaneous Manufacturing Industries			
E: Transportation, Communications, Electric, Gas, And Sanitary Services	40: Railroad Transportation			
	41: Local And Suburban Transit And Interurban Highway Passenger Transportation	4151 School Buses	School bus driver School bus driver School bus driver, seamstress, training dogs/horses Bus Driver	School bus driver School bus driver
	42: Motor Freight Transportation And Warehousing	421 Trucking and Courier Services, except air (need more information re: specific jobs to further classify) Unable to classify further.	Truck driver Semi-truck driver Truck driver Truck/trailer repair tech Truck driver Truck driver Receiving manager Logistics manager	Semi-truck driver Truck/trailer repair tech Truck driver Receiving manager Logistics manager

Table 3. Continued

	43: United States Postal Service			
	44: Water Transportation			
	45: Transportation By Air			
	46: Pipelines, Except Natural Gas			
	47: Transportation Services			
	48: Communications	Unable to classify further.	Communications tech Billing Analyst-telecommunication industry	Communications tech
	49: Electric, Gas, And Sanitary Services			
F: Wholesale Trade	50: Wholesale Trade-durable Goods			
	51: Wholesale Trade-non-durable Goods			
G: Retail Trade	52: Building Materials, Hardware, Garden Supply, And Mobile Home Dealers			

Table 3. Continued

	53: General Merchandise Stores	Unable to classify further.	Cashier Cashier Cashier at large retail store	Cashier Cashier Cashier at large retail store
	54: Food Stores	Unable to classify further. 5411 Grocery Stores	Senior planned - schedule & order materials need for food manufacturing **Educator for a food chain-grocery store** Assistant manager food grocery	Senior planned - schedule & order materials need for food manufacturing Assistant manager food grocery
	55: Automotive Dealers And Gasoline Service Stations			
	56: Apparel And Accessory Stores			
	57: Home Furniture, Furnishings, And Equipment Stores			
	58: Eating And Drinking Places	5812 Eating Places	dish washer Line chef at retirement home. Cook Property and Restaurant Management	Line chef at retirement home. Property and Restaurant Management

Table 3. Continued

	59: Miscellaneous Retail	5963 Direct Selling Establishments Unable to classify further.	Newspaper delivery Sales Sales Salesman Sales Consultant Sales Representative Self-employed sales	Newspaper delivery Sales Sales Salesman Sales Consultant Sales Representative Self-employed sales **SALES (was an Educator for a food chain-grocery store.)**
H: Finance, Insurance, And Real Estate	60: Depository Institutions			
	61: Non-depository Credit Institutions			
	62: Security And Commodity Brokers, Dealers, Exchanges, And Services			
	63: Insurance Carriers			
	64: Insurance Agents, Brokers, And Service	6411 Insurance Agents, Brokers, and Service	Insurance agent Insurance audit, selling insurance to potential customers Assistant Vice President for Crop Insurance	Insurance agent Assistant Vice President for Crop Insurance

Table 3. Continued

	65: Real Estate	Unable to classify further.	Real Estate	Real Estate
	67: Holding And Other Investment Offices			
I: Services	70: Hotels, Rooming Houses, Camps, And Other Lodging Places			
	72: Personal Services	7231 Beauty Shops	Cosmetologist	
	73: Business Services	7381 Detective, Guard, and Armored Car Services	Security officer Security guard Surveillance agent Site supervisor for security	Security officer Site supervisor for security
		7338 Secretarial and Court Reporting Services	Secretary, Administration Office Administrative assistant, college athletic department Receptionist Office clerk Clerk Clerk Shipping clerk	Secretary, Administration Office Administrative assistant, college athletic department Office clerk Clerk Clerk Shipping clerk
		7374 Computer Processing and Data Preparation and Processing Services	Customer Support Customer loyalty advocate dot.com Customer Service IT/GIS/e911 manager	Customer Support Customer loyalty advocate dot.com Customer Service IT/GIS/e911 manager

Table 3. Continued

		7349 Building Cleaning and Maintenance Services, Not Elsewhere	Housekeeping Custodial Supervisor house cleaner Janitorial Housecleaning self employed Custodian at elementary school Custodian Maintenance Maintenance supervisor at assist living	Custodial Supervisor house cleaner Janitorial Housecleaning self employed Custodian at elementary school Custodian Maintenance Maintenance supervisor at assist living
	75: Automotive Repair, Services, And Parking	753: Automotive Repair Shops	Work for a used car dealer-drive and check cars for repair	Work for a used car dealer-drive and check cars for repair
	76: Miscellaneous Repair Services	7699 Repair Shops and Related Services, Not Elsewhere Classified	Locksmith	Locksmith
	78: Motion Pictures			
	79: Amusement And Recreation Services	7997 Membership Sports and Recreation Clubs	General manger-country club	General manger-country club
	80: Health Services	8062 General Medical and Surgical Hospitals	Physician Psychiatrist Anesthesiologist, critical care physician Nurse	

Table 3. Continued

		8082 Home Health Care Services	Nurse for a PCW/CNA agency, WHNP for family planning Nurse Nurse Nurse Ortho Nurse VIA Licensed Practical Nurse Social work Physical Therapist; Manager of Wound Clinic Phlebotomy Activity coordinator In home health care Homecare for mentally disabled	Physician Psychiatrist Anesthesiologist, critical care physician Nurse for a PCW/CNA agency, WHNP for family planning Nurse Nurse Nurse Ortho Nurse VIA Licensed Practical Nurse Social work Phlebotomy Activity coordinator In home health care Homecare for mentally disabled
	81: Legal Services			
	82: Educational Services	8211 Elementary and Secondary Schools 8221 Colleges, Universities, and Professional Schools	Teacher, reading specialist Special education teacher special education director/ counselor Professor of Art Professor	Teacher, reading specialist Special education teacher

Table 3. Continued

	83: Social Services	8351 Child Day Care Services 8399 Social Services, Not Elsewhere Classified 8322 Individual and Family Social Services	Daycare and foster parent Fund raiser Driver for meals on wheels	Daycare and foster parent Fund raiser Driver for meals on wheels
	84: Museums, Art Galleries, And Botanical And Zoological Gardens			
	86: Membership Organizations	8661 Religious Organizations	Pastor Pastor of a small church	Pastor of a small church
	87: Engineering, Accounting, Research, Management, And Related Services	8721 Accounting, Auditing, and Bookkeeping Services 8734 Testing Laboratories	Book keeper accountant like Bookkeeper Clinical lab scientist research specialist Research Assistant Research Coordinator, Iowa DOT Research Assistant Nuclear medicine Technologist	Book keeper accountant like research specialist Research Assistant Research Coordinator, Iowa DOT Research Assistant Nuclear medicine Technologist

Table 3. Continued

	88: Private Households			
	89: Miscellaneous Services			
J: Public Administration	91: Executive, Legislative, And General Government, Except Finance			
	92: Justice, Public Order, And Safety	9223 Correctional Institutions	Correctional officer	Correctional officer
	93: Public Finance, Taxation, And Monetary Policy		Fiscal Analyst for Iowa Legislature Manager, division chief accountability/storage Finance manager	Fiscal Analyst for Iowa Legislature Manager, division chief accountability/storage Finance manager
	94: Administration Of Human Resource Programs	9411 Administration of Educational Programs	Educational Administrator (College Advising Center Director) Director of the Iowa health professions tracking center	Educational Administrator (College Advising Center Director) Director of the Iowa health professions tracking center
	95: Administration Of Environmental Quality And Housing Programs			
	96: Administration Of Economic Programs			

Table 3. Continued

	97: National Security And International Affairs			
	99: Nonclassifiable Establishments	Unable to classify further.	Director of non-profit business owner	Director of non-profit business owner

Table 4. Preoperative Workplace Modifications and Why

Workplace Modifications	Participant Report of why modifications were needed?
1) Environment	To be able to move knee to **change work station** so that feet can touch the ground.
	Knee hurts sit at a **high stool chair**
	They try to keep me out of the **ditches** as much as possible.
	Elevate knee, miss work, ice and elevate.
	Putting leg up on box-**elevated** while sitting.
	I cannot walk to all areas of our athletic fields without pain so must use **golf cart**.
	Crutch to stand and walk
	Used **pallet jack** to help with lifting, eliminate stairs if no handrails.
2) Behavior	
Depend on Others	Moving heavy boxes/items need to be **handled by others** lifting items over-head.
	Walking patrols of the outside of the building are **not done by me** anymore.
	I don't walk in the plant as much **as I used to** with customers
	Had to **give up** repairing computers because if involves crawling under desks and lifting.
	I used to work days **now I work** nights.
	Didn't go to the bathroom; eliminate hall trips, **co-worker helped**.
Take breaks	Foot **rest**, walk when the pain got bad, medication
	Not carry laundry up stairs, no breaks, **work slower**
	Go **slow**
	Because of pain, I **slow down** walking or sometimes I don't do or hold off doing- like lifts.
Avoid lifting	Harder to walk, **lift,** etc.
	I can't help **lift** patients
	I **don't move heavy** furniture or stand on the ladders.
	Hard to get down on the floor with children and **can't carry** children
Difficulty Kneeling	No **kneeling**
	Unable to **kneel** as needed.
	I have difficulty **kneeling** down and getting up.
	Left knee is "bone on bone." I have a hard time **kneeling**, and I cannot get down on my knee.
	Can't **kneel,** ladder & stairs cause pain & swelling, can lift but hard to carry heavy loads.

