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Biopsychosocial Variables Associated with the Development of Chronic Low Back Pain in Healthcare Workers

Jena Pauli
Virginia Commonwealth University

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BIOPSYCHOSOCIAL VARIABLES ASSOCIATED WITH THE DEVELOPMENT OF CHRONIC LOW BACK PAIN IN HEALTHCARE WORKERS

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

by

Jena Pauli

Bachelor of Science, Virginia Commonwealth University, Richmond, Virginia 1993
Master of Science, Georgetown University, Washington, DC 2009
Doctor of Philosophy, Virginia Commonwealth University, Richmond, Virginia 2020

Director: Dr. Jo Robins
Associate Professor
Department of Adult Health and Nursing Systems
Virginia Commonwealth University
Richmond, Virginia
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ABSTRACT

Purpose: Worldwide the incidence and prevalence of acute low back injury with pain (ALBIP) is increasing in healthcare workers (HCW). Approximately 27% of ALBIP result in chronic low back pain (CLBP). The primary aim of this study was to identify biopsychosocial factors that contribute to the development of CLBP. A secondary aim was to examine the predictive value of reliable and valid screening instruments to identify individuals at highest risk for CLBP.

Significance: Low back pain is the second most commonly reported pain condition in the United States, one of the leading causes of sick leave and is associated with cost estimates between $100 and $300 billion annually. While emerging evidence suggests that stress and work-related psychosocial factors play a role, it remains unclear which factors are the most significant. Use of a biopsychosocial conceptual model may illuminate the relationships among commonly co-occurring factors that contribute to the development of CLBP.

Methods: Using a descriptive repeated measures study design, HCW with an ALBIP were recruited from two healthcare systems. Data were collected on demographic, biological, and psychosocial variables, as well as screening instruments at enrollment and 12-weeks later.

Results: Results from this study contribute to the growing body of evidence regarding factors associated with the development of CLBP following an ALBIP occurrence in HCW. The participants in this study (N =21), fared better than anticipated following ALBIP. The majority did not miss time from work related to their injury, experienced minimal pain and disability and did not develop CLBP. Factors that may be associated with this include healthier lifestyles, the use of lift equipment in the workplace and high job satisfaction. Psychometric evaluation of two predictive screening instruments in this study evidenced strong reliability and validity.

Conclusion: This study contributes to elucidation of biopsychosocial variables associated with the development of CLBP following ALBIP as well as psychometric evaluation of two CLBP screening instruments to identify those at highest risk. Based on these results, additional research is needed to further examine factors that contribute to, as well as, prevent CLBP in HCW following ALBIP.

Keywords: Low back pain, Chronic low back pain, Biopsychosocial, Acute low back injury and pain, Healthcare Workers

Chapter I

Introduction

Statement of Problem

The prevalence of occupational back injuries among healthcare workers (HCW) worldwide has been estimated to be 15-64% in developed countries (Punnett & Wegman, 2004; Rezaee & Ghasemi, 2014; U.S. Bureau of Labor Statistics, 2018). Unfortunately, the incidence and prevalence are rising due to HCW factors including an aging nursing workforce, fatigue, prior back injury, psychosocial and workplace factors as well as increased overweight and obesity in the population (Occupational Safety and Health Administration, 2018; Vieira, Kumar, Coury, & Narayan, 2006). Prior research indicates that back injury is increasingly the reason nurses in particular leave or intend to leave their profession (Abolfotouh et al., 2015; Fochsen, Josephson, Hagberg, Toomingas, & Lagerstrom, 2006).

Nurses and other HCW are at increased risk for acute low back injury with pain (ALBIP). Unresolved injury occurs in 27% resulting in chronic low back pain (CLBP), which causes loss of wages, increased healthcare costs and decreased quality of life (Hartvigsen et al., 2018). Additional research identifying factors that contribute to the development of CLBP is needed.

Background and Significance

Worldwide ALBIP is a leading cause of work-related disability (Global Burden of Disease (GBD) Study 2016 Disease and Injury Incidence and Prevalence Collaborators, 2017; Lin, Tsai, Chen, & Huang, 2012). In developed countries, the prevalence of ALBIP in HCW is estimated to be 15-64%. It is the second most commonly reported pain condition in the United States (Institute of Medicine, 2011; Yang, Halderman, Lu, & Baker, 2016), one of the leading causes of sick leave (Hoy, Brooks, Blyth, & Buchbinder, 2010) and is associated with cost estimates between $100 and $300 billion annually (Freburger et al., 2009).

Within 22 occupation classifications, workers classified as health care practitioners and health care support workers, comprised 2 out of the 3 occupation groups with an increased risk of CLBP (Yang, Haldeman, Lu, & Baker, 2016). It affects HCW of all ages, ethnicities, levels of education and employment settings and is one of the most frequent reasons for sick leave and long-term absences from work (Dawson, Schluter, Hodges, Stewart, & Turner, 2011). Nurses and other HCW are among the highest risk occupations with respect to low back problems and have a higher prevalence of CLBP -- exceeding that of the general population (Yassi & Lockhart, 2013). For example, within nursing, the prevalence has increased from 21% in 1998 (Smedley, Inskip, Cooper, & Coggon) to 26.8% in 2018 (d'Ettorre, Vullo, Pellicani, & Ceccarelli, 2018) and according to the 2017 National Nursing Workforce Survey, it occurs in nurses during a life stage of high productivity (mean age of nurses at 51 years) (Smiley et al., 2018), thereby disrupting the role between work and family and compromising overall health and quality of life.

Although these injuries typically heal and pain resolves within 6-12 weeks, pain that lasts longer than 12 weeks is considered chronic and occurs in 20% of the US population (Von Korff, Lin, Fenton, & Saunders, 2007). CLBP is one of the nation's most expensive medical conditions and contributes to significant increases in health care spending (Yang et al., 2016). Research indicates because HCW typically cannot afford to be out sick for any length of time with an ALBIP, they often will continue to work (Lin et al., 2012), which interferes with healing and may contribute to development of repeated injury and CLBP. CLBP creates a burden both for the affected HCW and the work setting in which the HCW is employed due to the costs of absenteeism, compensation for injury and lost productivity. Psychosocial stressors and other workplace environmental factors are thought to contribute to the progression from ALBIP to CLBP (Bernal et al., 2015).

Biological, psychosocial and workplace environmental factors have been shown to contribute to and potentially predict the development of CLBP following ALBIP. For example, in nurses, age, sex, body mass index (BMI), muscle strength, pre-existing disability have also been associated with increased risk (Roffey, Wai, Bishop, Kwon, & Dagenais, 2010). Two systematic reviews of studies involving over 50,000 subjects revealed that previous back injury, psychosocial stressors and work-related factors such as lifting, job category, service area, organizational are significant predictors of back injury (Davis & Kotowski, 2015; Yassi & Lockhart, 2013). However, further research is needed to determine which factors contribute most significantly.

In addition to elucidating contributing factors, earlier identification of those at highest risk for the development of CLBP can help ensure early and specific treatment, which could significantly reduce the incidence of CLBP. To this end, a focus in the literature has been identification of predictive screening instruments to identify those at highest risk for CLBP following ALBIP. Two instruments have been identified as likely the most reliable and valid, but results have been mixed (Friedman et al., 2018; Karran et al., 2017; Mehling et al., 2015), thus, additional psychometric evaluation is need. Further, predictive models are rarely applied within the assessment of HCW yet are often used in research and practice within general patient populations. (Bergström, Hagberg, Busch, Jensen, & Björklund, 2014; Harris & Rampersaud, 2016; Melloh et al., 2011; Shearer et al., 2016).

Based on prior research and current gaps in the literature, the purpose of this study is to address gaps in knowledge related to biopsychosocial factors that contribute to the development of CLBP following an occupational ALBIP in HCW, as well as, to contribute to the literature on predictive screening tools to identify the ability of two of the most widely used instruments in predicting those at highest risk for progression to CLBP. Thus, the specific aims of this study are to: 1. Identify and describe biopsychosocial factors associated with the development of CLBP; and 2. Examine the psychometric properties and predictive strength of two CLBP risk screening instruments.

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Chapter 2

Conceptual Framework

An adaptation of the Biopsychosocial model guided design of this study. The adaptation of the original BPS model developed by Engel (1977), who proposed that biological, psychological, and social factors are crucial in determining when patients with a health condition are viewed as sick is the core framework guiding much of the research within LBP studies. This model highlights the dynamic relationships among a variety of BPS factors that can modulate a person's experience leading to the possible development of CLBP. For many who develop CLBP there is not a precise biological cause (Truchon, 2001). For the past 30 years, CLBP studies using the BPS model have provided evidence suggesting psychological constructs such as anxiety, depression, poor coping strategies, stress and pre-existing somatization are significant predictors of outcomes, such as increased functional disability, greater pain and work loss (Nicholas, Linton, Watson, Main, & "Decade of the Flags" Working Group, 2011; Gatchel, Peng, Peters, Fuchs, & Turk, 2007; Pincus, Burton, Vogel, & Field, 2002). Evidence also suggests that social and organizational factors influence the consequences of back pain such as work absenteeism, but fewer trials have evaluated the effect of social interventions (Loisel et al., 2005).

The World Health Organization's (WHO) Biopsychosocial Model (2001), as applied to The *International Classification of Functioning, Disability and Health*, known more commonly as ICF, also guided development of the study's conceptual model. The BPS model within the ICF provides a standard language and framework for the description of health and health-related states and integrates a coherent view of different perspectives of health: biological, individual and social.

