THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

DEPARTMENT OF KINESIOLOGY

AN EXAMINATION INTO THE RELATIONSHIP BETWEEN OCUPATIONAL PHYSICAL ACTIVITY AND BEHAVIORAL OUTCOMES

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SPRING 2020

A thesis
submitted in partial fulfillment
of the requirements
for a baccalaureate degree
in Kinesiology
with honors in Kinesiology

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ABSTRACT

Physical activity has been associated with a broad range of positive advances to health status, chronic disease, and mental illnesses. Exercise provides protective effects against many noncommunicable diseases such as cardiovascular disease, diabetes, cancer, stroke, that tend to have high mortality rates. Exercise has also shown to be a beneficial form of treatment for mental illnesses such as anxiety and depression. A typical individual spends approximately 8 hours of their day at work, so their workplace movement is significantly influential in their overall physical activity. Occupational physical activity can impact health in many ways depending on if a position is typically sedentary or active. Additionally, exercise may provide additional benefits to workplace performance and employee health and psychosocial outcomes. The purpose of this study was to identify if occupational physical activity influenced constituent behaviors underlying overall health and workplace success in employees. Participants were asked to participate in a subjective survey analyzing self-reported leisure PA, occupational PA, pain, workplace performance and psychosocial behaviors. Data was analyzed by SPSS software, where t-tests and correlations were set at $p<0.05$. This experiment served as an exploratory study to determine if relationships existed between leisure PA, occupational PA and these underlying behaviors of successful workplace outcomes. Future studies could benefit from using a larger sample size and more objective measurements of PA to potentially find more significant differences between occupational PA and health outcomes.

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ACKNOWLEDGEMENTS

First and foremost, I would like to thank Dr. Melissa Bopp for all of the guidance she's provided as my mentor throughout my time in Schreyer Honors College. Her office has always been such an inviting space where I've felt comfortable to share ideas, collaborate, and think critically. In times of stress and uncertainty surrounding this project, she has been extremely available, patient, and reassuring. I've also had the privilege of having Dr. Bopp as a professor. She is kind and fair to her students and makes class interesting, challenging and fun. Despite her enormous workload, she finds time to make personal relationships with her students. My time working with her in the Physical Activity and Public Health laboratory have been my favorite years while at Penn State. She is an incredible resource for the Kinesiology department and students and I'm so grateful I got the privilege to work with her.

Additionally, I would like to thank Oliver Wilson, a graduate student in the PAPH laboratory. Olly, you have been one of the most helpful individuals I've ever worked with. From having you as a teaching assistant to working with you in the lab, you have always been ready to answer my sometimes-never-ending questions with patience. You are one of the hardest working people I've ever met and your passion for helping undergraduate marginalized groups and women on campus inspires me to help others. Penn State is lucky to have you.

Lastly, I'd like to thank my family and friends for their support throughout my whole college experience. My parents have always been right behind me and incredibly loving. I'm incredible grateful they were always a phone call or short drive away. My friends have been a tremendous help in keeping college fun and relieving stress. From working out to weekend hangouts, they always know how to make me smile, laugh and appreciate how Penn State can

bring people together. I don’t know what I would’ve done without them. They are all so incredibly talented and I cannot wait to see how far they go in life.

Chapter 1 Literature Review

Physical Activity and Health Outcomes

A broad range of evidence exists that explains the significant benefits that physical activity (PA) has on general health. Despite the benefits to health from PA being far ranging, over 80% of adults and adolescents do not achieve the minimum PA recommendations (Piercy et al., 2018). Adults who increase their PA levels as they age, even if they were inactive when they were younger, have decreased risk of all-cause mortality (Mok, Khaw, Luben, Wareham & Brage, 2019, Saint-Maurice et al., 2019). This relationship was examined in 14,599 men and women whose overall PA energy expenditure (PAEE) was measured over the course of 12.5 years. Individuals with increasing levels of PAEE over the years had lower risks of mortality, and more longevity benefits. Also, adults who meet at least the minimum levels of recommended PA levels had potentially 46% less risk of death from incidences related to being physically inactive (Mok et al., 2019). Another study following 315,059 adult AARP members, categorized into different age groups ranging from 18 to 61, measured self-reported leisure time physical activity (LTPA) in relation to all-cause or cause-specific mortality. Individuals who were able to increase their LTPA through later adulthood had 32% to 35% lower risks for all-cause mortality. Adults who were able to maintain 2 to 7 hours per week of LTPA had a 14% reduced risk for cancer-related mortality (Saint-Maurice et al., 2019).

In other studies examining epidemiological trends, physical inactivity has been shown to increase the risks of non-communicable diseases (NCDs) and create significant costs to health (Lee et al., 2012; Powell & Blair, 1994). The population attributable fraction (PAF) was calculated and used with associated relative risk to determine the impact of physical inactivity on NCDs on longevity of a population. In the United States physical inactivity was estimated to be responsible for 6%-10% of major NCDs including CHD, type 2 diabetes, colon cancers, and breast cancers. This would be equivalent to physical inactivity being responsible for about 9% of premature deaths or 57 million deaths in 2008.

Another study used population attributable risk (PAR) to calculate how much inactivity contributes to the public health burden for NCDs such as CHD, diabetes, and colon cancer (Powell & Blair, 1994). Based on estimates of PAR and relative risk for NCDs if individuals would've participated in regular vigorous PA, 35% of deaths from CHD, 32% of deaths from colon cancer, and 35% of deaths from diabetes could have been prevented in 1988. If these deaths were prevented the overall mortality rate in the United States would decrease by about 5% (Powell & Blair, 1994).