Table 4. Continued

Decrease Walking	**Less walking**/standing
	Limited mobility, pain
	Tell them to stand, **no walking**
	Walk frequently/**shorter distances**; get up and down frequently; exercises knee straighten/bend.
	Decreased amount of **walking**
	Less walking to alleviate pain.
Avoid Uneven Surfaces	I **do not go** on the manufacturing floor as often as before, also it is wet & can be slick. I slip more.
	Use elevator, avoid stairs or **downhill** walking
	Pain in knee on stairs and **uneven surfaces**
	Don't walk on **steep roofs**.
Avoid Stairs	Don't carry heavy things, use **stairs less**
	Can't climb steps everyday
	Do not go up and down **stairs** as often
	Can't reach lower cabinets**, can't climb stairs**.
	No heavy lifting**, no stairs**, no heavy delivery.
	Walking lifting, **climbing stairs**
	When I walk I have a lot of pain. I have a hard time going up and **down stairs**.
Decrease Standing Time	Excess pain in knee if I am on it **too long.**
	Pain in my knee-after **standing about 1 hour.**
	Can't stand **very long**.
	Knee locks up so I can't **stand for very long**. Have trouble getting things off of the floor.
	Can only work up **to 5-6 hours** without severe pain. Knee pops and buckles after that.
	Cannot **stand for 9 hours**.
Painful at Work	Because of the work activity I **do causes more pain**
	If I drive the forklift and get off numerous times, my **knee is very tired** and hurts.
	Knee **hurts**
	Painful to work
	Knee **pain**
	Because **it hurts so bad.**

Table 4. Continued

	Lack of arm strength, lower back pain, trick knees.
	It **hurts**
	Too much pain/discomfort
	Pain

Table 5. Details of Attrition

Preoperative Variables	Excluded, Withdrew or Lost to follow-up (n=31)	Total Participants (N=101)	Type of Test, p-value
Age	60.6±9.22	57.9±7.57	t-test, p=0.092
Sex (female)	48.4%	57.4%	Chi-square, p=0.376
Comorbid conditions	n=26, 2.2±1.5	2.01±1.6	t-test, p=0.678
Race (white)	96.8%	94.1%	Chi-square, p=0.717
Ethnicity (not Hispanic or Latino)	100%	97%	Fisher's Exact, p=0.445
Annual Income $0-39,999 $40,000-99,999 $100,000 and greater Decline to answer	 14 (46.7%) 12 (40%) 3 (10%) 1 (3.3%)	 25 (26.6%) 45(47.9%) 15(16%) 2(0.02%)	Chi-square, p=0.194
Education High School Grad College/Some College Post-Grad School	 14 (46.7%) 11 (36.7%) 5 (16.7%)	 27(28.7%) 51(54.3%) 16(17%)	Chi-square, p=0.163
***Marital Status** Married or living with SO	 50%*	78.7%*	*** χ^2 (1, N=124) = 9.26, p=0.002**
Social Support (SPS, 0-96)	81.3±8.7	82.5±8.79, 85 (76.5-90)	Mann-Whitney U, p=0.414
Depression (GDS, yes)	(19.4%)	(11.5%)	Chi-square, p=0.289
Anxiety (STAI, 0-80)	33.6±8	31.9±7.7	t-test, p=0.319
Pain Catastrophizing (PCS, 0-52)	11.3±9.7	9.78±7.6	Mann-Whitney U, p=0.676
Pain (KOOS, 0-100)	n=29 45.3±17.5	46.3±17.1	t-test, p=0.784
Physical Function (KOOS, 0-100)	n=29 55.9±18.9	56.3±17.2	t-test, p=0.929

Table 5. Continued

Activity at Work (Baecke, 0-5)	2.9±0.7	2.8±0.64	t-test, p=0.330
Hours per week (Full-time)	21(68%)	66%	Chi-square, p=0.858
Years at current work status?	20.4±13.8, 18.5(8.75-33)	17.7±14.1, 15(5-30)	t-test, p=0.366
Modify work prior to surgery (yes)	51.6%	50%	Chi-square, p=0.914
Last day of work prior to surgery (1-2 days)	21(70%)	86(67.7%)	Chi-square, p=0.723
Plan to return to work? (yes)	26(84%)	90(91%)	Chi-square, p=0.541
6 week Pain	n/a	65.4±16.3	n/a
6 week Physical Function	n/a	76.3±13.9	n/a

Mean ±SD, n (%), or median (IQR)

Table 6. Normality Determination of Continuous Variables with Histograms

Variable	Mean ± SD	Median (IQR)	Normal/Abnormal Distribution
Age	58.52 ± 8.04	59.00 (53-63)	Normal
Comorbid conditions	2.04 ± 1.56	2 (1-3)	Normal
Social Support (SPS, 0-96)	78.55 ± 19.21	84.0 (74-89)	Abnormal
Anxiety (STAI, 0-80)	32.4 ± 7.8	32.0 (26-37)	Normal
Pain Catastrophizing (PCS, 0-52)	10.1 ± 8.11	9 (4-15)	Abnormal
Pain (KOOS, 0-100)	42.9 ±20.2	44.4 (30.6-55.6)	Normal
Physical Function (KOOS, 0-100)	56.2 ± 17.6	57.4 (28.6-53.6)	Normal
Activity at Work (Baecke, 0-5)	2.8 ± 0.8	2.7 (2.3-3.3)	Normal
6 week Pain	n=113, 64.31 ±17.08	63.9 (52.8-75.0)	Normal
6 week Physical Function	n=111, 75.7±13.98	75 (64.7-85.3)	Normal

(n=132)

Table 7. TENS Treatment Allocation in Primary Study

Variables	< 5 weeks	@ 6 weeks	> 7 weeks	Total	Test & p-value
TENS group	n=25	n=30	n=39	n=94	
Active	9 (36%)	10 (33%)	13 (33%)	32 (34%)	Chi-square
Placebo	8 (32%)	14 (46.7%)	18 (46.2%)	40 (42.6%)	=0.734
Standard Care	8 (32%)	6 (20%)	8 (20.5%)	22 (23.4%)	

Table 8. Correlation Matrix: Candidate Variables (Spearman's Rho)

Sig (2-tailed) p= n=	Comorbid Conditions	Income	Pain Catastrophizing	Modify work for Knee OA	Work Activity	Hours/Week	6 wk Pain	6 wk Physical Function
Comorbid Conditions	x	-0.115 0.239 106	0.265* 0.004 116	0.096 0.298 120	-0.256** 0.004 122	0.038 0.677 121	-0.115 .239 106	-0.256* 0.009 104
Income		x	-0.061 0.505 120	-0.056 0.537 123	-0.151 0.095 124	0.414** 0.000 124	0.050 0.611 106	0.043 0.664 104
Pain Catastrophizing			x	0.159 0.078 124	0.025 0.784 125	-0.125 0.166 125	-0.391** 0.000 106	-0.328** 0.001 104
Modify Work for Knee OA				x	0.144 0.102 130	-0.109 0.219 130	-0.260* 0.006 111	-0.157 0.104 109
Work Activity					x	0.104 0.237 131	-0.045 0.640 113	-0.087 0.364 111
Hours/week						X	-0.079 0.409 112	-0.092 0.339 110
6 wk Pain							x	0.766** 0.000 111
6 wk Physical Function								x

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

Table 9. Multinomial Logistic Regression for Aim 1: Predictors of TRTW following a TKR- Physical Function

Model 1	Predictor Variables	Odds Ratio	95% CI	P-value
< 5 weeks	6 week Physical Function	1.023	0.968-1.080	0.425
	Modify work for knee (yes)	0.131	0.032-0.539	0.005*
	Income (>$100,00 reference)			
	0-$39,999	0.258	0.046-1.462	0.126
	$40,000-$99,999	0.207	0.040-1.060	0.059
> 7 weeks	6 week Physical Function	0.952	0.910-0.995	0.031*
	Modify work for knee (yes)	0.333	0.106-1.045	0.059
	Income (>$100,00 reference)			
	0-$39,999	1.188	0.185-7.635	0.856
	$40,000-$99,999	1.569	0.273-9.008	0.613