LBP has historically been characterized and managed such that treatment for LBP was based on a biomedical model and included monotherapies such as bedrest, prescriptions from a wide array of pharmacotherapies, injections or surgery (Gatchel, 2015). However, Engel in 1977, posited that not all chronic health conditions were attributable to a specific pathophysiology suggesting the role of lifestyle and psychosocial factors as contributing to the development and exacerbation. This is true with regard to CLBP.

Although the BPS model has been incorporated into many LBP studies, often there are various and inconsistent integrations of the constructs utilized from the BPS model. This model acknowledges that LBP is a complex, multifactorial BPS problem that must be holistically examined to identify and address particularly modifiable factors (Mehrdad, Dennerlein, Haghighat, & Aminian, 2010).

The following sections describe each of the three constructs individually and the associated variables examined in this study.

Biological Construct

As identified in the WHO ICF guide (2001), the biological construct is based on physiological functions of body systems described as disability and functioning and are viewed as outcomes of interactions between health conditions (diseases, disorders and injuries) or related to body structures (anatomical parts of the body such as organs, limbs and their components). Previous research has identified several biological factors that contribute to the development of CLBP (Kim et al., 2014). In alignment with this research, the biological factors included in this study are described below.

Age. The highest incidence of LBP is between the age range of 35 to 55 years and symptom duration increases with age (National Institute of Neurological Disorders and Stroke, 2020; Wong, Karppinen, & Samartzis, 2017). In one longitudinal cross-sectional study of 1,008 persons aged 65 and older, researchers found that LBP prevalence is associated with increased age (Cecchi et al., 2006).

Body Mass Index. A multicenter cross-sectional study of 4,796 adults found that participants with a BMI of ≥ 25 was significantly higher in patients with an elevated BMI compared to those with normal or underweight BMI, as well as, shown evidence of a higher risk association between overweight, obesity and LBP (Heuch, I., Hagen, Heuch, I., Nygaard, & Zwart, 2010; Leboeuf-Yde, 2000; Manchikanti, Singh, Falco, Benyamin, & Hirsch, 2014; Shiri et al, 2008; Su, Kusin, Li, Ahn, & Ahn, 2018).

Function/disability. Low back pain is the number one cause of disability globally (GBD Study, 2017). Disability from LBP was responsible for over 60 million disability-adjusted life-years in 2015, an increase of 54% since 1990, with the biggest increase seen in low- and middle-income countries, and highest occurrence in working age groups worldwide (Hartvigsen et al., 2018). Research into the causes of actual physical impairments and functionality is not fully understood, however, impairments are readily demonstrated. One study conducted a systematic review of research studies (*N* = 15) regarding structural muscle changes of the lumbar and found results indicating atrophy in the multifidus and paraspinal muscles (Goubert, Oosterwijck, Meeus, & Danneels, 2016). Another study utilized a non-randomized case-control design to investigate trunk muscle recruitment patterns around the spine in those with chronic mechanical LBP and asymptomatic controls. Subjects included 20 with CLBP and lumbar instability, 20 asymptomatic controls and 12 patients with non-specific CLBP. Findings after a standing reach exercise under two different loading conditions, results showed those with instability demonstrated significantly higher activation level of the external oblique and rectus abdominus muscles compared to the control group (Silfies, Squillante, Maurer, Westcott, & Karduna, 2005).

Gender. Females are more susceptible to LBP and ultimately CLBP compared to males, regardless of age (Fernández-de-las-Peñas et al., 2011; Kim et al., 2014; Williams et al., 2015). One cross-sectional epidemiological study of adults 16 years of age and older (*n* = 29,478) evidenced a higher incidence of LBP among females (24.5%) compared to male (15.1%) participants (Fernández-de-las-Peñas et al., 2011).

Past medical history. A previous LBP occurrence is one of the best predictors of chronic disability (Truchon, 2001). While LBP is common among HCW and the majority of cases often resolve within the first six-weeks, 5% to 10% of will develop persistent back pain (Manchikanti et al., 2014) with most experiencing multiple episodes (Cassidy, Côté, Carroll, & Kristman, 2005; Hestbaek et al., 2003). A cross-sectional study of 740 HCW participants found in their analysis that the probability of having LBP was significantly higher among HCWs with a positive history of back trauma in the form of over exertional back trauma, falling or lifting heavy objects (Alnaami et al., 2019). Additionally, other studies confirmed over exertional back trauma and LBP is more common among HCWs with long working hours and more frequent patient transfers (Andersen et al., 2014). Another study utilizing a retrospective cross-sectional design in 72 non-HCW found that a history of LBP was associated with changes in attitudes, body composition, and functional movement in response to a variety of motor and stability challenges (McGill et al., 2003).

Physical activity. Different types and amounts of physical activity are related to persistent LBP in older adults (Fernández-de-las-Peñas et al., 2011). Generally, moderate or vigorous physical activity heightens the risk of LBP regardless of age (Heneweer, Picavet, Staes, Kiers, & Vanhees, 2012). A population-based study found that moderate (at least 30 minutes of moderate intensity activity on five or more days per week) and vigorous (at least 20 minutes of vigorous activity on three or more days per week) physical activity were significantly associated with increased risk of persistent LBP among women aged 65 years and older, while walking for 30 minutes on five or more days a week combined with strengthening exercises on two or more days per week lowered the risk of persistent LBP after adjusting for age and BMI (Fernández-de-las-Peñas et al., 2011).

Smoking. Smokers were more likely to experience LBP. It is thought that smokers may have different pain perception as compared to non-smokers although the underlying mechanism remains unclear (Shi, Weingarten, Mantilla, Hooten, & Warner, 2010). For example, in a cross-sectional study of 34,525 adults there was a significant association between smoking and back pain in the general population (Green, Johnson, Snodgrass, Smith, & Dunn, 2016). In fact, back pain increased with smoking exposure such that back pain was present in 23.5% of never-smokers, 33.1% of former smokers, and 36.9% of current smokers.

The biological factors examined in this study included relevant anthropomorphic measures of height and weight for calculation of body mass index (BMI). Additionally, age, past medical history (prior back injury and treatment and chronic illness diagnoses) and lifestyle factors (smoking, alcohol intake, and physical activity (although in some studies they may be considered social/environmental factors)) were included in this model.

Psychological Construct

An injury generates pain that disrupts homeostasis thereby producing stress that often triggers physiological and psychological responses. Psychological factors such as stress, have been identified as significant predictors of outcomes including greater functional disability, work loss and more severe pain (Pincus et al., 2013). Among adults, across the age spectrum, several studies have reported associations between stressful life events, PTSD, perceived stress, and chronic pain (Heidari et al., 2017).

Stress. While research is limited, at least two prior studies have shown associations between perceived stress and disability (Lindegård, Larsman, Hadzibajramovic, & Ahlborg, 2014; White et al., 2014). A two-year longitudinal cohort study examined the influence of stress and musculoskeletal pain work ability and job performance in 770 HCW. Perceived stress was measured as stress persisting for at least one month during the preceding 12 months and musculoskeletal pain noted as pain located in the joints, neck or low back. Study results indicated that frequent musculoskeletal pain in combination with perceived long-lasting stress at Time 1 was associated with a decreased work ability and work performance at follow-up.

In a cross-sectional study of 578 adults 70 years of age and older, researchers examined the association of perceived stress with pain intensity and pain interference measures over a 4-week period. Results showed that higher scores on the perceived stress scale (PSS) were associated with an increase in both pain intensity and pain interference and remained significant when pain intensity level was included as a model predictor (White et al., 2014).

Evidence from the above studies indicate a greater stress was associated with higher levels of pain intensity and interference. Since both are modifiable risk factors for cognitive decline and poor health outcomes, combined they reflect proactive interventions should be initiated in the workplace to minimize persistent stress reactions and conditions contributing to the development of ALBIP situations and to help promote well-being for HCWs and therefore, the organization.

As HCWs are often involved in a high-stress work environment and stressful situations, the psychological variable addressed in this study was perceived stress.

Social Construct

A growing body of research has begun to include the social construct of the BPS model. Social factors such as lack of support, unstable family life, poor previous work experiences, low job satisfaction, environmental stressors, work absenteeism and cultural influences have been demonstrated to contribute to the development of CLBP (Cano & Williams, 2010; Smith, Dainty, Williamson, & Martin, 2019).

Evidence from prior research indicates that the physical health of an individual can be greatly affected by his or her social support system (Clark, 2005; Keely et al., 2008). A lack of social support has been shown to affect progression to CLBP (Jordan, Thomas, Peat, Wilkie, & Croft, 2008). There is evidence that patients receiving higher levels of social support show lower levels of depression and pain severity and increased functional status (Deyo, 2015; Kerns, Rosenberg, & Otis, 2002; Wernicke, de Witt Huberts, & Wippert, 2017). Of research that has been done to date, heterogeneity in study variables and outcomes has been an issue. For example, when measuring social factors, some studies evaluate individual factors and others evaluate group factors. Also, with regard to outcomes, social factors have been typically measured as secondary outcomes with many case studies insufficiently powered to draw reliable conclusions. Thus, additional research is needed.

Education level and income. Associations between LBP and low levels of education and low income also have been reported (Webb et al., 2003). A multiphase cross-sectional study of 5,752 adults found that living in a low socioeconomic area was one of several significant predictors of spinal pain (Fernández-de-las-Peñas et al., 2011; Williams et al., 2015).

Work environment. Part of the social domain of the BPS model, prior research suggests that work related factors of physical demands, work satisfaction, support (Jones et al., 2006) and low job control (Bernal et al., 2015) may impact the CLBP trajectory. With the high prevalence of musculoskeletal disorders documented in HCW, questions regarding the individual's role, average number of work hours, average number of patients they care for on a typical work day, overtime hours worked, heavy lifting, use of lift equipment and work satisfaction are some of the main questions posed to the study participants. In alignment with and to build on prior research, social support and work environment factors were examined in this study.