The association between physical inactivity, NCDs and all-cause mortality rates of a population are also associated with significant direct and indirect economic burdens (Ding et al., 2016; Colditz, 1999). An estimation of the cost of physical inactivity is relevant for national healthcare costs (Ding et al., 2016). Worldwide costs of inactivity were measured by using physical inactivity data from 142 countries based on their population attributable fractions associated with physical inactivity (Ding et al., 2016). The direct healthcare costs of NCDs, productivity loses, and disability-adjusted life years (DALYs) are all significant portions of the economic costs of inactivity. Based on the 2013 data, $67.5 billion dollars worldwide could be contributed to direct healthcare costs of inactivity or losses of productivity from sedentary behaviors, this was equivalent of the GDP of Costa Rica. In the United States, the estimated costs of inactivity have varying estimates. In a study using a database search and population attributable fractions, the economic costs of obesity, diabetes, hypertension, and CHD accounted for 24 billion or 2.4 percent of healthcare costs in the U.S. in 1995 (Colditz, 1999). Another study used data from the National Health Interview Survey (NHIS) to determine how many adults met guidelines combined with data from the Medical Expenditure Panel Survey (MEPS) to estimate the costs of healthcare associated with sedentary behavior (Carlson, Fulton, Pratt, Yang & Adams, 2015). Carlson estimated overall U.S. healthcare costs associated with physical inactivity to be 11.1%. The difference between the two percentages accounts for an enormous amount of money. While the exact healthcare expense is hard to determine precisely because of the large amounts of data available and the different techniques for calculating costs, it is obvious there is a huge economic cost associated with being physically inactive.

Decreased physical health from NCDs and lower PA can also influence mental health in a negative way. A large amount of evidence also exists supporting the positive influence PA has on mental health. PA's positive influence on anxiety, depression, and neurodegenerative diseases has positive growing support in the literature (2018 Physical Activity Guidelines Advisory Committee, 2018; Mikkelson et al., 2017,;Deslandes et al., 2009). In a study reviewing literature on PA's associations with major depressive disorder, Alzheimer's disease, and Parkinson's disease on the elderly found exercise to be beneficial to healthy brain function (Deslandes et al., 2009). There was an inverse relationship between aerobic PA and strength training on depression. Mild to moderate major depressive order can be effectively treated with aerobic exercise consistent with PA guidelines. Another review article summarized multiple studies showing the benefits of exercise on mental health, specifically anxiety and depression (Mikkelsen, Stojanovska, Polenakovic, Bosevski & Apostolopolulos, 2017). Exercise helps to decrease inflammation, releases endorphins and improves self-efficacy which can greatly improve quality of life of someone with anxiety or depression.

The U.S Department of Health and Human Service published the most recent guidelines in 2018 for U.S. citizens. In order to obtain the health benefits of PA, the guideline recommendations based on age; for adults, these guidelines recommend 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity PA must be met. Additionally, two days of resistance training and interrupting long periods of sedentary behavior are recommended. The 2008 guidelines were updated expanding upon what constitutes PA, how to track PA throughout the day, and emphasizing the positive associations PA has with sleep quality and mental health benefits (2018 Physical Activity Guidelines Advisory Committee, 2018).

Occupational Physical Activity

Occupational PA has a large influence on an individual's overall health. Considering an average person spends 8 hours of their day at work, not including travel time, this accumulates and accounts for a significant portion of their life. Evidence shows that if someone's occupation requires them to be active or sedentary then an individual's overall health is impacted. The classic London Busman study shows that despite having a more stressful job with human interaction, the ticket takers had significantly lower rates of CVD than the bus drivers who seemed to have a stress-free occupation (Morris & Crawford, 1958). This study ignited the interest in how occupational PA can impact health.

The relationship between type of occupation and health has been well documented. A study measured 5-year exposure to occupational hazards and the corresponding health effects on employees using information on workplace conditions from the Dictionary of Occupational Titles combined with information about different occupations from the Panel Study of Income Dynamics (Fletcher, Sindelar & Yamaguchi, 2009). They concluded that occupations with physical requirements have negative health effects but fail to separate physical and psychological components of PA. In another study using German data on different types of occupational stressors from over 29 years to examine the relationship between occupational physical and psychosocial stressors (Ravesteijn, Kippersluis & Doorslae, 2018). Blue collar workers have higher physical demands and lower job control, choice over their daily tasks, and overall lower health than white collar workers. The health disparity between blue collar and white-collar workers is equivalent to aging 29 months. The physical stress of blue-collar work is hard on the body but there are also forms of psychological stress, such as job control, that can contribute to health deterioration in workers.

When assessing occupational activity or inactivity, it is important to consider potential pain employees are experiencing because of their occupation and if PA can help prevent pain. In a cross-sectional observational study of 1059 participants, low back pain data from a Spanish twin registry and self-reported leisure and occupational physical activity were used to the measure outcome of recurrent lower back pain (Amorim et al., 2019). The study found that leisure PA is negatively associated with prevalence of chronic lower back pain. The study also found a negative relationship between people with existing chronic lower back pain and their levels of leisure PA. Additionally, occupational PA that required awkward postures, lifting, and twisting were associated with a higher prevalence of lower back pain but postures such as sitting, standing, and walking were not associated with more lower back pain (Amorim et al, 2019). A meta-analysis of 12 studies examined if workplace PA interventions were effective at reducing musculoskeletal pain (Moreira-Silva et al., 2016). PA interventions were found to be generally helpful at reducing musculoskeletal pain but different there was not enough evidence for different occupational subgroups and employees had to change their behavior to see improvements in pain. PA is supported but more evidence needs to emerge to make more specific recommendations for improving pain.

