THE RELATIONSHIP BETWEEN MODERATE EXERCISE AND

DEPRESSION AMONG ADULTS AGED 45 YEARS AND ABOVE.

By

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A Thesis Submitted in Partial Fulfilment of Requirement of

MS in Health and Human Performance (Health concentration)

Middle Tennessee State University

Murfreesboro,

May 2016

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I dedicate my thesis work to my husband, Gaurav Thareja for always encouraging and supporting me throughout the thesis process, making me learn the technical skills and helping me in facing challenges of graduate school.

I would also like to extend my gratitude and dedication to my parents and in-laws for motivating me to study and work hard so that I can achieve my inspirations.

Also special thanks to my sister Ritika for always being on my side and being my cheerleader.

I appreciate the support and motivation from my family that helped me in continuing my studies in graduate school.

ACKNOWLEDGEMENTS

I have been able to complete my thesis with the support and guidance from my Advisor, Professor's, and Colleagues at Health and Human Performance Department as without their precious guidance, this thesis would not have been able to become a reality.

I would like to thank and express my sincere gratitude to my Advisor and Thesis Committee chair, Dr. Norman Weatherby for supporting, encouraging and guiding me throughout my Master's program and thesis. The pool of knowledge that he has shared with me throughout the research process in thesis helped in finalizing the topic and conducting the research. I am glad and obliged to him for being my mentor and advisor.

Along with my Advisor, I would also like to thank my Committee member, Dr. Brian Ragan, for his patience, insightful comments and encouragement that helped in my thesis. He shared his valuable knowledge with me about the research process and thesis and helped me in analyzing the results and completing the thesis.

I would also like to deeply appreciate Tracy Morris for providing me her guidance and suggestions throughout the process and providing me encouragement.

ABSTRACT

Depression affects 9.5% of the US population annually (National Alliance of Mental Illness [NAMI], 2014). Most of the adults above 45 years of age experience some kind of chronic illness and 50% of adults with chronic illness also suffer from mental illness (Center for Disease Control and Prevention [CDC], 2008). This study seeks to better understand phenomena by examining the effect of moderate exercise on depression among adult aged 45 years and above while controlling for age, gender, race, baseline depression score, education, marital status and social support. Moderate exercise has positive effects on various physiological systems of the body (CDC, 2000).

This study incorporates perceived susceptibility and perceived severity constructs from Health belief model (Rosenstock & Hochbaum 1972). Individuals who have mental illness as perceived threat are more likely to perform the advised behavior change than those who do not have mental illness as perceived threat.

Results indicate that moderate exercise at baseline and 12 months is not a significant predictor of depression at 12 months. Thus individuals who performed moderate exercise do not have lower depression scores than those who did not perform moderate exercise for 12 months. Additionally, access to social support was found to be beneficial for depression. Overall more research needs to be done to strengthen findings of this study. This future research would also help in developing and evaluating more effective

interventions for exercise and social support that can help in reducing depression and its

effects among adults aged 45 years and above or may be in other populations as well.

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CHAPTER 1

INTRODUCTION

Annually, depression affects about 19 million (9.5% population) out of 318.9 million Americans according to the survey conducted by National Alliance of Mental Illness (NAMI) in 2014. Depression is the mental disorder characterized by mood disorder, feeling low, loss of self-esteem, feeling guilty, sadness, lack of interest, irritability, loss of concentration and lack of pleasure as defined by World Health Organization (WHO) in 2012. It can alter and affect the person's ability to live a normal life in performing the basic and instrumental activities of daily living. The mental health is associated with the overall smooth functioning of the person and is treated with the same urgency as physical health according to Center for Disease Control (CDC) in 2010. Depression can have various levels ranging from mild, moderate to severe cases (National Institute of Mental Health, 2011). In mild to moderate cases, it can lead to feeling of helplessness, anger, stigma while in severe cases it can lead to suicide (WHO, 2012). There are about 1 million lives lost every year or about 3000 lives lost every day due to suicide (WHO, 2012). The psychiatric illness such as depression results in unnecessary hospitalization along with increasing the social and economic burden of disease on the nation (NAMI, 2011).