In summary, with regard to LBP research guided by the BPS framework, one systematic review identified two significant limitations (Pincus, 2013). First, there is significant heterogeneity in study measures and outcomes making it difficult to replicate or synthesize results. Second, intervention trials rarely integrate all three constructs of the BPS model. In another systematic review, Tagliaferri et al. (2020) stated that while a BPS approach to CLBP management may improve outcomes, application of the model in research and practice has been challenging and results to date have been mixed, thus additional, well designed, pragmatic research is needed.

In addition to identifying biopsychosocial factors associated with progression from ALBIP to CLBP, reliable and valid instruments that can predict individuals who are at highest risk are needed to inform ALBIP management and ultimately CLBP outcomes. Previous comprehensive literature reviews revealed two promising instruments, the Örebro Musculoskeletal Pain Questionnaire (ÖMPQ) and the STarT Back Screening Tool (SBST) (Lhereux & Bergin, 2019; Pauli, Starkweather & Robins, 2019). These instruments incorporate biological, psychological and social constructs of CLBP and thus align with the conceptual framework guiding this study.

CLBP varies in each individual from minimal limitations to severe impairment and disability. Several studies have found poor correlation between structural damage and disability levels in those with CLBP. Other studies indicate psychosocial factors have a greater influence than biomedical factors when transitioning from acute to chronic pain (Cleland, Fritz, & Brennan, 2008; Jellema et al., 2005; Sattelmayer, Lorenz, Röder, & Hilfiker, 2012). Patient's attitudes and beliefs towards pain, however, are factors that are predictive of disability in patients (Friedman et al, 2012; Hill, Dunn, Main, & Hay, 2010; Jellema, van der Windt, van der Horst, Stalman, & Bouter, 2007; Shaw et al, 2013). The BPS model allows for examining the process in which LBP causes disability and which factors can result in the pain becoming chronic (Hill, Vohora, Dunn, Main, & Hay, 2010).

Based on recommendations by the WHO for use of the BPS model to build on and address gaps in prior research, the BPS conceptual model was adapted to HCW with ALBIP and sought to examine factors associated with the participants' outcome of either recovery or a chronic trajectory as well as the psychometric properties and predictive ability of the ÖMPSQ and the SBST (Figure 1).

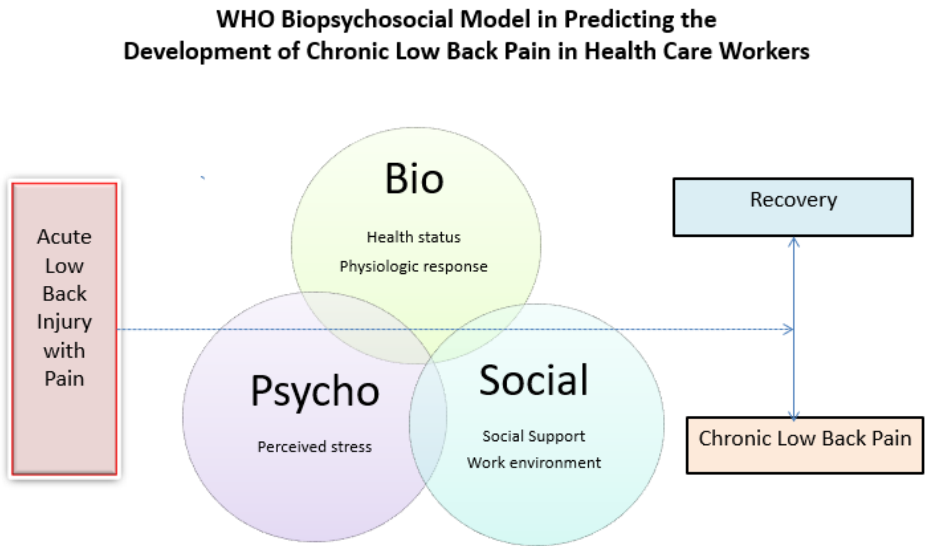

Figure 1. Biopsychosocial Conceptual Framework adapted from the World Health Organization's (WHO) biopsychosocial (BPS) model (2001).

Outcomes

Outcomes in this study include assessing recovery following ALBIP or persistence of pain at 12 weeks post injury, indicating the development of CLBP.

Conclusion

The Biopsychosocial Model guided the design of this study examining factors contributing to the recovery of, or the development to CLBP, from an occupational ALBIP in healthcare workers. This included identifying and describing potential variables within the three constructs of the BPS model, as well as the measurement of outcomes from screening instruments as they relate to the development of a chronic condition. Utilization of the BPS model provides a standard for future studies to better understand the integration of factors including biological, lifestyle, psychological, social, and occupational factors that contribute to the overall prevalence and outcome of CLBP.

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Chapter 3

Methods

Design/Sample/Setting

Research was conducted using a descriptive repeated measures study design in a non-probability convenience sample of HCW with an ALBIP. Participants were recruited from two Central Virginia health care systems and had recently experienced an ALBIP episode. To be eligible for inclusion, participants were HCW (defined as workers who have direct patient care responsibilities) who had experienced an occupational ALBIP within the prior 30 days, ages 18 years and older, and who speak and read English. Exclusion criteria included pregnant women or those who had given birth within the last three months and individuals who had been diagnosed with any type of musculoskeletal chronic pain (e.g., fibromyalgia, neuropathy, rheumatoid arthritis). Multiple outreach settings within the two healthcare systems were used to recruit the needed sample for the study including staff lounges, health and wellness clinics, email notifications, education/skills labs, and online newsletters.

Data Collection Procedures

Following Institutional Review Board approvals from both health systems, recruitment and enrollment were initiated. Individuals who showed interest in participating were screened for eligibility either in person with the Principal Investigator (PI) in a private meeting space for consent, or through filling out comparable electronic documents in REDCap, a secure online survey database (Harris et al., 2009). After confirming eligibility, participants had the option to complete study measures on paper in person or via REDCap. For those who chose to meet in person, a convenient time and place was selected. Demographic data was collected at baseline (Time 1) along with biological, psychosocial and CLBP risk screening instrument data. At 12 weeks (Time 2), the biological, psychosocial and a CLBP risk screening instrument data were re-collected.

Variables and Measures

Sample characteristics. During enrollment, pertinent data was collected on demographic variables (age, sex, race/ethnicity) and socioeconomic status (income / education level, head of household, number of dependents). *Biological variables* included height, weight, and BMI. Body weight and height at baseline were used to calculate BMI, which is computed by kilograms per square meter (kg/m^2) and classified according to the WHO classification (Weir, & Jan, 2020). Other biological variables included functional/disability status; acute back injury details (currently experiencing back pain, date of injury, diagnosis, treatment received, return to work); health history (prior back injury and treatment, chronic illness diagnoses, medications); and health habits (smoking, alcohol intake, and physical activity). *Psychosocial variables* included perceived stress, pain, and work environment factors (hours worked, use of lift equipment, job satisfaction). The outcome variable of the development of CLBP was assessed through risk *screening instruments* (SBST, ÖMPSQ).

Perceived stress. Stress was measured by the Perceived Stress Scale (PSS) (Cohen, Kamarck, & Mermelstein, 1983). The PSS-10 is a widely used 10-item instrument that measures the degree one perceives aspects of life as stressful using a 5-point Likert rating scale with response options from 0=never, 1=almost never, 2=sometimes, 3=fairly often, and 4=very often. This instrument has shown high reliability (Cronbach's α 0.75 - 0.91) and validity (0.89) and used in low back pain studies (Cohen et al., 1983). In this study, the PSS instrument demonstrated strong reliability at both Time 1 (Cronbach's $\alpha = .82$) and Time 2 (Cronbach's $\alpha = .90$), which is in line with previous findings.

Functional status. The Oswestry Disability Index (ODI) (Fairbank & Pynsent, 2000), is a 10-item instrument used to measure functional status and pain-related disability in patients with LBP through a self-administered questionnaire divided into 10 sections. It is designed to assess limitations of various activities of daily living. Each section is scored on a 0–5 scale, 5 representing the greatest disability (Cronbach's α 0.71 - 0.87). The ODI reflected reliability at both time points (Time 1: Cronbach's α = .92, Time 2: Cronbach's α = .85), which aligns with its reliability found in most studies (Chiarotto et al., 2016; Irmak, 2019).

Social support. The Medical Outcomes Study Social Support Survey Instrument (SSSI) (Sherbourne & Stewart, 1991), is a 19-item instrument assessing social support especially in those with chronic conditions (Cronbach's $\alpha > 0.89$ with concurrent validity ranging from relationship with loneliness (–.67), family functioning (.53), marital functioning (.56), and mental health (.45)). Four domains (emotional/informational support, tangible [also called instrumental] support, positive social interaction, and affection) are recommended for both combined and individual use. Response observations are provided on a 5-point Likert Scale, ranging from 1 (“none of the time”) to 5 (“all of the time”). Additional social support data was collected by free text and categorical/fixed questions from the demographic section relating to relevant characteristics of the work environment (role at work, type of work unit, typical shift worked, and number of hours per week, number of days unable to work due to injury, and satisfaction with work). The Cronbach's α was .97 and .96 respectively for Time 1 and at Time 2 demonstrating high reliability.

Predictive screening instruments. Identification of individuals at increased risk for developing CLBP following ALBIP requires a reliable and valid predictive screening tool. Three comprehensive literature reviews have been conducted and each identified two predictive tools, the STarT Back Screening Tool (SBST) and the Örebro Musculoskeletal Pain Questionnaire (ÖMPSQ) as the most widely used (Karran et al., 2017; Lhereux & Bergin, 2019; Pauli, Starkweather & Robins, 2018).