Absenteeism due to illness is another huge issue in the workplace and recently studies have shown a negative relationship between PA and absenteeism (Losina, Yang, Deshpande, Katz, & Collins, 2017; López Bueno, Casajús Mallén, & Garatachea, 2018; Kerner, Rakovac, & Lazinica, 2017). A sample of 292 employees participated in a 24-week study to examine the relationship between PA and unplanned absences due to illnesses (Losina et al., 2017). Participants were placed into three categories based on how much average PA they participated in per week. The group meeting the CDC guideline for PA had the lowest levels of unexpected absences due to illness, and the lowest active group had the highest illness related absenteeism. Two review studies came to similar conclusions. A review analyzing 15 studies that examined the relationship between leisure PA and absenteeism due to illness found most of the studies showed a significant negative relationship (Kerner, Rakovac, & Lazinica, 2017). The review also found a trend that vigorous PA had positive and preventative influences on musculoskeletal and mental health issues which can also help reduce an individual's absenteeism. Another review of 10 papers, examining the same relationship between PA and workplace absences due to illness, found a significant negative relationship in five articles (López Bueno et al., 2018). Four articles measured a dose-response relationship and found the least active group had the most illness related absenteeism. The most active group used 5 fewer sick days per year from work than the less active population (López Bueno et al., 2018). A company should already promote PA to improve the health of employees, however a strong negative relationship between PA and workplace sick days shows promoting PA to employees can benefit overall productivity of a company and potentially save money.

Aims

1. To evaluate differences in occupational and leisure-time physical activity among adult employees in two different occupational groups.
2. Examine associations between physical activity outcomes and their workplace health, absenteeism and performance.
3. Examine associations between physical activity levels and workplace health, absenteeism and performance to help further develop workplace health interventions.

Hypotheses

1. Warehouse and CDS drivers will report higher levels of physical activity than office workers.
2. Employees who engage in higher levels of physical activity will have negative associations with stress and depression.
3. Employees who engage in higher levels of occupational physical activity will have lower rates of leisure physical activity.

Chapter 2 Methods

Participants and Recruitment

This was a one-time cross-sectional analysis following employees of Dot Foods Inc, Mount Sterling Illinois (n = 48) from June 2019 to August 2019 using an online survey. The University's Institutional Review Board approved this study.

Recruitment was conducted via Dot Foods Human Resource department and Occupational Health department. The survey was distributed by email to current employees via internal email listservs. The Human Resource department were requested to encourage participation however, employee participation was voluntary and did not impact employee performance reports. Data were password protected, and only accessible to research team members. Employees were presented an informed consent statement upon opening the survey link.

Survey Design

Participants were asked to complete the survey delivered online via Qualtrics (Qualtrics, Provo, UT). Employees were invited to take part in a 65-question survey focusing on the following areas: Background/Consent (2), Work-Related Physical Activity (7), Travel (5), Leisure Physical Activity (9), Housework House Maintenance and Caring for Family (5), Sitting (4), General Feelings Towards Physical Activity (3), General Health (6), Mental Health (4), Absenteeism and Presenteeism (6), Pain (8), Demographics (5). Participation took approximately 20 minutes.

Measures

Demographics – Subjects self-reported their current employment classification (warehouse employee, office employee, CDS driver, transfer/no-touch driver); age; gender identity (man, woman, and non-binary), race/ethnicity; and height and weight from which body mass index (BMI) was calculated. Participants with a BMI greater than 25kg/m_2 and 30kg/m_2 were considered to have overweight or obesity respectively. Those with a BMI between 18.5 and 25kg/m^2 were considered “normal”, and those less than 18.5kg/m^2 were underweight (ACSM citation).

Physical Activity – Participants self-reported occupation-related and leisure aerobic and strength-training PA per week, transportation related PA, and sedentary behavior during the week and weekend was assessed using the Global Physical Activity Questionnaire (GPAQ citation). Participants were categorized based on meeting the national recommendations for aerobic and muscle-strengthening activities (≥150min/week of moderate PA; ≥75min/week or vigorous PA; ≥2 sessions of muscle-strengthening activity/week)(2018 Physical Activity Guidelines Advisory Committee, 2018).

Substances – Participants were asked if they had used the following substances in the past 30 days (yes or no); cigarettes, smokeless tobacco, and vaporizer and/or electric cigarettes.

Sweetened beverages – Participants were asked how many times per day they usually drank sugar sweetened beverages or energy drinks (excluding diet or artificially sweetened beverages). Participants responded to a seven-point scale ranging from zero to six or more times per day.

General Health – Participants were asked how satisfied they were with the following personal health aspects; work performance, sleep, stress levels, weight, appearance, physical health, mental health, overall health. Participants responded to a seven-point scale ranging from extremely dissatisfied to extremely satisfied.

Depression – Participants level of depression was assessed using the Center for Epidemiology Studies-Depression Scale 7 (CESD-7), a seven-item version of the original version (Radloff, 1977; Santor & Coyne, 1997) that measures depressive symptoms. Participants were asked items pertaining the following from the CESD-7: poor appetite, trouble keeping one’s mind on task, feeling depressed, restless sleep, feeling sad, and inability to ‘get going’. Respondents rated how often they experienced different symptoms on a four-point scale ranging from (1) rarely or none of the time (less than one day a week) to (4) most or all of the time (5-7 days a week). In the current study the scale showed a poor level of consistency, with a Cronbach’s alpha of 0.636.