Individuals with 45 years of age and older constitute the fastest growing population of North America (U.S. Bureau of the Census, 1992). By 2030, adults above 45 years of

age will account for 20% of the nation's people, an increase in 13% from today's population (Department of Health and Human Services, 2001). This increase in population of adults above 45 years is expected to continue further for 60 years resulting in great need for improved health, functional ability, and quality of life (Conner, 2015). The lifestyle changes in the past century have shifted the leading cause of death from acute to chronic diseases and degenerative illness (CDC, 2013). There has been increase in nine selected chronic health conditions among all racial groups in both men and women and in most income groups (CDC, 2010). The nine selected diseases are hypertension, heart disease, diabetes, cancer, stroke, chronic bronchitis, emphysema, current asthma and kidney disease (CDC, 2010). According to the survey, the percentage of adults aged 45 years and above, suffering with two or more chronic conditions have either not received the treatment or received delayed treatment have increased from 17% to 23% (CDC, 2010). Also, due the high cost of medical treatment and prescribed drugs for chronic illness, there has been an increase in percentage of adults from 14% to 22%, who have not been able to receive drug treatment (CDC, 2010). There has been increase in the economic burden of disease and health outcomes among adults who have either received delayed treatment or who have not received treatment for these chronic conditions. Also, adults who suffer from chronic medical conditions and receive delayed treatment or no treatment are more likely to suffer from mental illness such as anxiety and depression due to pain and stress of the disease.

During the normal process of aging, the individuals can experience stressors such as declines in health, loss of loved ones, medical illness and various other factors that can trigger abnormal emotional responses resulting in mental illness (DHHS, 2001). Living with mental health can be challenging and difficult, especially when individuals age. More health issues are experienced due to aging (NAMI, 2001). The majority of the individuals above the age of 45 years' experience some kind of chronic health issues such as cardiovascular illness, respiratory problems, arthritis and about 50% of these adults aged 45 years and above with chronic illness have mental illness (CDC, 2008). Mental illness can result in poorer health outcomes, further deteriorating the health thus resulting in increased rates of mortality and morbidity (NAMI, 2001). Increase in life expectancy does not mean better mental and physical health or great social determinants of health (Geib, 2012) rather it can be increase in economic burden of disease due to illness and morbidities linked with aging. The focus of the public health systems should include increasing the survival of adults aged 45 years and above so that they can be independent, contribute in the economic growth of the nation, while simultaneously reducing the burden of disease on the society. This need for functional independence, improved cognitive and mental functioning among adults aged 45 years and above has become important aspect to improve the health of adults aged 45 years and above (Katz, 1983; Phillips & Haskell, 1995). Mental health for adults aged 45 years and above has been added in the priority list by surgeon general's report on mental health (CDC, 2008) and also by Healthy people 2020.

According to the United States of Aging survey, one in every four adults aged 45 years and above experience diagnosed psychiatric illness like depression, anxiety or cognitive impairment (NCOA, 2015). The rapidly growing adults aged 45 years and above with a psychiatric disorder is expected to double to 15 million by 2030 (NCOA, 2011). Depression is very common among adults aged 45 years and above with two or more chronic conditions such as heart disease, cancer, osteoarthritis illness (CDC, 2012). It can be also due to side effects of medications commonly taken by adults aged 45 years and above such as corticosteroids and Beta blockers (Neel, 2012). The risk factors for depression among adults aged 45 years and above include widowhood, less educational level, degenerative illness, impaired functional status, heavy alcohol consumption and physical illness (CDC, 2013; Schaik et al, 2014). Stigma and fear associated with the mental illness and negative associations continue to further deteriorate the health (NAMI, 2001). The underlying fear can be due to societies and healthcare provider's attitude towards mental illness or the complex medical treatment associated with mental illness. The mental illness in adults aged 45 years and above is often underdiagnosed and untreated for the mental health as primary concern for healthcare provider is to treat the physical symptoms and condition (NAMI, 2001). Hispanics and blacks above age 45 years are at high risk for developing mental illness and depression (CDC, 2013). Women as compared with men are the high risk for developing chronic mental illness such as depression (CDC, 2013).

As there are large numbers of people that are affected by depression, it is important to study preventive measures and interventions that would help in making effective strategies and improve the quality of life among adults aged 45 years and above (Hughes, 1997). With timely diagnosis of depression, it can be treated and cured (Beekman et al, 1995). A study concluded that adults aged 45 years and above who became depressed or who were persistently depressed over one year exhibited significantly greater declines in cognitive and functional status than did those whose depression remitted or who were never depressed (Katz and Parmelee, 1997). We need to develop strategies and interventions which can improve the functional ability, dependence and reduce the limitations and cognitive impairments among adults aged 45 years and above.