To contribute to emerging evidence on reliable and valid instruments to predict CLBP risk, further population specific psychometric and predictive data are needed on the Keele STarT Back Screening Tool (SBST) and the Örebro Musculoskeletal Pain Questionnaire (ÖMPSQ-Short). The SBST is a brief validated tool, designed to screen primary care patients with LBP for prognostic indicators relevant to initial decision making focusing on pain and psychosocial factors (reliability and validity Cronbach's $\alpha > 0.79$). The SBST items relate to physical and psychosocial factors that have been identified as strong independent predictors for persistent disabling LBP. The SBST overall scores (ranging from 0 to 9) are determined by summing all positive responses, and its psychosocial subscale scores (ranging from 0 to 5) are determined by summing items related to bothersomeness, fear, catastrophizing, anxiety, and depression (Beneciuk et al., 2013). Participants with a score of 0-3 are classified into the low-risk subgroup and those with scores of 4-9 into the medium-high risk subgroup (Weir, & Jan, 2020).

The ÖMPSQ is used in the same capacity, but its objective is to identify strong independent factors predicting work absence based on psychosocial factors (Linton & Boersma, 2003) (Cronbach's $\alpha > 0.83$). For this study the ÖMPSQ-Short (10-items) was used for its brevity and ease of comparison. The five categories analyzed are: self-perceived function, pain experience, distress, fear-avoidance beliefs, and return to work expectancy. The ÖMPSQ evidenced an acceptable level of internal consistency and reliability (Time 1: Cronbach's $\alpha = .80$, Time 2 Cronbach's $\alpha = .68$). ÖMPSQ includes 10 items scored 0-10, where 0 refers to absence of impairment and 10 to severe impairment. The total score ranges between 1 and 100, with a score >50 indicating higher estimated risk for future work disability (Linton, Nicholas & MacDonald, 2011).

Additional analysis of both screening instruments included a test-retest for Time 1 and Time 2 total scale scores and a correlation analysis. The SBST Time 1 and Time 2 resulted in a statistically significant correlation ($r = .565, p = .008$) with a medium effect size. Similar results were found with the ÖMPSQ at Time 1 to Time 2 with statistically significant correlation ($r = .754, p = .000$) with a large effect size. The SBST Time 1 was next analyzed to the ÖMPSQ Time 1 scores resulting in a statistically significant correlation ($r = .785; p = .000$) and again at Time 2 ($r = .773; p = .000$) both with a large effect size. The SBST and ÖMPSQ change in difference scores were analyzed and also had a statistically significant result with a medium effect size ($r = .477; p = .029$).

Data Analysis

All analyses were done with SPSS 26.0 (IBM SPSS, 2011). The data analysis plan was conducted in two phases. First, data was cleaned, and exploratory analysis was conducted, including recoding of variables and computing of subscales and scales as needed. All study variables were presented using descriptive statistics with the means, standard deviation, and minimum/maximum values for continuous variables (Interval/Ratio level) and frequencies and percentages for categorical variables (Nominal/Ratio level). Each variable was examined for normality and they were not normally distributed. Cronbach's α and test-retest reliability were also conducted for the predictive instruments.

The second phase of data analysis was bivariate testing. Time 1 to Time 2 change scores were computed through subtracting outcome variable Time 1 scores from respective Time 2 scores. Bivariate tests (Pearson's r correlation, independent-samples t-test, and One-Way ANOVA) were then used to identify if the outcome variable change score was related to any of the demographic and participant related characteristics at a statistically significant level (p<.05). Paired-samples t-tests were also used to identify if matched outcome variable scores evidenced significant mean score changes from Time 1 to Time 2. The SBST and the ÖMPSQ instruments were scored according to the methods specified by the instrument developers and participants classified into 'low', 'medium', and 'high' risk groups using derived cut-off scores for each instrument (Hill et al. 2008; Linton & Hallden, 1998)**.** In terms of statistical power for the paired-samples t-test, the G*power software indicated that a medium/large size effect (Cohen's d = .70) between the related means within the paired-samples t-test (2-tailed) with power set at .80 and α set at .05, would require a sample size of 19 study participants. Thus, the current sample of 21 study participants would provide approximately sufficient statistical power for the current analysis. However, due to the relatively low number of study participants in the independent-samples t-test and One-Way ANOVA analysis, the non-parametric version of all bivariate tests was conducted to compliment these parametric tests.

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Chapter 4

Results

Sample Demographics

The final sample was composed of 21 participants (90% females, 10% males) with the majority registered nurses (52%, $n = 11$) followed by nursing assistants (38%, $n = 8$) and radiology technicians (10%, $n = 2$). The mean age was 41 (± 14.10) and ranged from 22 to 60 years. Participants identified as primarily non-Hispanic White (62%, $n = 13$) or Black (38%, $n = 8$) and graduated with a high school education (24%, $n = 5$), Associate/Technical degree (24%, $n = 5$) or a Bachelor's degree (33%, $n = 7$). The majority of the participants had an annual household income in the range of $25,000-$49,999 (28.6%, $n = 6$) or $50,000-$74,999 (28.6%, $n = 6$) and all participants were non-smokers.

Work-related findings identified the majority of participants had been in their current position between 0 – 4 years (43%, $n = 9$), worked full-time (71%, $n = 15$) 12-hour day shifts (62%, $n = 13$) and were satisfied (71%, $n = 15$) or very satisfied with their job (29%, $n = 6$). The majority also reported not missing any workdays related to their ALBIP (71%, $n = 15$) and of those that did most missed only one day (14%, $n = 3$). Participants also reported they typically used lift equipment when lifting, moving or transferring a patient (86%, $n = 18$). Although the majority of participants reported they exercised or participated in physical activities two times per week (24%, $n = 5$) for 30 minutes (33%, $n = 7$) to 60 minutes (24%, $n = 5$) with most walking/hiking (29%, $n = 6$) followed by weightlifting (24%, $n = 5$) or running/jogging (19%, $n = 4$), the majority of the sample had a BMI considered as obese (48%, $n = 10$).

Participants were asked if they currently had LBP pain from their ALBIP with the majority reporting at Time 1 they did not currently have pain (57%, $n = 12$) and the majority also reported no pain at Time 2 (52%, $n = 11$). Treatments for their injury included the following:

prescribed medication (33%, *n* = 7 at Time 1, decreasing to 24%, *n* = 5 at Time 2); rest (62%, *n* = 13 at Time 1 and Time 2); physical therapy (5%, *n* = 1, at Time 1 and 10%, *n* = 2 at Time 2); other (24%, *n* = 5 at Time 1 and Time 2). Other treatments reported at Time 1 included Ibuprofen (46%, *n* = 23), chiropractic care/massage (2%, *n* = 1) and surgery (2%, *n* = 1). Although surgery was reported at both Time 1 and Time 2, this was not a current treatment for the participant but rather a past treatment. Similar treatments were reported at Time 2 except for one participant reporting exercise. Almost half of the participants reported having previous LBP (43%, *n* = 9). Demographic and other sample characteristics are provided in Table 1.

Descriptive Statistics for Model Variables

Perceived stress. The mean level of stress was *13.19 (SD = 5.73, MIN/MAX = 3.00 - 25.00)* at Time 1 and *13.86 (SD = 6.87, MIN/MAX = 2.00 - 28. 00)* at Time 2, a non-significant difference in stress change scores between the two of *0.67 (SD = 4.89, MIN/MAX = -11.00 - 11.00)*. Scores around 13 are considered average while high stress groups usually have a stress score of around 20 points (Cohen, Kamarck, & Mermelstein, 1983). Thus, results indicate most participants were not experiencing high stress levels at either time.

Functional/disability status. Descriptive analysis of this outcome at Time 1, Time 2, and change scores data revealed a mean level disability of *.0015 (SD = .0014, MIN/MAX = .0000 - .0058)* at Time 1 and *.0008 (SD = .0008, MIN/MAX = .0000 - .0024)* at Time 2, with a change score of -*.0007 (SD = .0011, MIN/MAX = -0.0038 - 0.0012)*. This change was significant (*p* = *.005*). Paired samples t-test analysis of Time 1 to Time 2 disability change in outcome variable mean scores indicated less disability differences from Time 1 *(M = .00153, SD = .00135)* to Time 2 *(M = .00079, SD = .00076*) at a statistically significant level, *t(20) = 3.17, p<.01* (see Table 2). The ODI uses a total score represented as a percentage from 0% to 100%, in 20%

increments and categorized from a low of minimal disability, through moderate, severe, crippled to bed bound (Davidson & Keating, 2000).

Social support. Mean social support total scores were *83.46 (SD = 21.10, MIN/MAX = 26.32 - 100.00)* at Time 1, *85.53 (SD = 16.69, MIN/MAX = 47.37 -100.00)* at Time 2, and evidenced a Time 1/Time 2 change score of *2.07 (SD = 12.33, MIN/MAX = -23.68 - 38.16)* but was not statistically significant. The survey consists of four separate social support subscales and an overall functional social support index. The four subscales were individually analyzed for Time 1 to Time 2 comparison. Results indicated no statistically significant findings in each of the four subscales: emotional support (*p = 4.27*), tangible support *(p = .265*), affectionate support (*p = .919*), and social support (*p = .592).* A higher score for an individual scale or for the overall support index indicates more support (Sherbourne & Stewart, 1991).