Stress - Stress was assessed using the Perceived Stress Scale (PSS) 4 (Camacho, Roberts, Lazarus, Kaplan, & Cohen, 1991), which measures perceived stress on a five-point scale ranging from never (1) to very often (5). Participants rated how often they have felt the following in the past month: unable to control the important things in your life; confident about your ability to handle your personal problems; that things were going your way; and, difficulties were piling up so high that you could not overcome them.

Weight - Perceived weight status was assessed using an item from the NCHA (ACHA, 2018), where participants indicated how they would describe their weight. Participants responded to a five-point scale ranging from very underweight to very overweight. Weight change attitudes were assessed using an item from the NCHA (ACHA, 2018), where participants if they were trying to do any of the following about their weight; do nothing about their weight, stay the same weight, lose weight, or gain weight.

Absenteeism – Subjects level of absenteeism was assessed via self-report using the World Health Organization's Health and Work Performance Questionnaire [HPQ] Short Form. The HPQ Short Form takes only the absenteeism and presenteeism questions from the HPQ Long Form. The HPQ Long Form is has been viewed as a reliable quick measure of work performance (Kessler et al, 2003).

Absenteeism was evaluated as the ratio of total hours worked in a given month in relation to employer's expectations. Absenteeism was scored on a scale of -100% through 100%. Values above zero designated time spent at work beyond the job description hours (i.e. overworked). In the current study the scale showed a poor level of consistency, with a Cronbach's alpha of 0.574.

Presenteeism – Subjects had their presenteeism assessed using the Stanford Presenteeism Scale (SPS-6). The SPS-6 (Appendix B) has been proven to accurately measure employee productivity and has been used in multiple environments and studies (Koopman et al., 2002; Turpin et al., 2004; Musich, Hook, Baaner & Edington, 2006).

The questionnaire used a six-item Likert scale, with answers ranging from zero through five. Presenteeism was scored on a scale of 0 – 30. The scores of the five items added together create the final score for an employee's presenteeism. The scale had a high level of internal consistency in the current study, as determined by a Cronbach's alpha of 0.924. A high presenteeism score is viewed as positive and translates to a highly productive employee. A low score translates to poor productivity and is negative.

Pain – Subject's low back pain levels were assessed using portions of the Oswestry Low Back Pain Disability Questionnaire (Appendix B). The Oswestry Low Back Pain Disability Questionnaire is derived from the Oswestry Disability Index. It is considered the gold standard of low back pain assessment and has been proven reliable and valid, with a Cronbach's alpha ranging from 0.71 - 0.87 10. The Oswestry Low Back Pain Disability Questionnaire can be seen in Appendix B.

The questionnaire used a ten-item Likert scale, with answers ranging from zero through five with a final score calculated by summing the five items. Pain Score was calculated as a summary score. Lower scores indicated lower levels of perceived pain while at work and higher scores indicated higher levels of perceived pain. In the current study the scale had a moderate level of internal consistency, as determined by a Cronbach's alpha of 0.774.

Statistical Analysis

Basic descriptive statistics were used to describe the sample. Pearson correlations examined the relationships between PA at work, home and during leisure time and behavioral variables. Independent t-tests were used to compare the differences between dichotomized variables to determine if significance existed between the two occupational groups. Significance levels were at $p<.05$ and all analyses were run using SPSS 22.0 (IBM, Armonk, NY).

Chapter 3 Results

The demographics of the sample (n = 48) are depicted in Table 1. The sample was majority female (51.1%), non-Hispanic white (83.0%). The sample was divided into two groups, Office Workers comprised 62.5% (n = 28) of the population and Warehouse and CDS drivers comprised 37.5% (n = 14) of the population. African Americans comprised of 2.1% (n = 1) of the population, Hispanic/Latinx comprised of 10.6% (n = 5) of the population, and Native Americans comprised of 4.3% (n = 2) of the population. The mean BMI for the study was 28.4 ± 5.6 kg/m^2. The health behaviors, psychological, and occupational outcomes for the sample (n = 48) are depicted in Table 2. The mean work-vigorous physical activity, WVPA, was 287.02 ± 438.96 minutes/week, the mean work-moderate physical activity, WMPA, was 221.83 ± 387.64 minutes/week, and the mean work walking time was 228.13 ± 340.12 minutes/week. The mean leisure-vigorous physical activity, LVPA, was 180.71 ± 161.40 minutes/week, the mean leisure-moderate physical activity, LMPA, was 121.43 ± 122.72 minutes/week, and the mean leisure muscle-strengthening activity, LMSA reported was 115.27 ± 250.21 minutes/week. The mean active transportation, AT, reported was 132.17 ± 284.20 minutes/week. The mean housework-vigorous physical activity, HWVPA, was 165.56 ± 195.50 minutes/week, the mean housework-moderate physical activity, HWMPA, was 284.50 ± 334.92 minutes/week.

Examining Differences Between Occupational Groups

The Office workers mean BMI was 27.83 ± 5.83 kg/m^2. Warehouse and CDS drivers mean BMI was 29.45 ± 5.19 kg/m^2. Office workers were majority female (65.5%, n = 19). Warehouse and CDS drivers were majority male (72.2%, n = 13). The mean age of Office worker was 34.54 ± 10.94 years. The mean age of Warehouse and CDS drivers was 38.29 ±

14.05 years. Significant differences for absenteeism, pain, LMPA, LVPA, Body-Mass Index, stress, and depression exist between the two groups.