Purpose

One of the major reasons for depression are social factors, such as unemployment, lack of intimate and confiding relationships, low income status, feeling of dependency, marital breakdown, loss of job or loss of spouse (Cembrowicz & Kingham, 2006). This study of relationship between moderate exercise and depression among adults aged 45 years and above is focused on providing the physical activity level by developing the intervention programs that can help to reduce depression by performing moderate exercise. It incorporates theoretical framework of social support and networking, perceived susceptibility and perceived severity from Health belief model (Rosenstock & Hochbaum 1972)**.** The study will be done by using existing database from osteoarthritis

initiative (OAI) which is prospective cohort study and has been collected from participants who are at high risk for developing significant osteoarthritis.

This study has primary research question –

When controlling for baseline depression, age, gender, race, education, access to social support and marital status, what is the effect of the moderate exercise on depression among adults aged 45 years and above? The study will help us in planning the various interventions such as social support and performing moderate physical exercise that can be implemented at various community levels to reduce depression among adults aged 45 years and above.

Rationale

The study will be done with the help of the existing database by Osteoarthritis Initiative (OAI). The OAI is the research study conducted nationwide to prevent and treat osteoarthritis and is sponsored by National Institute of Health. The OAI database is the prospective cohort study collected from 4,796 participants who either had significant osteoarthritis or are at risk of developing significant osteoarthritis.

The study created a public archive of data, biomarkers and joint images that were collected at baselines and follow-up visits. As osteoarthritis is one of the major causes of disability among adults above 45 years of age, the OAI has developed public domain research resource to facilitate the scientific research on osteoarthritis. Adults aged 45 years and above as individuals in this age group are likely to suffer from one or two

chronic illness which can lead to depression or other mental illness and functional impairment due to burden of disease and pain. Functional impairment further increases the dependency of the individuals and increases the economic burden of the chronic illness on the society and affects health outcomes.

There are both practical and theoretical reasons for analyzing adults above 45 years of age. From the practical point of view, we will know the effect of the intervention programs such as social support, exercise, physical activity level and fitness in the treatment of depression (CDC, 2010). If there is inverse relationship between exercise and social support on depression, then physicians and healthcare providers might benefit in planning the treatment for depression by administering these lifestyle modifications and interventions along with the medications to improve the success of the treatment. From the theoretical point of view, the study will include all facets of self-efficacy, positive social support, psychological measures, and behavioral measures, to help in reducing depression among adults aged 45 years and above (OAI, 2015). Moreover, we will better understand if increases in social support and average minutes of moderate exercise will led to enhanced and mental health. The improved mental health will result in better overall functioning and independence among adults aged 45 year and older. This may also provide information if moderate level of exercise will help in reducing depression. There has been evidence that showed the inverse effect of social support and self-efficacy on functioning in depressed adults aged 45 years and above with Chronic Obstructive Pulmonary Disease (Paula et al, 1999). Another study has shown that the

individuals who performed moderate exercise did not had much noticeable change in depression as compared to those individuals who did not performed moderate exercise (Pearsall et al, 2014). Another experimental study has been done among college students that showed the positive effect of exercise in reducing depression among them (Edman et al, 2012). Some studies have also suggested that there is a positive relationship between exercise and depression due to negative attitudes related with exercise and body (Edman et al, 2007). Negative motivation, fear of pain post exercise, exercising only to look good resulted in dissatisfaction and increased depression (Edman et al, 2007).

We study the relationship between moderate exercises as adults aged 45 years and above as the previous studies have mixed conclusions and no clear relationship have been found, especially among adults aged 45 years and above. If this study concludes the inverse relationship between exercise and depression, then adults aged 45 years and above can be encouraged to perform moderate intensity exercise to help them in maintaining or improving their mental health and overall functioning.

Hypothesis

Specifically, the study has following is hypothesis:

When controlling for baseline depression scores, age, gender, race, education, marital status and access to social support, participants who perform moderate exercise have lower depression scores than those who did not perform moderate exercise.