SBST. Mean SBST scores were *2.57 (SD=1.75, MIN/MAX=.00-5.00)* with seven participants at an increased risk for a poor outcome at Time 1 then decreased to *1.90 (SD=1.73, MIN/MAX=.00-5.00)* with four participants still at risk for a poor outcome at Time 2, and evidenced a Time 1/Time 2 change score of -*.67 (SD=1.62, MIN/MAX=-5.00-2.00).* A score of zero to three is considered low risk and both Time 1 and Time 2 mean scores fall within the low risk subgroup. Although there was a decrease in the differences, the findings were not statistically significant (*p =.07*). The SBST has an overall score used to separate LBP participants between low, medium, and high-risk subgroups for a poor outcome (Hill et al., 2008) and the majority of the participants had a score consistent with low risk by Time 2.

ÖMPSQ. Mean ÖMPSQ scores were *33.81 (SD = 16.12, MIN/MAX = 5.00 - 64.00)* at Time 1 with four participants at risk of a poor outcome, followed by 29.10 (*SD* = 12.58, MIN/MAX = 9.00 - 53.00) with one participant at risk for a poor outcome at Time 2, and incorporated a Time 1/Time 2 change score of *-4.71 (SD = 10.60, MIN/MAX = -27.00 -15.00)*. Results showed a decrease between Time 1 and Time 2; however, this change was not statistically significant (p =*.06*).

Although both the SBST scores *(M = 2.57, SD = 1.75 vs M = 1.90, SD = 1.73,* respectively) and the ÖMPSQ scores *(M=33.81, SD=16.12 vs M=29.10, SD=12.58,* respectively) both decreased from Time 1 to Time 2, the findings were not statistically significant *(SBST: t(20)=1.88, p=.07; ÖMPSQ: t(20)=2.04, p=.06)* (Table 2).

A descriptive analysis of outcome variables for Time 1, Time 2 and change scores is presented in Table 2.

Tests of Significant Differences

At the bivariate level, examining various demographics and relationships to the different study variables provided mixed results. In relation to age, a Pearson's r did not show significant differences between Time 1/Time 2 change scores for stress, disability, social support, or the SBST and ÖMPSQ variables (Table 3). Additionally, an independent samples t-test and one-way ANOVA of Time 1/Time 2 change scores was examined by demographic and participant related characteristics. Data indicated there were no significant differences between gender, education, income, BMI, exercise, or pain recovery when examined with Time 1/Time 2 change scores for stress, disability, social support, SBST, or ÖMPSQ. Job satisfaction also did not indicate any significant differences.

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Chapter 5

Discussion

The purpose of this study was to address gaps in knowledge related to biopsychosocial factors that contribute to the development of CLBP following an occupational ALBIP in HCW, as well as, to contribute to the literature and psychometric data of two screening tools to help identify those at highest risk for progression to CLBP.

While there is a steadily growing body of evidence related to the development of CLBP guided by the BPS model, previous studies with HCW and this model are limited. Yet, HCW have a higher prevalence of LBP than in the general population (54% and 19%, respectively) (Dagenais, Caro, & Haldeman,2008; Davis, & Kotowski, 2015). Given this higher prevalence and with the US employing approximately 4 million HCW (National Council of State Boards of Nursing, 2017), additional research is needed. This study contributes to this growing body of work.

The final study sample was composed of 21 participants who were similar to state and national demographic trends of HCW (Health Resources and Service Administration (HRSA), 2018). Results are discussed within each individual construct and variable below.

Biological Construct

Age. The average study participant was 40 years of age (*M*=40.52, *SD*=14.10, MIN/MAX=22-60), with no statistically significant association of age to stress, disability, social support, SBST and ÖMPSQ. This finding may be attributed to the small study sample size, yet it is consistent with two other studies where age was not associated with LBP (Ferreira et al., 2011; Oksuz, 2006). However, multiple studies have identified increasing age as a risk factor for LBP (National Institute of Neurological Disorders and Stroke, 2020; Williams, J. et al., 2015; Wong, Karppinen, & Samartzis, 2017). Increased risk is thought to be related to age associated changes including reduced flexibility, postural issues, and increased musculoskeletal degeneration, leading to pain aggravation (Oksuz, 2006).

Gender. The majority of study participants were female (90%, *n* = 18). This is reflective of national demographic trends for HCW, with nurses representing the largest group, a profession that is predominantly female (90.9%, *n* = 19). While prior research indicates that gender is a non-modifiable risk factor for LBP, it is unclear whether it is more prevalent in males than females. Research indicated a higher prevalence and risk factor for LBP in female participants than in men regardless of age (Fernández-de-las-Peñas et al., 2011; Kim et al., 2014; Mas et al., 2019; Williams, J. et al., 2015; Wong, Karppinen, & Samartzis, 2017). Yet some studies show an increased age was associated with LBP in men (Bento et al., 2019) while other studies evidence this association in both genders (Biglarian et al., 2012; Palacios-Cena, Hernandez-Barrera, Carrasco-Garrido, Jimenez-Garcia, & Fernandez-de-Las-Peñas, 2015). Given that national data shows nurses are increasing in age with the national average age as 53 and this group indicates they have no plans to retire soon, findings demonstrate the potential for LBP risk (Smiley et al., 2018).

Race/ethnicity. Study participants identified as primarily non-Hispanic White (62%, *n* = 13) or Black (38%, *n* = 8). Although over decades the prevalence of CLBP has remained higher among Whites compared to Blacks (Andersson, 1999; Meucci, Fassa, & Faria, 2015), Black individuals with LBP report greater pain intensity and worse functional disability (Selim et al., 2011). Research has shown there are sex and race differences in pain sensitization among healthy pain-free individuals and Black participants (relative to non-Hispanic white participants) that demonstrate lower pain tolerance and threshold for experimental noxious stimuli (Bartley, 2016; Campbell, Edwards, & Fillingim, 2005). Additionally, members of diverse ethnic groups appear to use different coping methods in managing pain complaints with growing evidence that CLBP is associated with pain sensitivity and sensitization (Jensen, Karoly, & Braver, 1986) and that there are race disparities in CLBP (Merry et al., 2011; Siedlecki, 2009). Findings from this study did not show statistically significant results but that may be due to the small sample size, the minimal level of pain and stress levels reported and the limited diversity of the participants. Future LBP studies should fully describe ethnic differences and provide more focus on the disparities within and between LBP participants.

Body Mass Index. The majority of participants had a BMI of ≥ 30, which is considered obese (48%, n = 10) and is similar to the general HCW population as studies have indicated a high prevalence of overweight and obese nurses, 54% (N = 760) to 65% (N = 187) (Nahm, Warren, Zhu, An, & Brown, 2012; Zitkus, 2011). This result aligns with prior research reporting increased CLBP risk among obese and overweight HCWs (Jensen et al., 2012; Mirtz, & Greene, 2005). One study utilizing a pre-test, post-test design with 25 female RNs over the age of 45, found most to have a BMI ≥ 24, which combined with high levels of stress, placed them at higher risk for CLBP (Nahm et al., 2014). However, the current study did not support a positive association of increased BMI with a higher risk of developing CLBP among this study sample and the BPS variables of stress, disability, social support, or risk to CLBP from the SBST or ÖMPSQ.

Function/disability. Although there was a statistically significant difference between Time 1 and Time 2, at both times participant results were in the minimal disability category (0 to 20%) and are not considered clinically significant. A literature review and discussion by an international expert panel determined that 10 points or a 30% change from baseline score should be considered a clinically meaningful improvement when comparing before and after measures or an important change in function or disability (Ostelo et al., 2008). Interpretation of the disability scores using the ODI indicates the minimal disability level as being able to cope with most living activities and no treatment is indicated apart from advice on lifting, sitting and exercise (Fairbank & Pynsent, 2000; Smeets, Köke, Lin, Ferreira, & Demoulin, 2011).

Past medical history. Close to half of the participants reported having previous LBP (43%, *n* = 9), however, the majority did not have recurrent LBP problems (53%, *n* = 12). This finding is contrary to prior research that showed a positive history of back trauma in the form of over exertion, falling or lifting heavy objects was associated with a significantly higher probability in HCW having LBP (Alnaami et al., 2019). Similar results were shown to include an association with a higher risk of developing LBP in HCW when working long hours and assisting in patient transfers (Engkvist, Hjelm, Hagberg, Menckel, & Ekenvall, 2000; Hoy et al., 2012). This study did not determine the specific cause of the ALBIP, however, 90% (*n* = 19) of the participants reported working 12 hour shifts or longer. Of concern is the recurrence of LBP back pain ranging from 12 months as the definition of recurrence, to 33%, using pain at follow-up as the definition of recurrence (Stanton et al., 2008). This number is higher than the conventionally believed 10%, which is often reported (Manchikanti, Singh, Falco, Benyamin, & Hirsch, 2014).

Pain and treatment. Participants were provided the opportunity to report what treatments they sought, if any, at either Time 1, Time 2, or both and whether they currently had LBP pain from their ALBIP. The majority reported at Time 1 they did not currently have pain (57%, *n* = 12) and slightly fewer at Time 2 (52%, *n* = 11). Results from this study align with other findings in that most episodes are short-lived, with 80% to 90% of injuries resolving within six weeks, regardless of the administration or type of treatment, with only 5% to 10% of patients developing persistent back pain (Anderson, 1999; Manchikanti et al., 2014).

With regard to treatment, the majority reported they did not seek care from a health care provider for their ALBIP (57%, n = 12). The majority of participants initially sought bed rest (62%, n = 13) but it is unclear whether treatment options were a decision the participant made for themselves or if a health care provider recommended that treatment. Treatment options included: prescribed medication (33%, n = 7 at Time 1, decreasing to 24%, n = 5 at Time 2); rest (62%, n = 13 at Time 1 and Time 2); physical therapy (5%, n = 1, increased to 10%, n = 2 at Time 2); or other (24%, n = 5 at Time 1 and Time 2). Included with Other was a free text section allowing participants to write in a different treatment option. Write-ins at Time 1 included Ibuprofen (4%, n = 2), Motrin (2%, n = 1), Chiropractic care/massage (2%, n = 1) and Surgery (2%, n = 1). Although surgery was recorded at both Time 1 and Time 2 by the same participant, this was not a current treatment for the participant but instead reporting a treatment from the past. Write-in results at Time 2 were identical except for in place of Motrin, a participant wrote Exercise.