Office workers reported a higher BMI compared with Warehouse and CDS drivers ($t = 0.91$, $p = 0.37$) as shown in Table 1. Office workers reported a higher age compared with Warehouse and CDS drivers ($t = 0.95$, $p = 0.35$). Warehouse and CDS drivers reported a higher amount of WVPA compared with Office workers ($t = 9.18$, $p < 0.001$). Warehouse and CDS drivers reported a higher amount of WMPA compared with Office workers ($t = 6.09$, $p < 0.001$). Warehouse and CDS drivers reported a higher amount of walking work activity compared with Office workers ($t = 2.81$, $p = 0.007$). Warehouse and CDS drivers reported a higher amount of active transportation compared with Office workers ($t = 2.88$, $p = 0.01$). Warehouse and CDS drivers reported a higher amount of LVPA compared with Office workers ($t = 2.67$, $p = 0.01$). Warehouse and CDS drivers reported a higher amount of LMPA compared with Office workers ($t = -0.534$, $p = 0.60$). Warehouse and CDS drivers reported a higher amount of LMSPA compared with Office workers ($t= 1.49$, $p = 0.143$). Warehouse and CDS drivers reported a higher amount of vigorous housework activity compared with Office workers ($t = 1.57$, $p = 0.125$). Office workers reported a higher amount of moderate housework activity compared with Warehouse and CDS drivers ($t= -0.50$, $p = 0.618$). Warehouse and CDS drivers had higher self-reported stress scores compared with Office workers ($t= 1.94$, $p = 0.06$). Office workers had higher self-reported pain scale scores compared with Warehouse and CDS drivers ($t= -0.68$, $p = 0.50$). Office workers had higher self-reported work performance scores compared with Warehouse and CDS drivers ($t= -0.65$, $p = 0.52$). Warehouse and CDS drivers had higher self-reported depression scale scores compared with Office workers ($t= -0.50$, $p = 0.618$).

Office workers were more likely to be female compared with Warehouse and CDS drivers (χ^2= 6.33, p = 0.01). Office workers were more likely to be Caucasian compared with Warehouse and CDS drivers (χ^2 = 3.13, p = 0.37). Office workers were more likely to use cigarettes compared with Warehouse and CDS drivers (χ^2 = 0.25, p = 0.62). Warehouse and CDS drivers were more likely to use tobacco compared with Office workers (χ^2 = 1.22, p = 0.27). Warehouse and CDS drivers were more likely to use vapes or e-cigarettes compared with Office workers (χ^2 = 1.22, p = 0.27).

Correlational Analyses

Office Worker

The correlational analysis between PA levels and behavioral variables for Office worker are found in Table 4. BMI was positively correlated with pain (r = 0.72, p < 0.001) and negatively correlated with LVPA (r = -0.49, p = 0.01). Pain was positively correlated with depression (r = 0.40, p = 0.03). HWMPA was positively correlated with stress (r = 0.415, p = 0.04). LMPA was positively correlated with LVPA (r=0.62, p < 0.001) and LMSPA (r = 0.53, p = 0.003). LVPA was positively associated with LMSPA (r = 0.68, p < 0.001). Active transportation was negatively correlated with depression (r = -0.39, p = 0.04). Stress was positively associated with depression (r = 0.52, p = 0.004). Self-evaluated work performance was negatively associated with depression (r = -0.51, p = 0.005).

Warehouse and CDS Driver

The correlational analysis between PA levels and behavioral variables for Warehouse and CDS drivers are found in Table 3. HWVPA was positively associated with LMPA (r = 0.82, p = 0.002). LMPA was positively associated with LVPA (r = 0.57, p = 0.03). Stress was positively associated with depression ($r = 0.842$, $p < 0.001$). Absenteeism was positively associated with self-reported work performance ($r = 0.63$, $p = 0.01$).

Chapter 4 Discussion

This study assessed the relationships between occupational PA on leisure PA on workplace outcomes in adults employed at Dot Foods, Mount Sterling Illinois. Few studies to date have focused on the relationship between both occupational and leisure PA on the behaviors and health of adults. The aim of this study was to continue research into determining the role of occupational PA in adult's overall health. This study attempted to examine how subjects' occupational physical requirements related to their overall physical and mental health. The implications of this study are relevant for occupational health companies, worker compensation costs, healthcare providers, employers and management for providing preventative intervention focused on impacting work performance and health behaviors.

The current study recorded a significant difference in self-reported time spent doing PA by occupational groups as shown in Table 2. Warehouse and CDS drivers reported significantly more vigorous and moderate work-related PA per week than office workers. In the current study, warehouse employees face more physical job demands than office workers and must maintain production rates in order to remain employed. Their ability to be quick and efficient physically influences their job status. Office workers have different work performance measures that do not depend on physical performance or speed. Our findings were in line with a similar study examining brewery employees and office workers who wore activity trackers (Thompson, Severson & Rosecrance, 2018); the blue-collar brewery employees had higher mean heart rates and step counts than office workers. Additionally, another systematic review examining wearable devices on different types of occupation types found that office workers had the lowest step count of the 11 occupational groups they examined. Postal workers in the same previous review had the highest step count (Prince, Elliott, Scott, Visintini & Reed, 2019). Similar to the Warehouse employees, postal workers have physical efficiency demands and often work as long as it takes them to finish their assigned route, which motivates them to work at a faster pace. Although the current study did not use wearable devices, previous literature supports that active occupations record more PA than office employees during a workday. Positions such as brewery employees, postal workers or warehouse employees may have different motivators that increase their PA intensity and volume during their workday. These motivators could include hitting productivity standards or having shorter hours if they finish early. Employers should examine how they assess their employees in order to increase their PA levels. This could include incentives to office workers or other traditionally sedentary positions based on PA measures.