(n=81) The reference category is: at 6 weeks.
*Significant at the 0.05 level.
Pseudo R-Square (Nagelkerke)=0.368

Table 10. Multinomial Logistic Regression for Aim 1: Predictors of TRTW following a TKR- Pain

Model 2	Predictor Variables	Odds Ratio	95% CI	P-value
< 5 weeks	6 week Pain	1.015	0.969-1.063	0.545
	Modify work for knee (yes)	0.145	0.33-0.637	0.011*
	Income (>$100,00 reference)	4.059	0.722-22.816	0.112
	0-$39,999	0.860	4.061-0.182	0.848
	$40,000-$99,999			
> 7 weeks	6 week Pain	0.949	0.910-0.980	0.012*
	Modify work for knee (yes)	0.229	0.068-0.774	0.018*
	Income (>$100,00 reference)	0.767	0.122-4.810	0.777
	0-$39,999	1.199	0.360-3.995	0.767
	$40,000-$99,999			

(n=81) The reference category is: at 6 weeks.
*Significant at the 0.05 level.
Pseudo R-Square (Nagelkerke) = 0.386

Table 11. Multinomial Logistic Regression for Aim 1: Predictors of TRTW following a TKR- Physical Function and Pain

Model 3	Predictor Variables	Odds Ratio	95% CI	P-value
< 5 weeks	6 week Pain	1.001	0.939-1.067	0.978
	6 week Physical Function	1.021	0.947-1.101	0.590
	Modify work for knee (yes)	0.135	0.030-0.610	0.009*
	Income (>$100,00 reference)	3.890	0.686-22.059	0.125
	0-$39,999	0.834	0.175-3.987	0.820
	$40,000-$99,999			
> 7 weeks	6 week Pain	0.961	0.912-1.013	0.138
	6 week Physical Function	0.979	0.924-1.013	0.486
	Modify work for knee (yes)	0.252	0.073-0.869	0.029*
	Income (>$100,00 reference)	0.835	0.129-5.408	0.850
	0-$39,999	1.257	0.369-4.276	0.714
	$40,000-$99,999			

(n=81) The reference category is: at 6 weeks.
*Significant at the 0.05 level
Pseudo R-Square (Nagelkerke) = 0.393

Table 12. Details of Those Working Preoperative but Not at 6 Months Following TKR (n=7)

Variables	Not working at 6 months after TKR (Homemaker, Retired, Unemployed)
	Data
Age	61.4±6.6
Sex (female)	57.1%
Comorbid conditions	1±0.8
Race (white)	85.7%
Ethnicity (not Hispanic or Latino)	100%
Annual Income	
$0-39,999	1(14.3%)
$40,000-99,999	4 (57.1%)
$100,000 and greater	1 (14.3%)
Decline to answer	1 (14.3%)
Education	
High School	3 (42.9%)
Grad College/Some College	4 (57.1%)
Post-Grad School	0
Marital Status	85.7%
Married or living with SO	
Social Support (SPS, 0-96)	80.3±11.5
Depression (GDS, yes)	14.3%
Anxiety (STAI, 0-80)	31.3±8.7
Pain Catastrophizing (PCS, 0-52)	10.4±10.2
Pain (KOOS, 0-100)	42.1±16.9
Physical Function (KOOS, 0-100)	52.2±17.9
Activity at Work (Baecke, 0-6)	3±0.6
Modify work prior to surgery (yes)	57.1%
Last day of work prior to surgery (the date of surgery minus the planned last day of work, in days)	9.3±19.7
6 week Pain	67.1±17.1
6 week Physical Function	80.2±18.0

Table 13. Postoperative TRTW Following a TKR: Aim 2.

Practice of TRTW	< 5 weeks	At 6 weeks	>7 weeks	Total
	n=25	n=30	n=46	N=94
Was your TRTW appropriate? Yes No	23 (92%) 2	27 (90%) 3	32 (84.2%) 6	93 82 (88.2%) 11 (11.8%)
If no, Why?	Went back too soon, had to take more time off.	- Not enough physical therapy - Might have rushed things 1st week of work was part-time & suffered with pain & swelling	- Sitting at work hurt my ability to flex my knee. - Pain & stiffness - Knee was swelling - Should have went back to work part-time, exhausted. - Took 5 months to be able to return to work.	n/a
Hours worked per week (at 6 months)? Full time Part time	19 (76%) 6 (24%)	27 (90%) 3 (10%)	23 (51%) 16 (36%)	94 69 (73.4%) 25 (26.6%)
Work Status (at 6 months): Same as Preop Increased Hours (PT to FT) Decreased hours (FT to PT)	21 (84%) 3 (12%) 1 (4%)	27 (90%) 3 (10%) 0 (0%)	43 (93.5%) 2 (4.3%) 1 (2.2%)	101 91 (90.1%) 8 (8%) 2 (2%)
Workplace Modifications	8 (32%) 3 (12%)	20 (69%) 0 (0%)	22 (47.8%) 3 (7.9%)	68 50 (73.5%) 6 (8%)

Table 13. Continued

Preoperative Modification New Postoperative Modification Post same as Pre	1 (4%)	4 (13.3%)	7 (18.4%)	12 (17.6%)
Planned to RTW Yes No Maybe	22 (88%) 2 (8%, stayed at same job) 1 (4%, stayed at same job)	27 (90%) 0 (0%) 2 (6.9%: 1 changed, 1 stayed at same job)	41 (89%) 0 (0%) 4 (8.9%, stayed at same jobs)	99 90 (91%) 2 (2%) 7 (7%)
Changed Jobs	None	1-Receptionist to a Sr. Demand food Planner in a Food plant	1-Pt. educator in grocery store to sales	2

Table 14. Postoperative Workplace Modifications by TRTW

Have you had to modify you work environment or job duties to accommodate your knee pain AFTER surgery?		
Time to Return to Work	**Postoperative Workplace Modifications**	**Matching with Preoperative Workplace Modifications Themes**
Less than 5 weeks	**can't stand/walk** as much	Behavioral: Decrease Walking
	not as much **walking**	Behavioral: Decrease Walking
	Small **stool under desk** to stretch & **rest knee** occasionally.	Environmental
	walking w/ cane, walking less, modified shoes	Environmental
At 6 weeks	when getting down under desks it is difficult due to **pain** and positioning	Behavioral: Painful at Work
	initially I was on a 25lb **weight limit**	Behavioral: Avoid Lifting
	I handle **less heavy loads** exp. Where steps are involved, climb & descend steps **slower**	Behavioral: Avoid Lifting
	But only if carrying heavy things. Sometimes I feel the **knee won't hold me** up but it has	Behavioral: Avoid Lifting
Greater than 7 weeks	Wearing **knee brace**, "ramped up to normal activity"	Environmental
	cane (sometimes), **walker** (some), high spot **lifting** help.	Environmental
	Use of stool to **limit standing**	Environmental/ Behavioral: Decrease Standing Time
	part time for a week or so, odds & ends, **more sitting** emptying cassettes.	Behavioral: Decrease Standing Time
	walk slower, no lifting	Behavioral: Take Breaks
	cut back to **not as many days**	Behavioral: Take Breaks
	didn't go back to the same job, dishwasher, cook server, then when the opened main cook line was open.	Behavioral: Take Breaks
	Had to **slow** down a little, also have a hard time getting up and down from the floor	Behavioral: Take Breaks
	lighter work, not climbing ladder	Behavioral: Avoid Lifting
	have to ask for **help lifting** items a lot more often	Behavioral: Avoid Lifting

CHAPTER V

DISCUSSION AND IMPLICATIONS

Introduction

This is the first study to investigate predictors of TRTW following a TKR, which included demographic, psychosocial, workplace, preoperative physical function and pain, and post-operative pain and physical function. Some unique features of this study were inclusion of preoperative and postoperative workplace modifications, organizing occupations based on OSHA standard industry classification codes, measuring TRTW around typical recovery times after a TKR, and development of a conceptual framework for TRTW following a planned medical event. This study builds on a recent systematic review of return to work following a joint replacement (Tilbury et al., 2014), which found evidence of low methodological quality with a limited use of multivariate analyses among return to work literature following a TKR. In this multivariate analysis, there were two major findings that will be discussed in this chapter: 1) not needing preoperative workplace modifications predicts earlier TRTW and 2) poor physical function predicts delayed TRTW following a TKR.