Systematic reviews regarding the effects of treatments for ALBIP on short-term pain outcomes give evidence that there are no specific treatments that can be provided for non-specific LBP (Dahm, Brurberg, Jamtvedt, & Hagen, 2010; Furlan, Giraldo, Baskwill, Irvin, & Imamura, 2015; Hayden, van Tulder, Malmivaara, & Koes, 2005; Roelofs, Deyo, Koes, Scholten, & van Tulder, 2008). Instead, management focuses on reducing pain and any associated disability by reviewing components of management including education and reassurance, analgesic medicines, non-pharmacological therapies, and timely review based on individual patient needs (Maher, Underwood, & Buchbinder, 2017). Current study results for participants that sought treatment followed a comparable and appropriate management plan. Of interest is that most participants utilized bed rest as a treatment, which traditionally has been advised for LBP. However, the current view for the general population recommends that in most cases bed rest should be avoided. Instead, one should remain as active as possible by either continuing or gradually resuming normal activities, and if possible, remain at work. However, remaining at work does not sound prudent given the actions and workload most HCW are continually exposed to on a daily basis, further providing the need for additional research as it applies to those working in patient care settings.

Physical activity. The majority of participants reported they exercised or participated in physical activities two times per week (24%, n = 5) for 30 minutes (33%, n = 7) to 60 minutes (24%, n = 5) with most walking/hiking (29%, N = 6) followed by weightlifting (24%, n = 5) or running/jogging (19%, n = 4). Current recommendations for adults are to have a minimum of 150 minutes of moderate-intensity physical activity a week, with sessions of 10-minutes or greater at least three times a week (U.S. Department of Health and Human Services, 2019). Results from a randomized clinical trial (RCT) of nursing personnel (n = 219), confirmed that meeting physical activity recommendations reduced the number of sick days and total associated costs related to recurrent non-specific LBP (Kolu, Tokola, Kankaanpää, & Suni, 2017). Another prospective longitudinal cohort study (n = 130) of women with CLBP found that lower physical performance scores, higher clinical stress symptoms and activity limitations predicted activity limitation two years later (Nordeman, Thorselius, Gunnarsson, & Mannerkorpi, 2017). Yet, a systematic review by Schaafsma et al., (2013) of workers with back pain related work disability in a physical conditioning program yielded mixed results. In those with acute LBP (pain lasting 1-4 weeks), physical conditioning had no effect on number of sick days. Mixed findings of the impact of interaction between prognostic factors and levels of physical activity for those with LBP shows a need for further investigation.

The American College of Physicians (ACP) recommend for acute or subacute LBP lasting <4 weeks or 4-12 weeks, respectively, superficial heat, massage, acupuncture, or spinal manipulation are recommended as first-line therapy and rated with a strong recommendation (low- to moderate-quality evidence) (Wenger, & Cifu, 2017). However, Maher et al. (2017) report that general guidelines vary in their recommendations for non-pharmacological therapies for ALBIP. Thus, such contrary evidence reinforces the need for further research in this area. Additionally, to gain clearer insight future studies should include validated physical activity measurements.

Smoking. Smoking has been associated with an increase in risk of LBP (Green, Johnson, Snodgrass, Smith, & Dunn, 2016; Shiri, Karppinen, Leino-Arjas, Solovieva, & Viikari-Juntara, 2010; Wai, Rodriguez, Dagenais, & Hall, 2008), however all study participants were non-smokers (100%, n = 21). This may be due to the increased stigma related to smoking and that many healthcare facilities have instead promoted a healthy lifestyle and designated "no smoking" campuses (The Joint Commission, 2011; Williams, S., 2009).

Psychological Construct

Perceived stress. At the multivariate level, there was statistically significant change reflecting a large effect size ($F(1, 19)=4.97, p<.05, PES=.21$) in stress scores between Time 1 and Time 2 while controlling for the effect of study participant race. A surprising result was shown with the Black participants having a higher stress score at Time 2 while the White participants stress scores went down from Time 1. An explanation for this result may be that the Black participants did not have the opportunity to rest and rehabilitate from the initial injury and perceived more stress as a consequence of pain in combination with reduced resources to unwind effectively (Sonnentag & Fritz, 2015). Another consideration for this result is that there is growing evidence that suggests that CLBP is associated with pain sensitization (Baliki et al., 2012) and that there are race disparities in CLBP (Carey, & Garrett, 2003; Meints, Wang, & Edwards, 2018). In a cross-sectional study of 324 participants (73% non-Hispanic White, 27% Black), Black patients demonstrated greater pain sensitivity (Meints et al., 2018).

Social Construct

Education and income. Participants reported they graduated with a high school education (24%, *n* = 5), Associate/Technical degree (24%, *n* = 5) or a Bachelor's degree (33%, *n* = 7). Although the highest percentage of education level reported within this study of HCW have a Bachelor's degree (33%, *n* = 7), this percentage is lower when compared to the national average of 42% (Smiley et al., 2018). There have been mixed results in earlier studies associated with education or income with LBP. One cross-sectional study with the general population found that participants (*n* = 600) with fewer years of formal education (0-4) was associated with LBP, especially in males (39.1%) (Bento et al., 2020). Similar results were found in other studies as well with men with low levels of formal education being at higher risk for developing LBP (Grobschadl et al., 2015; Leclerc et al., 2009). The majority of the participants had an annual household income in the range of $25,000-$49,999 (28.6%, *n* = 6) or $50,000-$74,999 (28.6%, *n* = 6).

Work environment. The majority of participants were registered nurses (52%, *n* = 11) followed by nursing assistants (38%, *n* = 8). Work-related findings identified the majority of participants in their current position between 0 – 4 years (43%, *n* = 9), worked full-time (71%, *n* = 15) 12-hour day shifts (62%, *n* = 13) and overall were satisfied (71%, *n* = 15) or very satisfied with their job (29%, *n* = 6). The majority also reported typically using lift equipment when lifting, moving or transferring a patient (86%, *n* = 18) and not missing any workdays (71%, *n* = 15) and of those that did most were only for one day (14%, *N* = 3). Overall, these results align with the literature as numerous studies have reported occupational factors significantly associated with LBP (Melloh et al., 2013; Truchon, 2001; Widnarko, 2012). One systematic review and meta-analysis of 18 studies (*n* = 19,572 employees), found workplace factors such as job satisfaction and support were associated with decreased CLBP (Bernal et al., 2015; Lang, Ochsmann, Kraus, & Lang, 2012). In the current study sample, 71% of the participants stated they have job satisfaction. This aligns with the evidence of work factors helping to prevent the development of CLBP. Having a better understanding of how ALBIP may impact HCW requires data quantifying the prevalence of not only pain associated with ALBIP but reports of injuries and disability and the potential risk factors for associated health outcomes.

Screening Variables

SBST and ÖMPSQ. While both the SBST and ÖMPSQ were not statistically significant between their respective Time 1/Time 2 collections, the risk mean scores decreased for each to an improved level: **SBST** (*M*=2.57, *SD*=1.75 vs *M*=1.90, *SD*=1.73, respectively) to an, *t*(20)=1.88, *p* =.07; **ÖMPSQ**: (*M*=33.81, *SD*=16.12 vs *M*=29.10, *SD*=12.58, respectively), *t*(20)=2.04, *p* =.06 (see Table 5). Small sample size may have contributed to the lack of statistically significant changes in these screening variables. Interestingly, the SBST at Time 1 indicated that seven of the participants were at risk for developing CLBP and this decreased to four participants at Time 2. Similarly, the ÖMPSQ at Time 1 indicated four participants were at risk and this decreased to one participant at Time 2. This reflects a consistent decrease of three participants (14%) across both instruments from Time 1 to Time 2. The proportion of participants with LBP was considerably lower at Time 2 which aligns with prior research in individuals with ALBIP (Deyo et al., 2014; Friedman, Conway, Campbell, Bijur, & Gallagher, 2018; Mehling, Avins, Acree, Carey, & Hecht, 2015). While a comprehensive review of the literature (Pauli et al., 2019) evidenced that these two predictive screening instruments were the most reliable and valid of the instruments that have been developed, several studies have shown limited predictive abilities (Friedman et al., 2018; Karran et al., 2017; Mehling et al., 2015). Nevertheless, studies with valid and reliable instruments are needed to further strengthen identification and treatment of those at highest risk for developing CLBP.

Additional analysis of both screening instruments included a test-retest for Time 1 and Time 2 total scale scores of both time events to examine the strength of the correlation. Statistically significant correlation results were evident with the SBST at Time 1 and Time 2 ($r = .565, p = .008$), with the ÖMPSQ at Time 1 to Time 2 ($r = .754, p = .000$), and with both the SBST and the ÖMPSQ at Time 1 ($r = .785; p = .000$). Correlation strength was interpreted according to the following criteria: $r<0.30$ indicates low correlation, $r\geq0.30$ to $r<0.60$ indicates moderate correlation, and $r\geq0.60$ indicates strong correlation (Campbell, & Swinscow, 2011). These high correlations indicate the instruments overlap in some ways. The a priori hypotheses of correlation and the Pearson (*r*) correlations between the SBST and the ÖMPSQ showed moderate to high correlation with the outcomes and aligns with current psychometric testing for the SBST (Medeiros, Costa, Oliveira, & Costa, 2019). This was also similar to the correlation coefficients for the SBST total scores and psychosocial subscale scores with the ÖMPSQ score results that were 0.802 and 0.769 respectively (Hill, Dunn, Main, & Hay, 2010).