The correlational analysis between LVPA, LMPA, and LMSPA were all positive for office workers as shown in Table 4. In the abovementioned systematic review, with 11 different occupational groups, office workers had the greatest amount of moderate-to-vigorous intensity PA despite their low occupational PA (Prince et al. 2019). The current study also shows higher mean values for LMPA among office workers compared with warehouse and CDS drivers. The elevated levels of LMPA may be an attempt to compensate for sedentary time while at work. This suggests that if individuals with sedentary occupations actively choose to participate in leisure-time PA, they are more likely to participate in all types of PA rather than just one type. If we can initiate leisure-time PA, individuals will be likely to participate fully. Employers should take interventions to help employees start being physically active in order to increase all types of leisure-time PA.

The analysis of the data showed a positive correlation for body mass index and pain among office workers but no association among warehouse and CDS drivers which can be referenced in Table 3 and Table 4. A positive association between pain and depression existed for office workers when there was no correlation between pain and depression for warehouse and CDS drivers. Warehouse and CDS drivers had slightly lower mean BMI values, but both categories of employees were still considered overweight with mean BMI's close to 30 (ACSM). Since the mean BMI for both groups are so similar but activity levels between the groups vary so greatly this may suggest that more movement causes less pain. In a review of studies examining overweight and obese adults with chronic low back pain following different exercise prescriptions (Wasser, Vasilopoulos, Zdziarski & Vincent, 2017), all exercise types had improved perception of pain. Functional complex muscle activation provided the most improvement and increased the subjects' overall satisfaction with daily living (Wasser et al., 2017). Relevant to the current study, this research implies that exercise may provide more benefits to employees than just strength and aerobic fitness; it could decrease perceived pain and benefit overall life and mood.

Further analysis compared the relationship between stress and depression among the two occupational groups and found a positive relationship for both with a stronger relationship among the two variables in warehouse and CDS drivers as shown in Table 3. Warehouse and CDS drivers reported higher average levels of stress and depression than office workers. In a studying reviewing physical and psychological burdens of German panels, blue-collar workers were found to have lower health, higher physical and lower job control than white collar workers (Ravensteijn et al. 2018). Lower job control means blue-collar workers don't have as much choice in their daily job tasks. For example, warehouse workers have a handheld device that tells them what order they need to fill and as soon as one is done, the next order appears. They must be able to fill orders at a certain production rate or potentially lose their job. Office workers have more autonomy in their everyday tasks. The office workers are continuously working on projects and have performance reviews once a year so their daily stress levels may be less since their jobs don't depend on their daily production rates. To decrease the stress warehouse and truck drivers face, it may be beneficial to implement lower productivity standards and award workers for more than just productivity and following directions. Incentives for new ideas and innovation might help blue-collar workers feel more control over their job and improve overall stress and depression levels. A study giving a survey to 1,502 participants measured how leadership communication and job autonomy impacted employee vitality, or positive energy (Tummers, Steijn, Nevicka & Heerema, 2018). Employees with high vitality tend to be less stressed than employees with lower vitality. Autonomy seemed to have a high influence on vitality due to participants with the highest job autonomy having more vitality than those with low autonomy (Tummers et al, 2018).

Limitations

The primary limitation to this study centered on the small, volunteer sample size (n=48) included; there sample size was too small to draw major conclusions around the constituent variables involved with this study. A larger sample size would also allow examination of differences in sex alongside different occupational categories. This study was too small to determine any significant differences between sexes. Volunteer bias might have affected outcomes of the study; those who chose to answer the survey could've been more interested in the results than those who chose not to take the survey. Secondary limitations to the study include reliance on self-report measures to determine these variables effect without another source of objective physical fitness as well as being a one-time cross-sectional analysis. Future studies would benefit from incorporating an additional objective measure such as an accelerometer and tracking the groups over a longer period and identifying changes in PA in their occupation and during leisure activity.

Conclusion

The aims of the study were met by furthering the discussion on how occupational PA and leisure-time PA influence the health of adults. The data supported the hypothesis that warehouse employees and truck drivers would have higher self-reported occupational PA. The data did not support the that adults who engage in higher levels of PA will have negative associations with stress and depression or that adults who engage in higher levels of occupational PA will have lower rates of leisure PA. While higher amounts of PA can positively influence a worker's health, "blue-collar" employees still face many job stressors, mainly productivity standards and less job security. Additionally, office workers experienced more pain than warehouse employees and truck drivers. PA may be a great preventative measure for developing chronic pain from sedentary lifestyles. Pain may be an important topic to further investigate in relation to occupational PA. This study was limited by its small sample size and subjective measures. A significant amount of opportunities remain to examine the relationship between occupational PA and overall health further.