Using Preoperative Workplace Modifications Predicts TRTW at 6 Weeks

In this sample, the use of preoperative workplace modifications predicted TRTW at 6 weeks versus either greater than 7 weeks or less than 5 weeks following a TKR. This predictive relationship held true if the multinomial regression model included postoperative pain individually or with physical function, but not if the model included postoperative physical function alone. When compared to those returning to work at 6

weeks, fewer participants returning to work in less than 5 weeks used preoperative workplace modifications (69% and 32%, respectively) when income, postoperative pain, and postoperative physical function were held constant. Similarly, fewer participants returning to work in greater than 7 weeks used preoperative workplace modifications compared to those returning to work at 6 weeks (47.4% and 69%, respectively) when income and postoperative physical function were held constant. This finding was unexpected as it is inconsistent with previous research. Preoperative workplace modifications predicted faster return to work in patients with carpal tunnel release surgery (Cowan et al., 2012). While total knee replacement is quite different from a carpal tunnel release surgery, both typically require preoperative workplace modifications to minimize pain and improve function during work activities in the preoperative period. However, the mechanisms by which preoperative workplace modifications delay return to work after a TKR, but not after other planned medical events, are not known.

It is important to note that annual income was significantly different between the three TRTW groups ($p = 0.009$), indicating that income may influence TRTW following a TKR. Annual income was included as a predictor of TRTW and the difference in annual income was approaching significance ($p=0.059$). These findings support that those who returned to work in less than 5 weeks compared to those who returned to work at 6 weeks were more likely to have higher incomes. Therefore, one could hypothesize that jobs with higher incomes may have differences in work: have others available to assist them (secretary, employees), more autonomy at the workplace that allows them to choose their physical job requirements or work activity (sedentary vs. mobile/active work). One could assume that participants who returned to work in less than 5 weeks had jobs that

were less active (more sedentary) and the participants that returned to work at 6 weeks had jobs that were more active and required more preoperative workplace modifications to be able to perform their work. However, the preoperative work activity score was similar for both these TRTW groups (mean 2.68, 0.70sd; mean 2.68, 0.67sd; respectively). This finding is clinically relevant for health care providers and highlights the need for an individualized plan to return to work for workers that aren't using preoperative workplace modifications (and perhaps earn higher incomes), as they may be able to return to work sooner than the recommended timeframe after a planned medical event.

This sample included a wide variety of industries and occupations, representing workplace physical activities that ranged from sitting to intense manual labor. Despite this variation in activities, the modifications implemented were uniformly simple but specific to the workers' usual workplace activities. For example, jobs that require walking, particularly over long distances or on slick or uneven surfaces, might require the worker to take an alternative route to avoid such surfaces or ride in a vehicle. Jobs that require kneeling or squatting to reach supplies might require the worker to move supplies to a location that does not require kneeling or squatting. While most jobs in the current study required workers to implement some sort of modification during the preoperative period to complete work activities, there was a significant delay in TRTW when these modifications were used.

Preoperative workplace modifications in this sample focused on strategies to avoid knee discomfort or further injure the knee joint. Participants who implemented these strategies preoperatively had worse knee function at baseline, indicating more

severe underlying knee pathology (Dowsey et al., 2012). Those with more severe knee osteoarthritis would have developed more severe deterioration in surrounding muscles that support the knee joint (Pisters, Veenhof, van Dijk, Dekker, & CARPA Study Group, 2014), thus complicating recovery from the TKR and delaying the return to work. This hypothesis is consistent with recent findings that many indicators of muscle function around the knee, particularly those involved with maintaining postural stability while walking, remain unchanged from pre-TKR to 6 months post-TKR (Vahtrik, Ereline, Gapeyeva, & Paasuke, 2014). This finding from the current study seems to support a relationship between the use of preoperative workplace modifications, indicating poor preoperative knee function, and prolonged TRTW. A similar relationship between low pre-TKR knee function and 1-year nonparticipation in social roles has been described in the literature (Maxwell et al., 2013). Future studies are needed to explore an alternative approach to preoperative care may be necessary to hasten return to work following a TKR.

Poor Postoperative Physical Function Predicts Delayed TRTW

In this sample, poor postoperative physical function predicted TRTW in greater than 7 weeks versus at 6 weeks, but not at 6 weeks versus in less than 5 weeks. This predictive relationship held true only if the multinomial regression model did not adjust for postoperative pain. When postoperative pain was added to the model, neither postoperative physical function nor postoperative pain was significantly predictive of TRTW. Those who returned to work in greater than 7 weeks had a postoperative KOOS physical function sub-score that was 6.7% lower than those who returned to work at 6

weeks, indicating that poor postoperative physical function predicts delayed TRTW. The finding that poor physical function delays TRTW is consistent with the current literature (Styron et al., 2011). While Styron eand colleagues (2011) found that preoperative physical function was a significant predictor of TRTW at 3 months after TKR, they did not examine the predictive relationship between postoperative physical function and TRTW. However, it is well established that preoperative physical function is associated with postoperative physical function, so participants in this study with higher preoperative physical function likely also had higher postoperative physical function (Halket, Stratford, Kennedy, & Woodhouse, 2010; Ip, Abrishami, Peng, Wong, & Chung, 2009; Rakel et al., 2012).

The current study supports the use of a standardized disease specific questionnaire to measure postoperative physical function around the time of expected recovery following a planned medical event. Because the correlation between postoperative physical function and postoperative pain was statistically significant in this study, indicating that there was high collinearity between postoperative physical function and postoperative pain, only one of these postoperative variables (i.e. physical function) was chosen as a candidate variable for the final regression model.

Since the pseudo R-squared values are similar, all models appear to have similar goodness-of-fit to these data, indicating that their predictive accuracies are roughly equivalent. Taken together, these findings indicate that, although neither postoperative pain nor postoperative physical function appear to predict TRTW following a TKR, they may influence TRTW through different pathways. To investigate this further, the mechanisms through which postoperative physical function and postoperative pain

influence other TRTW predictors need to be more comprehensively identified, measured with great precision and accuracy, and then tested in predictive models using large and demographically diverse samples.

This finding has direct implications in the clinical setting. Nurses can educate patients about postoperative pain management strategies that help patients as they recover from a planned medical event and may include (but not limited to): meditation, passive muscle relaxation, ice, and stretching. Incorporating these pain management strategies into care of the postoperative patient could help decrease pain and improve physical function. Future research is needed to better understand the role of the nurse in postoperative pain management and TRTW following a planned medical event.

Other Variables

Age, sex, comorbid conditions, race, ethnicity, income, education, preoperative physical function, social support, depression, trait anxiety, pain catastrophizing, and activity at work were not predictors of TRTW following TKR. Past research suggests mixed evidence that age (Lyall et al., 2009; Sultan et al., 2006), sex (Mobasheri et al., 2006; Nunley et al., 2011), and race/ethnicity (Blinder et al., 2012) may predict TRTW following a variety of planned medical events. These disparate findings can be explained primarily through differences in sample characteristics between the current study and past studies.

The distribution of age in the current study was relatively small compared to the past studies (Lyall et al., 2009; Sultan et al., 2006), which had much wider age distributions. These wider age distributions combined with larger sample sizes allowed

their analysis to be completed with greater statistical power, and, thus, a greater likelihood of identifying statistically significant findings.

Distribution of the sexes was also unique in the current study, which had slightly more females (55%) than males, compared to past studies. Prior research about total hip replacements had different proportions of sex than we reported in the current study. For example, past studies (Mobasheri et al., 2006; Nunley et al., 2011), had more males (65% and 65.8% respectively) than females undergoing the planned medical event. This subtle difference in proportions of females versus males between past studies and the current study provides some evidence that sex (or a variety of unmeasured sex-dependent factors) may influence TRTW differently after TKR than after other types of planned medical events. Future research that examines predictors of TRTW following a planned medical event affecting more females than males, as in the current study, is necessary to validate this negative finding.

Although race and ethnicity were non-significant predictors of TRTW in this study, Blinder et al. (2012) found the opposite in a sample of female breast cancer survivors. These disparate findings can be easily explained by the difference in distribution of participant race and ethnicity between the Blinder study and the current study. Blinder et al. (2012) used purposive sampling techniques to recruit a predominantly Latina sample (62%) with the remaining participants (38%) being non-Latina white females. In contrast, the current study had an overwhelming proportion of whites (94.7%) and non-Latinos (97.7%). With such a homogeneous sample, the current study was severely underpowered to detect differences in TRTW between ethnic groups. This is not uncommon when using convenience sampling techniques, particularly in

research settings that are uniquely homogeneous, such as that used in the current study. Regardless, future research that oversamples for non-white and Latino participants is essential to explore the relationship between race, ethnicity, and TRTW following a planned medical event.

Comorbid conditions did not predict TRTW following a TKR. These surprising results are contradictory to the evidence that patients with comorbid conditions have a longer TRTW than those without (Luyckx et al., 2011; Wagner et al., 2007). Although the group that returned to work in less than 5 weeks tended to have fewer comorbid conditions than the group that returned to work at 6 weeks (1.5 versus 2.2), these differences were not statistically significant. Given that this variable was measured on a ratio scale, which should have provided optimal power to detect statistically significant differences between the TRTW groups, it is possible that this negative finding is related to an inadequate sample size. Future research using a larger sample size is necessary to confirm this finding.