As indicated by the sample characteristics, the participants in this study were not typical of samples included in prior research in that the majority had more minor injuries, were satisfied or very satisfied with their job, typically did not miss any or only one day from work due to their ALBIP, scored with low risk of developing CLBP, and were in the minimal disability category at both Time 1 and Time 2.

Strengths

While sample recruitment can be challenging in this population, this study evidenced that data collection using the REDCap electronic survey database, may enhance recruitment and enrollment. The results of this study align with prior research that modifiable factors may prevent the development of CLBP following ALBIP including smoking, exercise, the use of lift equipment when assisting patients and job satisfaction. Further this study provides a rich description of the participant sample characteristics based on the BPS conceptual model. All instruments demonstrated strong reliability and validity in this study which contributes to the literature on psychometric properties of the SBST and ÖMPSQ for future research examining predictive instruments.

Limitations

While this study was grounded in the recommended BPS model and well designed, this study has several limitations. First is the small sample size. The target sample size was 30 participants. Recruitment took place in two mid- to large healthcare organizations over 18 months and involved a number of strategies to increase enrollment to 21. These strategies included placement of flyers throughout the health systems, electronic message boards, as well as distributing flyers throughout the communities where the study was conducted. Although engaging the assistance of the Director of Nursing Research & Innovation at one of the institutions helped with networking and expanding contact with nurse managers as well as key locations for flyer placement, ultimately the most successful strategy was to convert the study questionnaires from paper to the electronic REDCap database. This was especially helpful as the database could be accessed by smartphone and scanning a QR code on the flyer. This evidences the challenge of recruiting in this population but also highlights a successful strategy for future studies.

Other limitations include that while a multivariate analysis was planned to address the study aims, the sample size was not sufficient to yield a valid analysis. Diversity of the recruited sample was limited; thus, limiting generalizability and highlighting the need for future studies with larger, more racially and ethnically diverse samples of HCWs. Another limitation was that study measures were entirely self-report. While self-reporting data can provide a wider range of responses, it is often deemed unreliable (Pannucci et al., 2010). Also, self-reporting sensitive data, such as, age, ability to cope with stress, weight and income can be affected by an external bias of social desirability and acceptability (Althubaiti, 2016). Pain was measured by asking a single question ("Do you currently have low back pain or injury that is related to patient care?"), therefore, limiting validity in pain measurement, a key outcome variable in this study. This decision was made based on pain being a component of the two risk screening instruments as well as to reduce further participant burden given the number of instruments included in the study. While four participants reported persistent pain at Time 2, it is not clear if these participants had developed CLBP. Future studies should include a valid and reliable measure of pain.

Finally, this study and many others like it depends on the feasibility of the quality and quantity of variables chosen to evaluate within the BPS framework and its application to CLBP. While variables for this study were chosen based on prior research and to limit further heterogeneity, there may be other BPS variables that would provide valuable information such as depression and other work-related factors that may contribute to the development of CLBP.

Implications for Nursing Practice

This study yielded several implications for nursing practice. First, nurses caring for patient's experiencing LBP can employ a more comprehensive BPS based approach to diagnosis, risk and treatment. Additionally, increasing personalization of care and effective communication which impacts outcomes in patients with LBP (Hopayian, & Notley, 2014).

Nurses can advocate within and beyond healthcare organizations to prevent ALBIP and the development of resultant CLBP through education and support including stress management and promotion of heathy lifestyles. Additionally, the development of policies and processes that ensure healthy work environments to reduce injury and promote job satisfaction may reduce risk in HCW.

Lastly, nurse scientists can contribute to this growing body of research in order to reduce ALBIP and related CLBP incidence and prevalence. This should include the management of ALBIP, and the investigation of BPS constructs associated with risk. Rigorous research including randomized trials and longitudinal case-control studies are needed (Buruck et al., 2019).

Conclusion

Results from this study contribute to the growing body of evidence regarding factors in the development of CLBP following an ALBIP occurrence in HCW. Statistically significant findings at Time 1 compared to Time 2 included minimal disability in the study sample and the majority of participants indicated they were satisfied or very satisfied with their job. With all of the participants indicating being satisfied or very satisfied with their job at Time 1 and then most reporting they did not have LBP at Time 2, helps to strengthen and support further research into the association of job satisfaction and the risk of developing CLBP.

Previously established risk factors for developing CLBP that were not confirmed in this study include age, sex, income, education level, BMI, and exercise/physical activity. Further, the SBST and ÖMPSQ screening data, while promising, did not yield any significant results.

Given the prevalence of LBP greater in HCW than in the general population, further research is needed along with a heightened awareness regarding risk factors for preventing CLBP among healthcare workers.

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Vita

JENA PAULI, PhD(c), NPD-BC, RN

7390 Azalea Drive ♦ Ruther Glen, Virginia 22546 ♦ (804) 867-5186 ♦ jpauli@verizon.net

EDUCATION

Graduate

2012 - Present	Virginia Commonwealth University, School of Nursing - Richmond, VA	PhD Program, Nursing Current Student
2008 – 2009	Georgetown University - Washington, DC	MS, Nursing Education August 2009

Undergraduate

1991-1993	Virginia Commonwealth University, Medical College of Virginia - Richmond, VA	BS, Nursing May 1993

PROFESSIONAL EXPERIENCE

Academic

8/09 – 12/09	Marymount University, School of Health Professions - Arlington, VA Educator overseeing assigned students in NU 490 – Senior Nursing Internship fulfilling their preceptor requirements in various units at hospitals around the region; Clinical Instructor for Junior student group NU 331 – Medical Surgical Nursing working on the Oncology unit at Sibley Memorial Hospital	Assistant Professor
8/09 – 12/09	Georgetown University, School of Nursing and Health Studies – Washington, DC Clinical Instructor for Junior nursing student group in the course Nursing Care of Adults with Physiological Alterations working on the Neurovascular/Stroke Unit at Inova Fairfax Hospital	Adjunct Clinical Instructor

Non-Academic

10/09 – Present	Stafford Hospital, Mary Washington Health Care – Stafford, VA Educator providing clinical and simulation	Nurse Educator

	education for inpatient areas of Cardiology, Medical-Surgical, and Intensive Care Unit in a 100 bed facility. Provide New Hire Orientation and staff development for clinical associates	
9/07 – 7/08	Independent Wound Consultant – Central/Northern, VA Educate and consult on difficult healing wounds and how best to use the V.A.C. medical device; educate and recommend how to promote various positive wound healing interventions	Wound Consultant
8/05 – 8/07	Kinetic Concepts, Inc. - Northern-Central VA/Southern MD Territory Provide clinical in-service presentations, formal and informal educational programs for account healthcare providers; training and education through in-services and one on one clinical support	Clinical Consultant – Acute Care
12/97 – 8/05	Health Management Corporation - Richmond, VA Medical consultation, assessment and triage, and recommendations guiding clients to the most appropriate healthcare setting through a 24/7 URAC accredited Nurse Line; key consultation related to adult, pediatric, maternity and disease management, i.e., diabetes, asthma, coronary artery disease and congestive heart failure	Nurse Consultant
4/94 – 10/97	Bon Secours, Stuart Circle Hospital - Richmond, VA Assessed, observed, evaluated and administered skilled nursing care and patient education for at-home patients. Successfully collaborated with multi-discipline health teams and doctors in establishing and implementing the plan of care for each patient. Prepared extensive documentation and reporting related to patient care. Effectively managed a 40-patient caseload	Case Manager / Registered Nurse - Home Health; Staff Nurse - Progressive Care Unit; Endoscopy Lab
7/93 – 4/94	University of Virginia Health Sciences Center - Charlottesville, VA Provided intensive patient care for 1-2 patients per shift. Performed complete	Registered Nurse – Neuro ICU

	assessments and monitoring of health status. Integral member of the department's continuing education committee, planning in-service seminars and creating handbooks and tutorial presentations for unit of 40 nurses	
6/90 – 6/93	Henrico Doctors' Hospital - Richmond, VA Managed front desk of the operating and emergency rooms, scheduling appointments, emergency procedures, alerting call teams and anesthesia department as needed. Efficient and effective in processing calls and providing information in a fast-paced environment	Nurse Technician – Emergency Room; Unit Secretary – Operating Room

LICENSURE AND CERTIFICATION

2016 - 2021	American Nurses Credentialing Center: Registered Nurse – Board Certified (NPD-BC), Nursing Professional Development	
2007, March	Pathways for Developing Quality, Presenter Certification on Wounds, KCI - San Antonio, TX; Program at KCI accredited through the American Nurses Credentialing Center	
2005, August	Advanced Clinical Management of NPWT: Optimizing Therapeutic Outcomes Certification; KCI - San Antonio, TX	
1993 – Present	Registered Nurse - Commonwealth of Virginia, Multi-State Privilege	0001134502

HONORS AND AWARDS

2008 – 2009	Project RN Scholarship Recipient, Georgetown University, School of Nursing and Health Studies - Washington, DC
1992 – 1993	Secretary, Senior Nursing Class; Senior Class Representative for Admissions Committee, Virginia Commonwealth University, Medical College of Virginia, School of Nursing – Richmond, VA
1991 – 1992	President, Junior Nursing Class, Virginia Commonwealth University, Medical College of Virginia, School of Nursing – Richmond, VA