Appendix A Results Tables

Table 1. Demographic Characteristics of the sample (n = 48) and Occupational Groups

		Total (n = 48)				**Warehouse and Drivers (n = 18)**				**Office (n = 30)**			
		n	%	Mean	SD	n	%	Mean	SD	n	%	Mean	SD
	Age	42		35.8	12.0	14		38.3	14.1	28		34.5	10.9
	Race	47											
	Caucasian	39	83.0			13	72.2			26	89.7		
	African American	1	2.1			1	5.6			0	0.0		
	Hispanic or Latinx	5	10.6			3	16.7			2	6.9		
	Native American	2	4.3			1	5.6			1	3.4		
Demographics	**Sex**												
	Men	23	49.8			13	72.2			10	34.5		
	Women	24	51.1			5	27.8			19	65.5		
	BMI (kg/m^2)	43		28.4	5.6	16		29.5	5.2	27		27.8	5.8
	Job Type												
	Warehouse	13	27.1										
	Office	30	62.5										
	CDS Driver	5	10.4										

Table key:
BMI = Body mass index in kg/m^2

Table 2. Health Behaviors, Psychological, and Occupational Outcomes for the Sample (n = 48) and Occupational Groups

		Total (n = 48)				Warehouse and Drivers (n = 18)				Office (n = 30)			
		n	%	Mean	SD	n	%	Mean	SD	n	%	Mean	SD
	Physical activity (min/week)												
	WVPA	48		287.0	438.7	18		737.7	428.3	30		16.6	51.1
	WMPA	48		221.8	387.6	18		552.6	473.7	30		23.4	57.8
	WW	48		228.1	340.1	18		394.4	436.3	30		128.4	220.1
	AT	48		132.2	284.2	18		274.1	416.9	30		47.0	95.1
	LVPA	48		180.7	161.4	18		256.2	196.0	30		135.4	118.5
	LMPA	44		121.4	122.7	14		106.9	137.8	30		128.2	116.9
Health behaviors	LMSPA	48		115.3	250.2	18		183.9	389.2	30		74.1	89.5
	HWVPA	34		165.6	195.5	15		223.7	224.5	19		119.7	160.7
	HWMPA	44		284.5	334.9	17		252.2	261.9	27		304.8	377.1
	Sitting	47		13.8	5.1	17		14.8	7.4	30		13.2	3.1
	Sleep	47		4.3	1.5	18		4.2	1.3	29		4.5	1.6
	Tobacco Use												
	Cigarettes	7	15.2			2	11.8			5	17.2		
	Smokeless tobacco	3	6.5			2	11.8			1	3.4		
	Vape/ecig	3	6.5			2	11.8			1	3.4		
	Depression	45		5.4	3.7	16		5.9	4.2	29		5.2	3.5
Psychological factors	Pain	47		9.4	2.8	17		9.1	2.2	28		9.6	3.1
	Stress	47		5.7	2.6	18		6.6	2.9	29		5.1	2.2
Work performance		47		5.9	1.1	18		5.8	1.2	29		6.0	1.1

Table key:
WVPA = Work vigorous physical activity
WMPA = Work moderate physical activity
WW = Work walking
AT = Active transportation
LVPA = Leisure moderate physical activity
LMPA = Leisure moderate physical activity
LMSPA = Leisure muscle strengthening physical activity
HWVPA = Housework vigorous physical activity
HWMPA = Housework moderate physical activity

Table 3. Correlations between main outcome variables for warehouse employees and CDS drivers (n = 18)

	Absenteeism	Pain	HWVPA min/wk	HWMPA min/wk	LMPA min/wk	LVPA min/wk	AT min/wk	LMSPA min/wk	Stress	Depression	Work perf	Sitting min/wk
BMI (kg/m2)	0.06	0.04	0.17	-0.15	0.20	0.19	-0.07	-0.11	-0.43	-0.53	0.20	-0.488
Absenteeism		-0.05	0.06	0.00	-0.29	-0.07	0.10	-0.06	-0.35	-0.41	0.625**	-0.28
Pain_Sum			0.12	0.24	-0.13	0.11	0.17	-0.14	0.03	-0.12	-0.04	-0.38
HWVPA min/wk				0.38	0.82**	0.42	0.17	0.34	-0.41	-0.34	0.214	-0.51
HWMPA min/wk					0.17	0.18	0.15	-0.03	0.18	-0.05	0.166	-0.32
LMPA min/wk						0.57*	-0.13	0.42	0.02	0.09	0.254	-0.16
LVPA min/wk							0.10	0.46	-0.05	0.00	0.09	-0.18
AT min/wk								0.21	-0.34	-0.27	-0.23	-0.16
LMSPA min/wk									-0.43	0.00	0.15	0.01
Stress										0.84**	-0.10	0.504*
Depression											-0.04	0.686**
Work perf												-0.295

Table Key:
* = Correlation is significant at the 0.05 level (2-tailed).
** = Correlation is significant at the 0.01 level (2-tailed).
BMI = Body mass index in kg/m2
HWVPA = Housework vigorous physical activity
HWMPA = Housework moderate physical activity
LMPA = Leisure moderate physical activity
LVPA = Leisure moderate physical activity
AT = Active transportation
LMSPA = Leisure muscle strengthening physical activity

Table 4. Correlations between main outcome variables for office employees (n = 30)

	Absenteeism	Pain	HWVPA min/wk	HWMPA min/wk	LMPA min/wk	LVPA min/wk	AT min/wk	LMSA min/wk	Stress	Depression	Work perf	Sitting min/wk
BMI (kg/m2)	0.01	0.723**	-0.09	-0.02	-0.35	-0.486*	-0.09	-0.37	-0.18	0.37	-0.30	-0.20
Absenteeism		0.02	0.30	0.14	-0.01	-0.10	0.04	0.03	-0.06	0.16	-0.07	0.03
Pain			-0.02	-0.25	-0.17	-0.09	-0.12	-0.14	-0.04	0.403*	-0.086	-0.227
HWVPA min/wk				0.46	0.01	-0.09	-0.03	-0.24	0.46	0.35	0.024	-0.246
HWMPA min/wk					0.32	-0.21	0.00	-0.12	0.415*	0.12	0.123	-0.187
LMPA min/wk						0.621**	-0.04	0.528**	0.22	-0.09	0.362	-0.261
LVPA min/wk							0.10	0.682**	0.09	-0.12	0.224	-0.235
AT min/wk								-0.16	-0.09	-0.39	0.18	-0.268
LMSA min/wk									-0.05	-0.13	0.137	-0.161
Stress										0.52**	-0.291	-0.308
Depression											-0.510**	-0.026
Work perf												0.027