Income, education, and activity at work were also not significant predictors of TRTW following a TKR. This negative finding, when controlling for other factors in the multivariate analysis, may be related to the small sample size. This study was underpowered to test for interaction effects between these variables and TRTW. To test for each interaction, an additional 10 participants would have been required. However, workplace activity and education were not significantly different between return to work groups at the $\alpha = 0.05$ level and were not included as candidates in the regression. Future research should include additional factors related to marital status (e.g. number of dependents, adequacy of additional incomes) should be considered as potential mediating

variables in exploring the relationship between marital status and TRTW following a planned medical event.

Social support was also not a statistically significant predictor of TRTW following a TKR. This finding is not consistent with the literature. A recent phenomenological study found that workers who were successful in returning to work with chronic musculoskeletal pain relied heavily upon support from both their family and their employer (Jakobsen & Lillefjell, 2014). Similarly, a meta-synthesis of qualitative studies that examined facilitators of return to work among those with a work absence related to mental illness found that social support from employers and colleagues were almost universally included as a theme or sub-theme (Andersen, Nielsen, & Brinkmann, 2012). In fact, the importance of coworker or colleague influence over successful return to work after a health-related work absence has recently been described in a theoretical model (Dunstan & MacEachen, 2013), which recommends that coworkers' perceived fairness of work accommodation mediates how coworkers behave toward the employee (e.g. supportive versus antagonism). Furthermore, strong social support from colleagues and others has been shown to promote return to work following a work-related illness or injury (Claudi Jensen, 2013). These findings suggest that the use of a tool that includes worker's colleagues, employer, and a broader definition of social support may be helpful in detecting differences in this variable. Despite the seemingly overwhelming importance of social support to return to work, the current study found no statistically significant relationship between perceived social support and TRTW in this sample. Several possibilities exist to explain this inconsistency. First, this is the only study to have specifically examined the relationship between social support and TRTW after a TKR,

whereas most other studies have focused on either a different outcome altogether (e.g. any return to work instead of TRTW) or an unplanned illness or injury. Workers who have experienced an unplanned illness or injury may require a different perceived level of social support to return to work, compared to workers who have experienced a planned medical event. Second, perceived social support is a complex phenomenon affected by characteristics that are intrinsic to the worker, intrinsic to those providing social support, and unique to the worker's personal or professional relationship with those providing social support. The SPS instrument didn't measure social support at the workplace, which could have explained the non-significant results. Therefore, future research should include social support that specifically measure social support at home and the workplace.

Depression, trait anxiety and pain catastrophizing were also not significant predictors of TRTW following a TKR, although each had a directional trend with TRTW that is consistent with findings from the literature. The presence of depression has been shown to delay TRTW after disc herniation surgery (Donceel & Du Bois, 1999) and after cardiac transplantation (White-Williams et al., 2011). In the current study, fewer participants in the "less than 5 weeks" group had depression than those in the two later groups. This study utilized a dichotomous measurement approach for depression ("present" or "absent"), which may have contributed to a diminished ability to detect a statistically significant relationship between intensity of depression and TRTW. Such a relationship may have been more readily identified had a more precise measure of depression been used. Alternatively, a larger sample size could have offset this measurement imprecision. Regardless, future research should examine the predictive

effect of depression on TRTW after a TKR using a measure of depression that is maximally precise and a sample that is adequately powered to test for such an effect.

In previous research, a high level of anxiety and pain catastrophizing were associated with delayed TRTW (Cowan et al., 2012). The current study showed a trend toward statistical significance a difference between TRTW groups for pain catastrophizing but not trait anxiety. Among patients undergoing a carpal tunnel release surgery, Cowan et al. (2012) found workers were more susceptible to catastrophic thinking and anxiety in those having less work activity. One possible explanation for these findings is that there was no difference detected for work activity in the current study. If there were differences in work activity, the current study may have been able to detect a difference in pain catastrophizing and anxiety as well. Also, differences in types of planned medical events (carpal tunnel release surgery vs. TKR) may be attributed in these differences in trait anxiety and pain catastrophizing in the current study. Researchers should continue to assess trait anxiety, pain catastrophizing and the relationship with TRTW following a planned medical event.

In summary, the current study was unable to provide evidence that age, sex, race, ethnicity, education, income, work activities, social support, depression, trait anxiety, or pain catastrophizing significantly predicted TRTW following a TKR. This finding is contrary to much of the published literature about return to work following a variety of planned medical events. However, none of these studies found all of these variables to predict TRTW, and many evaluated return to work as a dichotomous variable rather than one with an ordinal distribution. It is possible that the current study was inadequately powered to detect a true statistically significant relationship between all of these variables

and TRTW in this population. More precise and/or accurate measures, testing for interaction effects between independent variables, enrollment of a more diverse sample through oversampling of racial and ethnic minority groups, and increasing the sample size are potential solutions to better evaluate these relationships.

Routine Practices of TRTW Following TKR

In this study, the majority (93.1%) of participants returned to work after TKR surgery. However, previous return to work research reported smaller percentages that ranged from 56% to 85% of workers returning to work following a TKR (Foote et al., 2010; Husted et al., 2011; Styron et al., 2011). One possible explanation for these high return to work numbers is that this study's inclusion criteria was current employment at the time of enrollment. Another possible explanation for this discrepancy is the measurement of TRTW was collected at greater time intervals after the TKR in the previous studies, than the current study. The large variation of time points ranging from 3 months-5 years postoperatively could be attributed to a difference between these groups.

In the current study, most (91%) had also planned to return to work and most (84.2%) of participants reported that their TRTW was appropriate following a TKR. Although appropriateness of TRTW has not been studied after a TKR, Styron et al. (2011) found that sense of urgency was related to return to work at 3 months following a TKR. Appropriateness of TRTW and plan to return to work may be associated with urgency to return to work and would need to be explored in future studies. These novel findings can provide insight into workers plan and perceived appropriateness to return to work after a TKR. Therefore, workers may have preoperative return to work plans that may be earlier or later than the recommended amount (6 weeks) and those return to work

plans may be considered appropriate based on these findings. More research is needed to determine the role of the health care provider in the workers' plans to return to work.

Most of the participants returned to the same hours per week and the same occupation after their TKR surgery. Some participants were able to increase the hours worked per week (from part-time to full-time) following the TKR surgery. This finding is not surprising due to the debilitating nature of painful knee osteoarthritis and the purpose of TKR surgery is to restore optimal function to the joint. In fact, participants used more workplace modifications before a TKR and fewer workplace modifications after the TKR. Most of the preoperative workplace modifications described in this sample required low levels of technology, which are both inexpensive and can be implemented over a brief time frame. Some examples of workplace modifications include: avoiding certain physical actions, avoiding kneeling, decreasing standing time, decreasing walking, and elevating the knee when at rest. These preoperative modifications to help reduce the worker's knee osteoarthritis pain may be a temporarily needed until the worker can have surgery to replace their knee joint. Therefore, helping workers with osteoarthritis make simple modifications to their work environment is something that occupational nurses can implement in their daily practice. However, since the preoperative workplace modifications described in this study were significantly predictive of longer TRTW after a TKR, the clinical effectiveness of these interventions may need to be examined more closely in this population. Because these modifications may further weaken muscles surrounding the affected knee joint, an approach that combines strategies for pain avoidance and muscle strengthening may be a more effective intervention to promote TKR recovery and shorten TRTW. The current study has found that TKR can help

workers return to their same jobs, possibly have the ability to work more hours per week, and a decrease in workplace modifications. These findings have direct nursing practice implications. Occupational health nurses can use these findings to inform their conversations with workers about the occupational benefits of a TKR for severe knee osteoarthritis.

Strengths

The strengths of this study support its contribution to research about TRTW following a planned medical event, using TKR as an exemplar. The finding that not requiring preoperative workplace modifications predicts early TRTW following a TKR is unique in this study. Inclusion of a simple, dichotomous question to assess for workplace modifications was successful in this study and would be easy to include in future studies.

Another strength of this study was the study design. Study variables were collected at set-time points (preoperative visit, 6 weeks postoperative, and 6 months) during the normal recovery time after a TKR. This method lends itself well to future studies with other types of planned medical events with predictable patterns and routine follow-up office visits. A major strength of this study was the measurement of the dependent variable (TRTW). As discussed in Chapter 2, using a series of categories around the time of typical return to work following a TKR helped reduce recall bias when opposed to asking for a specific date that return to work occurred. This approach was adequate to identify helpful predictors of TRTW.

Finally, another strength of this study was the incorporation of the Occupational Safety and Health Administration's Standard Industry Classification Codes to report participants' occupations. This method provided a structured approach to report

occupations. Using a standardized approach has only recently been addressed in the literature via the Human Resources Development Canada National Occupation Classification Matrix (Sankar et al., 2013). This Canadian Classification Matrix, much like OSHA's SIC codes, provides clear definitions of occupations and higher level groupings (i.e. occupations in manufacturing a utilities, sales and service occupations, health occupations) and utilization of these occupation classification systems is lacking in the TRTW literature following a planned medical event literature. Future research should report industry classification codes as a standardized method to further classify worker's occupations.