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS

2005 – Present	American Nurses Association

2005 – Present	Virginia Nurses Association
2009 – Present	Association for Nursing Professional Development
2009 – Present	Sigma Theta Tau International, Tau Chapter
2010 – 2012	Oncology Nursing Society
2011 – Present	Central Virginia Nursing Staff Development Organization
2013 – Present	American Pain Society
2014 – 2015	International Nursing Association for Clinical Simulation & Learning
2017 – Present	Southern Nursing Research Society

RESEARCH

2019 Pauli, J., Starkweather, A., & Robins, J. (2019). Screening tools to predict the development of chronic low back pain: an integrative review of the literature. *Pain Medicine*, pny178, https://doi-org.proxy.library.vcu.edu/10.1093/pm/pny178

2017 Kinser, P. A., Pauli, J., Jallo, N., Shall, M., Karst, K., Hoekstra, M., & Starkweather, A. (2017). Physical activity and yoga-based approaches for pregnancy-related low back and pelvic pain. Journal of Obstetric, Gynecologic, and Neonatal Nursing. pii: S0884-2175(17)30012-6. doi: 10.1016/j.jogn.201612.006

2009 Principal Investigator: Jena Pauli
Georgetown University, Master's Scholarly Project
U.S. midwives' interest in and preparation for global midwifery: Survey results
Advisor, Jo Anne P. Davis, PhD, CNM, RN

PRESENTATIONS

2009, July *U.S. midwives' interest in and preparation for global midwifery: Survey results.* Graduate Thesis, Georgetown University - Washington, DC

2009, July *FDA considers decreasing recommended acetaminophen doses: Media coverage of this hot topic.* Professional Aspects of Nursing, N538, Georgetown University – Washington, DC

2009, April *What is the interest in obtaining a post-master's certificate in a global midwifery program?* Research Methodology, N903, Georgetown University - Washington, DC

TEACHING

2010 - 2012	Kaplan Health Central VA NCLEX Reviewer with pre-licensure Students preparing to take the NCLEX examination	Faculty
8/09 – 12/09	Marymount University, School of Health Professions - Arlington, VA	Assistant Professor

Educator overseeing assigned students in NU 490 – Senior Nursing Internship fulfilling their preceptor requirements in various units at hospitals around the region; Clinical Instructor for Junior student group NU 331 – Medical Surgical Nursing working on the Oncology unit at Sibley Memorial Hospital

8/09 – 12/09 Georgetown University, School of Nursing and Health Studies – Washington, DC — Adjunct Clinical Instructor

Clinical Instructor for Junior nursing student group in the course Nursing Care of Adults with Physiological Alterations working on the Neurovascular/Stroke Unit at Inova Fairfax Hospital

2009, June-July Care of Children and Adults with Physiologic Alterations in Circulation, Oxygenation and Cell Growth, during the Perioperative Process and with special Nutritional Needs, N173, for Practicum In Teaching and Learning, N730, Georgetown University – Washington, DC

2009, June-July Teaching Assistant for Clinical Rotations at Inova Fairfax Hospital, through Practicum in Teaching and Learning, N730, Georgetown University - Washington, DC

2009, February *Foodborne Diseases,* Public Health, N241, Undergraduate Nursing Program, Georgetown University - Washington, DC

COMMITTEES

2009 – Present Serve as representative at Stafford Hospital and/or combined Mary Washington Health Care system committees, task forces and Shared Governance; Co-chair - Educational Development Committee; Chair – Clinical Ethics Committee; Clinical Practice; Coordinating Council; CAUTI Prevention Team; Professional Practice Nursing Board; Stroke Steering Committee; Pharmacy & RN Collaborative Committee – Stafford, VA

1999 – 2005 Quality Improvement Committee
Health Management Corporation – Richmond, VA

1994 – 1997 Ethics Review Board, Staff Registered Nurse Representative, Bon Secours, Stuart Circle Hospital - Richmond, VA

1993 – 1994 Educational Development, Neuro Intensive Care Unit, University of Virginia Hospital – Charlottesville, VA

1992 – 1993 Undergraduate Admissions Policy & Procedure

	Committee, Senior class representative selected by faculty, Virginia Commonwealth University, Medical College of Virginia – Richmond, VA
1992 – 1993	Co-Founder of the MCV School of Nursing Student Mentor Committee, Virginia Commonwealth University, Medical College of Virginia – Richmond, VA

OTHER ACTIVITIES

2010 – 2012	Legal Nurse Consultant - Medical Case Review Independent Consultant for Allen, Allen, Allen & Allen – Fredericksburg, VA office
2006 – 2008	Architectural Review Board Committee, Ladysmith Village Association, Ladysmith, VA
2007 – 2008	The READ Center, Adult Literacy Program Volunteer – Richmond, VA
2001 – 2003	American Heart Walk Volunteer and Participant – Richmond, VA
1999 – 2001	Special Olympics Volunteer – Richmond, VA

CV-Jena Pauli
July 2020

Table 1

Descriptive Analysis of Demographic and Participant Characteristics (*n*=21)

Variable	N	%
Age	21	*M*=40.52, *SD*=14.10, MIN/MAX=22-60
Gender		
Male	2	10.0
Female	18	90.0
Missing	*1*	
Race/Ethnicity		
White	13	61.9
Black	8	38.1
Income		
< $25,000-$49,999	6	28.6
$50,000-$74,999	6	28.6
$75,000-$124,999	4	19.0
≥$125,000	5	23.8
Education Level		
Graduated High School	5	23.8
Associate or Technical Degree	5	23.8
Bachelor's Degree	7	33.3
Master's degree or higher	4	19.0
BMI Categories		
Normal	4	19.0
Overweight	7	33.3
Obese	10	47.6
Exercise		
Yes	17	81.0
No	4	19.0
Job Satisfaction		
Yes	6	28.6
No	15	71.4
Pain Recovery		
Yes	11	52.4
No	10	47.6

Table 2

Descriptive Analysis of Outcome Variable Time 1, Time 2, and Change Scores (*n*=21)

Variable	**M (SD)**	**Minimum/ Maximum**	**Skew (SE)**	**Kurtosis (SE)**
Time 1 PSS Scores	13.19 (5.73)	3.00-25.00	.61 (.50)	-.16 (.97)
Time 2 PSS Scores	13.86 (6.87)	2.00-28.00	.34 (.50)	-.45 (.97)
Time 1/Time 2 PSS Change Scores	**.67 (4.89)**	**-11.00-11.00**	**-.69 (.50)**	**1.33 (.97)**
Time 1 ODI Scores	.0015 (.0014)	.0000-.0058	1.43 (.50)	3.84 (.97)
Time 2 ODI Scores	.0008 (.0008)	.0000-.0024	.61 (.50)	-.74 (.97)
Time 1/Time 2 ODI Change Scores	**-.0007 (.0011)**	**-.0038-.0012**	**-1.02 (.50)**	**2.16 (.97)**
Time 1 SSSI Scores	83.46 (21.10)	26.32-100.00	-1.53 (.50)	1.54 (.97)
Time 2 SSSI Scores	85.53 (16.69)	47.37-100.00	-1.11 (.50)	.14 (.97)
Time 1/Time 2 SSSI Change Scores	**2.07 (12.33)**	**-23.68-38.16**	**1.05 (.50)**	**3.30 (.97)**
Time 1 SBST Scores	2.57 (1.75)	.00-5.00	-.01 (.50)	-1.29 (.97)
Time 2 SBST Scores	1.90 (1.73)	.00-5.00	.67 (.50)	-.72 (.97)
Time 1/Time 2 SBST Change Scores	**-.67 (1.62)**	**-5.00-2.00**	**-.83 (.50)**	**1.14 (.97)**
Time 1 ÖMPSQ Scores	33.81 (16.12)	5.00-64.00	-.10 (.50)	-.49 (.97)
Time 2 ÖMPSQ Scores	29.10 (12.58)	9.00-53.00	.03 (.50)	-.63 (.97)
Time 1/Time 2 ÖMPSQ Change Scores	**-4.71 (10.60)**	**-27.00-15.00**	**-.41 (.50)**	**-.18 (.97)**

Table 2 continued

Paired Samples T-Test Analysis of Time 1 to Time 2 Change in Outcome Variable Mean Scores (*n*=21)

Timepoint	n	M (SD)	t(df)	p
Time 1/Time 2 *Stress Score Change*			**-.62 (20)**	**.54**
Time 1	21	13.19 (5.73)		
Time 2	21	13.86 (6.87)		
Time 1/Time 2 *Disability Score Change*			**3.17 (20)**	**.005**
Time 1	21	.00153 (.00135)		
Time 2	21	.00079 (.00076)		
Time 1/Time 2 *Social Support Score Change*			**-.77 (20)**	**.45**
Time 1	21	83.46 (21.10)		
Time 2	21	85.53 (16.69)		
Time 1/Time 2 *SBST Score Change*			**1.88 (20)**	**.07**
Time 1	21	2.57 (1.75)		
Time 2	21	1.90 (1.73)		
Time 1/Time 2 ÖMPSQ *Score Change*			**2.04 (20)**	**.06**
Time 1	21	33.81 (16.12)		
Time 2	21	29.10 (12.58)		

Table 3

Pearson's r Correlation Between Age and Time 1/Time 2 Outcome Variable Change Scores (*n*=21)

Variable	1	2	3	4	5	6
1. Age	--	-.31	.13	-.31	.38	.10
2. Time 1/Time 2 Stress Change Scores		--	.21	-.38	.07	.41
3. Time 1/Time 2 Disability Change Scores			--	-.48	.37	.44*
4. Time 1/Time 2 Social Support Change Scores				--	-.52	-.40
5. Time 1/Time 2 SBST Change Scores					--	.48*
6. Time 1/Time 2 ÖMPSQ Change Scores						--

*$p<.05$