Table Key:
* = Correlation is significant at the 0.05 level (2-tailed).
** = Correlation is significant at the 0.01 level (2-tailed).
BMI = Body mass index in kg/m2
HWVPA = Housework vigorous physical activity
HWMPA = Housework moderate physical activity
LMPA = Leisure moderate physical activity
LVPA = Leisure moderate physical activity
AT = Active transportation
LMSPA = Leisure muscle strengthening physical activity

Appendix B Questionnaires

The Oswestry Low Back Pain Disability Questionnaire

Pain_intesity Section 1: Pain Intensity at the Moment (thinking about any back or leg pain you may have)

- ◯ I have no pain at the moment (1)
- ◯ The pain is very mild at the moment (2)
- ◯ The pain is moderate at the moment (3)
- ◯ The pain is fairly severe at the moment (4)
- ◯ The pain is very severe at the moment (5)
- ◯ The pain is the worst imaginable at the moment (6)

Pain_lifting Section 3: Lifting

- ◯ I can lift heavy weights without extra pain (1)
- ◯ I can lift heavy weights but it gives extra pain (2)
- ◯ Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently placed eg. on a table (3)
- ◯ Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned I can lift very light weights (4)
- ◯ I cannot lift or carry anything at all (5)

Pain_walking Section 4: Walking

- ○ Pain does not prevent me walking any distance (1)
- ○ Pain prevents me from walking more than 1 mile (2)
- ○ Pain prevents me from walking more than 1/2 mile (3)
- ○ Pain prevents me from walking more than 100 yards (4)
- ○ I can only walk using a stick or crutches (5)
- ○ I am in bed most of the time (6)

Pain_sitting Section 5: Sitting

- ○ I can sit in any chair as long as I like (1)
- ○ I can only sit in my favorite chair as long as I like (2)
- ○ Pain prevents me sitting more than one hour (3)
- ○ Pain prevents me from sitting more than 30 minutes (4)
- ○ Pain prevents me from sitting more than 10 minutes (5)
- ○ Pain prevents me from sitting at all (6)

Pain_standing Section 6: Standing

- ◯ I can stand as long as I want without extra pain (1)
- ◯ I can stand as long as I want but it gives me extra pain (2)
- ◯ Pain prevents me from standing for more than 1 hour (3)
- ◯ Pain prevents me from standing for more than 30 minutes (4)
- ◯ Pain prevents me from standing for more than 10 minutes (5)
- ◯ Pain prevents me from standing at all (6)

Pain_sleeping Section 7: Sleeping

- ◯ My sleep is never disturbed by pain (1)
- ◯ My sleep is occasionally disturbed by pain (2)
- ◯ Because of pain I have less than 6 hours sleep (3)
- ◯ Because of pain I have less than 4 hours sleep (4)
- ◯ Because of pain I have less than 2 hours sleep (5)
- ◯ Pain prevents me from sleeping at all (6)

Pain_social Section 9: Social Life

- ◯ My social life is unaffected because I have no pain. (1)
- ◯ My social life is normal but increases the degree of pain (2)
- ◯ Pain has no significant effect on my social life apart from limiting my more energetic interests eg, sport (3)
- ◯ Pain has restricted my social life and I do not go out as often   (4)
- ◯ Pain has restricted my social life to my home   (5)
- ◯ I have no social life because of pain (6)

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Academic Vita

Education

Bachelor Kinesiology, Movement Science May2020
The Pennsylvania State University *University Park, PA*
Schreyer Honors College

Experience

Barista | *Penn State Residential Dining* December 2019 – Present

- Greeted and assisted guests in a professional manner, *State College, PA*
- Successfully prepared and served drinks and food in accordance with health codes and café standards
- Responding quickly to complex requests in a fast-paced environment

Internship | *Physical Activity and Public Health Laboratory* August 2019 – Present

- Assist in research projects to understand and promote physical activity *State College, PA*
- in diverse populations and settings
- Produce an honors thesis project on occupational physical activity on health outcomes
- Assist with conducting interviews to understand women's barriers to exercise on college campuses

Internship | *Dot Foods Inc.* May 2019 – July 2019

- Shadow and Assist professional athletic trainers with employee injury rehabilitations *Mount Sterling, IL*
- Research and plan new employee injury prevention strategies
- Collaborate with Occupational Health Department to improve health of employees
- Network and develop professional relationships within and outside of the company

Emergency Medical Technician | *Kittanning Ambulance Service* May 2018 – August 2018

- Provide efficient and immediate care to the seriously ill and injured *Kittanning, PA*
- Perform critical thinking to ensure appropriate care is administered
- Empathize and comfort patients experiencing pain, illness or distress

Internship | *CrossFit Nittany* August 2018 – May 2019

- Shadow and Assist professional cross-training coaches *State College, PA*
- Communicate effectively with gym members and staff
- Learn to maintain and improve a business

Waitress | *Oakmont Country Club* April 2016 – May 2018

- Manage customer needs to facilitate an excellent dining experience *Oakmont, PA*
- Multitask efficiently to ensure spectacular service
- Communicate well to coworkers to produce a positive teamwork environment

Certifications

Emergency Medical Technician Trained May 2018 – Present
CrossFit Level 1 Certification June 2017 – Present
CPR, First Aid, AED Certified by American Heart Association January 2018 – Present