Implications for Future Research

These findings highlight the need for more research in TRTW following a planned medical event, especially after a TKR. In this case, workers are likely to interface with the orthopedic nurse while at the preoperative and postoperative visits. Incorporating simple workplace assessment questions into the preoperative orthopedic may help orthopedic nurses give the worker a more accurate time to expect to return to work after their TKR. In addition, more research is needed to better understand the role of the employer, work environment and work place factors (amount of sick leave, vacation time, coworkers, boss support) that effect TRTW following a planned medical event.

Limitations

Several limitations exist in this dissertation study that used a secondary data analysis approach. This study's work survey was created and added to the battery of tools that were administered during the primary study, and therefore bound by the variables

collected in the parent study. This approach prevented the study from being adequately powered to evaluate multiple relationships together. It also prevented the ability to look at interactions between variables. Every effort was made to eliminate missing data (phone calls, direct inspection of data collection form) and maximize the sample size. Follow up phone calls were made to collect missing data; however, these phone calls provided only a total of 11 participants with complete data (5 preoperative and 6 postoperative workplace questionnaires) and were a considerable amount of time after the worker's TKR surgery and this could have influenced the ability to retrieve missing data. The smallest category of TRTW was less than 5 weeks following a TKR (n=25) limited the number of variables that this study was powered to use in the regression model. This study was unable to test for interaction effects of the independent variables, or to control for the use of TENS in the primary study, which may have influenced TRTW in this sample. Univariate analysis revealed that a slightly higher proportion of participants who returned to work in less than 5 weeks used TENS than those who returned to work in more than 7 weeks, while this finding indicates that TENS use may hasten return to work, this variable was not included in multivariate analysis.

All measurements in this study were collected via self-report including questions related to work activity, workplace modifications, occupation, and return to work. It is possible that participants did not understand the meaning of some of these concepts, although the questionnaire was pilot-tested prior to implementation. In the future, a stronger design that includes a site visit and observation of work, objective physical function measurements (quad strength, timed up and go test, etc.) and a list of essential job functions would increase insight into the effect of these variables on TRTW,

particularly the effect of workplace modifications on TRTW following planned medical events.

Finally, this study used a sample that was highly homogeneous in terms of sex, race, ethnicity, and education. Therefore, generalizability of findings to non-similar populations is quite limited. Future research that attempts to oversample specific patient groups may be a useful strategy, particularly in research settings that are highly homogeneous.

Conclusion

In conclusion, preoperative workplace modifications predicted return to work at 6 weeks and delayed return to work can be predicted by poor physical function after a total knee replacement. These findings have important clinical implications for nurses. Preoperatively, nurses can incorporate patients' job requirements and preoperative modifications into an individualized plan for return to work. Postoperatively, nurses should educate patients about pain management strategies that to help decrease pain and improve physical function as they recover from a planned medical event. Knowledge gained from this study provides insight into the unique relationship between preoperative workplace modifications, postoperative physical function on TRTW following a planned medical event. More effort should be made to facilitate TRTW following a planned medical event to improve the health of our workforce.

Supplemental Analysis

In a supplemental analysis, a generalized logit models for TRTW (<5 weeks vs at 6 weeks, > 7weeks vs at 6 weeks, and >7 weeks vs <5 weeks; using the second category listed as the reference category) was fitted to include one independent variable of interest.

Odds ratios (with 95% confidence intervals), and P-values are listed in Tables 1a-4a included in this supplement. Variables with a P<0.10 for association with TRTW less than 5 weeks (6 weeks as the reference category) were annual income of $100,000 and greater (p=0.046), pain catastrophizing (p=0.065) and modify work prior to surgery (p=0.008; Table 15). Age, sex, cormorbid conditions, race, ethnicity, education, marital status, social support, depression, anxiety, pain, physical function, activity at work, hours worked per week, years at job, last day of work prior to surgery, plan to return to work, 6 week pain, and 6 week physical function were not significantly associated with TRTW less than 5 weeks following a TKR (P>0.10).

Variables with a P<0.10 for association with TRTW greater than 7 weeks (<5 weeks as the reference category) were comorbid conditions (p=0.057), annual income of $100,000 and greater (p=0.038), 6 week pain (p=0.006), and 6 week physical function (p=0.004; Table 16). Age, sex, race, ethnicity, education, marital status, social support, depression, anxiety, pain catastrophizing, pain, physical function, activity at work, years at job, modify work, last day of work prior to surgery and plan to return to work were not significantly associated with TRTW greater than 7 weeks following a TKR (P>0.10).

Finally, variables with a P<0.10 for association with TRTW greater than 7 weeks (6 weeks as the reference category) were activity at work (p=0.055), hours worked per week (p=0.036), modify work prior to surgery (p=0.080), 6 week pain (p=0.028), and 6 week physical function (p=0.011; Table 17). Age, sex, cormorbid conditions, race, ethnicity, annual income, education, marital status, social support, depression, anxiety, pain catastrophizing, pain, physical function, activity at work, years at job, last day of

work prior to surgery and plan to return to work were not significantly associated with TRTW greater than 7 weeks following a TKR (P>0.10).

The collinearity analyses described in Chapter 4 were used to select variables for inclusion in these specific regression analyses. Based on these results, 6 week pain was not included in the analyses due to its high correlation with 6 week function. Then, each potential candidate variable was examined for collinearity with other independent variables using Spearman's *rho* (see Dissertation, Chapter 4: Table 8). For the less than 5 weeks (vs 6 weeks) category, pain catastrophizing, income and work modifications were not correlated. Therefore, both variables could be included in the exploratory model.

In the greater than 7 weeks (vs. 5 weeks) category, comorbid condition was significantly correlated with 6 week physical function (Spearman's rho=-0.256, p=0.009) and 6 week pain is significantly correlated with 6 week physical function (Spearman's rho=0.766, p=0.000). Income was not correlated with any candidate independent variables for this TRTW category. Therefore, to eliminate collinearity between two independent variables only 6 week physical function was used along with annual income as candidate variables in this category.

In the greater than 7 weeks (vs. 6 weeks) category, workplace activity and hours worked per week were not correlated with any other independent variable in this category. Modify work prior to surgery was significantly correlated with 6 week pain (Spearman's rho=0.260, p=0.006) and, as previously established, 6 week pain is significantly correlated with 6 week physical function (Spearman's rho=0.766, p=0.000). Therefore, 6 week pain was eliminated from further analysis to avoid collinear variables.

Workplace activity, hours worked per week, modification to work prior to surgery and 6 week physical function was included as candidate variables in this category.

Next, three binary logistic regression models were fitted to predict the TRTW category based on the following candidate variables as described previously. The predictors of return to work vary based on time. Participants that had made a preoperative workplace modification were less likely to work at less than 5 weeks (95% CI 0.017-0.469, p=0.004) relative to those participants that returned to work at 6 weeks, while keeping pain catastrophizing and income constant in the model (Table 18).

Participants that at returned to work at greater than 7 weeks were less likely to make less money (95% CI 0.013-0.851, p=0.035) and have poor physical function (95% CI 0.852-0.975, p=0.007) than those participants who returned in less than 5 weeks, when comorbid conditions are constant in the model.

Finally, participants that returned to work in greater than 7 weeks were 3.087 more likely to have more active jobs (95%CI 1.218-7.822, p=0.017), less likely to have made a preoperative modification at work (95% CI 0.059-0.786, p=0.020), and have poor physical function (95%CI 0.882-0.980, p=0.007) compared to those who returned at 6 weeks following a TKR when work status is held constant in the model.

Table 15. Odds Ratios of Individual Preoperative Variables on TRTW (< 5 weeks)

		< 5 weeks (vs at 6 weeks)		
Variables	**n**	**Odds Ratio**	**95% CI**	**P-value**
Age	55	1.047	0.968-1.132	0.249
Sex (female)	55	0.462	0.155-1.375	0.165
Comorbid conditions	52	0.739	0.501-1.091	0.128
Race (white)	55	0.00	0.00	0.999
Ethnicity (not Hispanic/Latino)	55	0.00	0.00	0.999
Annual Income	54			
$0-39,999	15	Ref	Ref	
$40,000-99,999	21	0.800	0.191-3.347	0.760
$100,000 and greater	14	5.00	1.030-24.28	**0.046**
Education	54			
High School	11	0.833	0.162-4.295	0.890
Grad College/Some College	31	0.722	0.190-2.752	0.633
Post-Grad School	12	Ref	Ref	
Marital Status	54		0.268-3.130	
Married or living with SO		0.917		0.890
Social Support (SPS, 0-96)	53	1.011	0.948-1.077	0.742
Depression (GDS, yes)	55	2.667	0.260-27.38	0.409
Anxiety (STAI, 0-80)	53	0.966	0.896-1.041	0.366
Pain Catastrophizing (PCS, 0-52)	52	0.919	0.841-1.005	**0.065**
Pain (KOOS, 0-100)	53	1.022	0.987-1.058	0.213
Physical Function (KOOS, 0-100)	51	1.025	0.990-1.061	0.166
Activity at Work (Baecke, 0-6)	55	1.381	0.677-2.816	0.375
Hours per week (Full-time)	55	0.531	0.156-1.813	0.312

Table 15. Continued

Years at current work status?	48	1.023	0.982-1.067	0.278
Modify work prior to surgery (yes)	54	0.212	0.067-0.670	**0.008**
Last day of work prior to surgery (1-2 days)	55	1.312	0.326-5.291	0.702
Plan to return to work? (yes) Yes No Maybe	54 49 2 3	 1.630 0.00 Ref	 0.138-19.18 0.00 Ref	 0.698 0.999
6 week Pain (KOOS, 0-100)	55	1.023	0.985-1.062	0.244
6 week Physical Function (KOOS, 0-100)	55	1.016	0.975-1.058	0.463

Possible candidate variable at the p< 0.10 level (2-tailed).

Table 16. Odds Ratios of Individual Preoperative Variables on TRTW (7 weeks)

		7 weeks (vs. < 5 weeks)		
Variables	**n**	**Odds Ratio**	**95% CI**	**P-value**
Age	64	0.993	0.932-1.058	0.828
Sex (female)	64	0.713	0.290-1.955	0.511
Comorbid conditions	61	1.435	0.989-2.083	**0.057**
Race (white)	64	0.00	0.00	0.999
Ethnicity (not Hispanic/Latino)	64	0.00	0.00	1.00
Annual Income	57			
$0-39,999	14	Ref	Ref	
$40,000-99,999	26	1.852	0.446-7.691	0.396
$100,000 and greater	13	0.167	0.031-0.904	**0.038**
Education	57			
High School	18	3.900	0.762-19.95	0.102
Grad College/Some College	29	1.846	0.428-7.962	0.411
Post-Grad School	10	Ref	Ref	
Marital Status				
Married or living with SO	56	0.536	0.142-2.018	0.356
Social Support (SPS, 0-96)	59	0.994	0.936-1.055	0.837
Depression (GDS, yes)	64	0.190	0.22-1.653	0.133
Anxiety (STAI, 0-80)	59	1.042	0.972-1.117	0.249
Pain Catastrophizing (PCS,0-52)	58	1.053	0.979-1.132	0.167
Pain (KOOS, 0-100)	58	0.993	0.964-1.023	0.651
Physical Function(KOOS,0-100)	56	0.986	0.955-1.017	0.370
Activity at Work (Baecke, 0-5)	64	1.515	0.754-3.043	0.243
Hours per week (Full-time)	63	0.581	0.202-1.671	0.314
Years at current work status?	57	0.974	0.938-1.011	0.167

Table 16. Continued

Modify work prior to surgery (yes)	63	0.523	0.182-1.501	0.228
Last day of work prior to surgery (1-2 days)	64	2.063	0.575-7.393	0.264
Plan to return to work?	63			
Yes	57	0.530	0.052-5.424	0.593
No	2	Ref	Ref	
Maybe	4	0.00	0.00	0.999
6 week Pain (KOOS, 0-100)	63	0.951	0.918-0.985	**0.006**
6 week Physical Function (KOOS, 0-100)	62	0.937	0.896-0.979	**0.004**

Possible candidate variable at the p< 0.10 level (2-tailed).

Table 17. Odds Ratios of Individual Preoperative Variables on TRTW (> 7 weeks)

		>7 weeks (vs at 6 weeks)		
Variables	**n**	**Odds Ratio**	**95% CI**	**P-value**
Age	69	1.033	0.968-1.102	0.324
Sex (female)	69	0.647	0.241-1.738	0.388
Comorbid conditions	65	1.057	0.772-1.447	0.729
Race (white)	69	1.37	0.82-22.89	0.826
Ethnicity (not Hispanic/Latino)	69	0.368	0.032-4.268	0.424
Annual Income	63			
$0-39,999	19	Ref	Ref	
$40,000-99,999	35	1.481	0.482-4.550	0.492
$100,000 and greater	7	0.833	0.145-4.781	0.838
Education	63			
High School	16	Ref		
Grad College/Some College	34	3.250	0.661-15.98	0.147
Post-Grad School	10	1.333	0.318-5.590	0.694
Marital Status				
Married or living with SO	63	0.491	0.141-1.712	0.264
Social Support (SPS, 0-96)	66	1.004	0.948-1.065	0.884
Depression (GDS, yes)	69	0.508	0.120-2.157	0.359
Anxiety (STAI, 0-80)	66	1.011	0.947-1.079	0.752
Pain Catastrophizing (PCS, 0-52)	64	0.987	0.921-1.059	0.724
Pain (KOOS, 0-100)	65	1.013	0.983-1.043	0.404
Physical Function (KOOS, 0-100)	65	1.008	0.980-1.038	0.576
Activity at Work (Baecke, 0-5)	69	1.862	0.986-3.519	**0.055**
Hours per week (Full-time)	68	3.238	1.078-9.724	**0.036**

Table 17. Continued

Years at current work status?	61	0.994	0.958-1.032	0.757
Modify work prior to surgery (yes)	67	0.405	0.147-1.114	**0.080**
Last day of work prior to surgery (1-2 days)	69	1.571	0.505-4.886	0.435
Plan to return to work? (yes)	67			
Yes	62	Ref		
No	0	None		
Maybe	5	0.864	0.135-5.542	0.878
6 week Pain (KOOS, 0-100)	68	0.962	0.929-0.996	**0.028**
6 week Physical Function (KOOS, 0-100)	67	0.947	0.908-0.988	**0.011**

Possible candidate variable at the p< 0.10 level (2-tailed).

Table 18. Binary Logistic Regression of TRTW

n=48	**< 5 weeks (vs at 6 weeks)**		
Variables	**Odds Ratio**	**95% CI**	**P-value**
Modify work for knee pain	0.088	0.017-0.469	0.004
When pain catastrophizing and income are constant.			
n=51	**>7 weeks (vs <5 weeks)**		
Variables	**Odds Ratio**	**95% CI**	**P-value**
Income			
$0-39,999	Ref	Ref	
$40,000-99,999	0.914	0.158-5.306	0.921
$100,000 and greater	0.107	0.013-0.851	0.035
6 wk Physical Function	0.912	0.852-0.975	0.007
When comorbid conditions is constant			
n=65	**>7 weeks (vs at 6 weeks)**		
Variables	**Odds Ratio**	**95% CI**	**P-value**
Work Activity	3.087	1.218-7.822	0.017
Modify work for knee pain	0.215	0.059-0.786	0.020
6 wk Physical Function	0.930	0.882-0.980	0.007
When work status (full-time) is constant.			

APPENDIX A

KOOS KNEE QUESTIONNAIRE

Today's Date: ____/____/____ Date of Birth: ____/____/_____

Name: _____

Instructions: This survey asks for your view about your knee. This information will help us keep track of how you feel about your knee and how well you are able to perform your usual activities.

Answer every question by ticking the appropriate box, only one box for each question. If you are unsure about how to answer a question, please give the best answer you can.

Symptoms

These questions should be answered thinking of your knee symptoms during the **last week**.

S1. Do you have swelling in your knee?

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Always

S2. Do you ever feel grinding, hear clicking, or any other type of noise when your knee moves?

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Always

S3. Does your knee catch or hang up when moving?

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Always

S4. Can you straighten your knee fully?

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Always

S5. Can you bend your knee fully?

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Always

Stiffness

The following questions concern the amount of joint stiffness you have experienced during the **last week** in your knee. Stiffness is a sensation of restriction or slowness in the ease with which you move your knee joint.

S6. How severe is your knee joint stiffness after first wakening in the morning?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

S7. How severe is your knee stiffness after sitting, lying, or resting later in the day?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

Pain

P1. How often do you experience knee pain?

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Always

What amount of knee pain have you experienced the **last week** during the following activities?

P2. Twisting/pivoting on your knee

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

P3. Straightening knee fully

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

P4. Bending knee fully

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

P5. Walking on flat surface

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

P6. Going up or down stairs

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

P7. At night while in bed

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

P8. Sitting or lying

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

P9. Standing upright

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

Function and Daily Living

The following questions concern your physical function. By this we mean your ability to move around and to look after yourself. For each of the following activities please indicate the degree of difficulty you have experiences in the **last week** due to your knee.

A1. Descending stairs
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A2. Ascending stairs
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

For each of the following activities, please indicate the degree of difficulty you have experienced in the **last week** due to your knee.

A3. Rising from sitting
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A4. Standing
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A5. Bending to floor/pick up an object
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A6. Walking on flat surface
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A7. Getting in/out of care
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A8. Going shopping
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A9. Putting on socks/stockings
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A10. Rising from bed
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A11. Taking off socks/stockings
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A12. Lying in bed (turning over, maintaining knee position)

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A13. Getting in/out of bath
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

For each of the following activities please indicate the degree of difficulty you have experienced in the **last week** due to your knee.

A14. Sitting
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A15. Getting on/off toilet
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A16. Heavy domestic duties (moving heavy boxes, scrubbing floors, etc)
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A17. Light domestic duties (cooking, dusting, etc)
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

Function, Sports and Recreational Activities

SP1. Squatting
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

SP2. Running
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

SP3. Jumping
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

SP4. Twisting/pivoting on your injured knee
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

SP5. Kneeling
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

Quality of Life

Q1. How often are you aware of your knee problem?

☐ Never ☐ Monthly ☐ Weekly ☐ Daily ☐ Constantly

Q2. Have you modified your life style to avoid potentially damaging activities to your knee?

☐ Not at all ☐ Mildly ☐ Moderately ☐ Severely ☐ Totally

Q3. How often are you troubled with lack of confidence in your knee?

☐ Not at all ☐ Mildly ☐ Moderately ☐ Severely ☐ Extremely

Q4. In general, how much difficulty do you have with your knee?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

APPENDIX B

MODIFIED HABITUAL PHYSICAL ACTIVITY SCALE

Describe your level of physical activity at work.

☐ Sedentary, light work (e.g. minimal ambulation or activity, white collar, light cleaning)

☐ Light, somewhat mobile work (e.g. walking, heavy cleaning, light sports, assembly)

☐ Mobile, fairly heavy work (e.g. lifts >50 lbs., moderate sports, walking routinely)

☐ Heavy work (e.g. lifts 50 – 100 lbs., vigorous sports)

How often do you do each of the following activities at work:

Sit

☐ Never ☐ Seldom ☐ Sometimes ☐ Often ☐ Always

Stand

☐ Never ☐ Seldom ☐ Sometimes ☐ Often ☐ Always

Walk

☐ Never ☐ Seldom ☐ Sometimes ☐ Often ☐ Always

Lift heavy loads

☐ Never ☐ Seldom ☐ Sometimes ☐ Often ☐ Always

How often do you sweat at work?

☐ Very often ☐ Often ☐ Sometimes ☐ Seldom ☐ Never

How often are you tired after work?

☐ Very often ☐ Often ☐ Sometimes ☐ Seldom ☐ Never

APPENDIX C

RETURN TO WORK QUESTIONS (BEFORE TKR SURGERY)

1. Which best describes your current work status:

- ☐ Employed Full-time (approximately 40 hrs/wk)
- ☐ Employed Part-time (less than 40 hrs/wk)
- ☐ Disabled (SKIP to question #15)
- ☐ Retired (SKIP to question #15)
- ☐ Volunteer/Caregiver (SKIP to question #15)
- ☐ Homemaker (SKIP to question #15)
- ☐ Unemployed (not a Volunteer/Caregiver/Homemaker/Disabled/Retired)

If unemployed, skip to question #15.

2. Number of years at current work status: _____

3. What is your current occupation? _____.

4. Which best describes your general physical activity *during work*:

☐ Sedentary, light work (ex. Minimal ambulation or activity, white collar, light cleaning)	☐ Light, somewhat mobile work (ex. Walking, heavy cleaning, light sports, assembly)	☐ Mobile, fairly heavy work (ex. Lifts >50 lbs., moderate sports, walking routinely)	☐ Heavy work (ex. Frequently lifts 50-100 lbs., vigorous sports)

5. At work I sit:

☐ never ☐ seldom ☐ sometimes ☐ often ☐ always

6. At work I stand:

☐ never ☐ seldom ☐ sometimes ☐ often ☐ always

7. At work I walk:

☐ never ☐ seldom ☐ sometimes ☐ often ☐ always

8. At work I lift heavy loads:

☐ never ☐ seldom ☐ sometimes ☐ often ☐ always

9. After working I am very tired:

☐ very often ☐ often ☐ sometimes ☐ seldom ☐ never

10. At work I sweat:

☐ very often ☐ often ☐ sometimes ☐ seldom ☐ never

11. Have you had to modify your work environment or job duties to accommodate your knee pain?

☐ No

☐ Yes. If you answered “yes” please specify why: _____

12. Anticipated Last Day of Work Prior to Surgery: __ __ /__ __ / __ __

13. Do you plan on returning to work post-TKR:

☐ No

☐ Yes

☐ Maybe

APPENDIX D

RETURN TO WORK QUESTIONS (6 MONTHS AFTER TKR SURGERY)

1. Which best describes your current work status:

- ☐ Employed Full-time (approx 40 hrs/wk)
- ☐ Employed Part-time (less than 40 hrs/wk)
- ☐ Disabled (SKIP to the end)
- ☐ Retired (SKIP to the end)
- ☐ Volunteer/Caregiver (SKIP to the end)
- ☐ Homemaker (SKIP to the end)
- ☐ Unemployed (not a Volunteer/Caregiver/Homemaker/Disabled/Retired)

If unemployed, (SKIP to the end).

3. What is your current occupation? _____.

4. Which best describes your general physical activity *during work*:

☐ Sedentary, light work (ex. Minimal ambulation or activity, white collar, light cleaning)	☐ Light, somewhat mobile work (ex. Walking, heavy cleaning, light sports, assembly)	☐ Mobile, fairly heavy work (ex. Lifts >50 lbs, moderate sports, walking routinely)	☐ Heavy work (ex. Frequently lifts 50-100 lbs., vigorous sports)

5. At work I sit:

☐ never ☐ seldom ☐ sometimes ☐ often ☐ always

6. At work I stand:

☐ never ☐ seldom ☐ sometimes ☐ often ☐ always

7. At work I walk:

☐ never ☐ seldom ☐ sometimes ☐ often ☐ always

8. At work I lift heavy loads:

☐ never ☐ seldom ☐ sometimes ☐ often ☐ always

9. After working I am very tired:

☐ very often ☐ often ☐ sometimes ☐ seldom ☐ never

10. At work I sweat:

☐ very often ☐ often ☐ sometimes ☐ seldom ☐ never

11. Which best describes the date you returned to work?

☐ Less than 5 weeks after TKR

☐ **at** 6 weeks after TKR

☐ 7-9 weeks after TKR

☐ 10-12 weeks after TKR

☐ 13-15 weeks after TKR

☐ Greater than 16 weeks after TKR

☐ have not returned to work

12. Was your return to work day appropriate after your TKR?

☐ Yes

☐ No

☐ If No, why?_____

13. Have you had to modify your work environment or job duties to accommodate your knee pain?

☐ No

☐ Yes. If you answered “yes” please specify why: _____

APPENDIX E

COMORBID CONDITIONS

Secondary Diagnosis (include any that the patient has currently)	
□ Heart Disease	□ Lung disease
□ Hypertension	□ Diabetes
□ Ulcer/stomach disease	□ Kidney Disease
□ Liver Disease	□ Anemia/blood disease
□ Cancer	□ Depression
□ OA/degenerative arthritis	□ Back Pain
□ Rheumatoid Arthritis	□ Smoker
□ Obesity	□ Other Medical Problem
If other medical diagnosis, specify below:	

APPENDIX F

IRB PERMISSION LETTER

THE UNIVERSITY OF IOWA

Human Subjects Office/
Institutional Review Board (IRB)
105 Hardin Library for the Health Sciences
600 Newton Road
Iowa City, Iowa 52242-1098
319-335-6564 *Fax* 319-335-7310
irb@uiowa.edu
http://research.uiowa.edu/hso

December 20, 2013

TO: Nicole Petsas
Graduate College
Barbara Rakel

FROM: J. Andrew Bertolatus, BA, MD
IRB Chair or Chair Designee

RE: Not Human Subjects Research Determination

I have reviewed the information submitted with your project titled 201312757 Predictors of Time to Return to Work following a Planned Medical Event: A Total Knee Replacement as an Exemplar. I have determined that the project described in the application *does not* meet the regulatory definition of human subjects research and does not require review by the IRB, because this current activity is limited to analysis of de-identified data (note: since the parent study is still open you probably could have handled this with a modification to that application, but I think the HSRD form is OK)

We appreciate your care in submitting this application to the IRB for review. If the parameters outlined within this Human Subjects Research application request change, re review and/or subsequent IRB review may be required.

Please don't hesitate to contact me if you have any questions. The Human Subjects Office can be reached via phone (319)-335-6564 or email irb@uiowa.edu.

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