Limitations of the study

The study has various limitations such as

i.) It only gives information from the individuals who suffered osteo-arthritis or are at risk for developing symptomatic knee osteo-arthritis and does not have information about other selected chronic illness.

ii.) There are various causes of depression other than environmental causes such as brain chemistry, hereditary and genetics. The database does not provide access to the relationship between depression, brain chemistry, genetics and effect of moderate exercise on them.

iii.) The database has collected data from individuals aged 45 to 79 years who are at the risk of developing significant osteoarthritis. There are individuals who do not fall in this age category and are still at the risk of developing osteoarthritis. We do not have access to data from those individuals.

iv.) The social support and social networking theories have more detailed constructs than those used in the study. The database does not have access to all the aspects of social support.

v.) Some of the variables such as age, race, education status, weight were measured on the self-report scale and participants might not have reported the variables correctly.

Significance of the study

The study about the effects of moderate exercise is important because if depression can be reduced by performing the moderate minutes of physical activity daily, adults aged 45 years and above who suffer from depression can have better mental health and independence. Depression care management involves team effort by healthcare providers, case managers, psychiatrists and public health professionals (CDC, 2015). It is estimated that in United States, most important mental illnesses such as depression result in lost earnings of $193 billion every year. Loss earnings are defined as a situation in which a country or organization makes less money than expected (CDC, 2015).The cost added with the cost of mental disorder treatment per year is about $148 billion (Anxiety and Depression Association of America, 2015). There is continuously increasing healthcare cost, decreasing health outcomes of mental illness, and increasing functional dependence of adults aged 45 years and above due to depression. There is an important need to develop interventions that can help in reducing depression.

CHAPTER 2

LITERATURE REVIEW

Introduction and purpose of the study

This study examines the effect of moderate exercise on depression while controlling for baseline depression score, age, gender, race, marital status, education and access to social support. Through this examination, it was hoped to better understand moderate exercise factors that can help in reducing depression score at the end 12 months.

Depression

Depression is a mental disorder with symptoms such as loss of interest and pleasure, feeling low self-worth, feeling of guilt, feeling of tiredness, lack of concentration, lack of happiness, disturbance in sleep, change in food habits and appetite. It can have mild, moderate signs in early stages and if undiagnosed or untreated, it can worsen to have severe symptoms. In severe cases, it can lead to suicide while in mild cases; it can be treated without medicines and by adopting healthy lifestyle (WHO, 2015). It is a major contributor of economic burden on the community worldwide. It is been estimated that 1 in every 20 people were reported to suffer from depression (Marina et al, 2012).

At its worst, depression can lead to suicide (WHO, 2012). As per the statistics, about one million lives are lost due to suicide every year, which means about 3000 lives are lost every day due to suicide (WHO, 2012). We need to make our nation economically more

productive while simultaneously reducing the burden of those diseases which can be cured if diagnosed at the right time (Hyun & Hee, 2014).

This study is aimed at developing the interventions that can improve the health of the country by reducing depression.

Depression in adults aged 45 years and above

According to the United States (U.S.) census (U.S. Bureau of the Census, 1992), individuals over 45 years of age make up the fastest growing portion of the population in North America and have often been referred to as the "fastest growing minority". This booming population of adults above 45 years is expected to continue for further several decades (Leedahl et al, 2015), raising the concern for the public health providers to work for the improvement of their health outcomes. Depression is the most common mental disorder among these adults, and it is often under diagnosed and left untreated (Leedahl et al, 2015). It is overlooked in adults above 45 years of age, as they experience different symptoms and are less inclined to show symptoms of grief or sadness than do younger people (Leedahl et al, 2015). Approximately 85% of those individuals 45 years of age and older have one or more chronic health conditions, with an additional 50% having chronic conditions and mental illness resulting in poor health outcomes (CDC, 2011). Also, these adults may have other medical illness such as cardiac disease, stroke, respiratory illness, and atherosclerosis and might be taking medications which can cause depression (Leedahl et al, 2015). The highest prevalence of suicide is seen in adults between 45-85 years of age or more as their depressive symptoms are often left untreated

and undiagnosed (Leedahl et al, 2015). The overall picture will result in lack of functional independence, prolonged institutionalization, mortality, morbidity, years of potential life lost (YPLL), disability adjusted life years (DALY), utilization of excessive resources and an urgent need for more healthcare providers (Beekman et al, 1995).

There are several causes of depression among adults aged 45 years and older such as changes in daily routine, pain, loss of social contacts and effect of medications (Cembrowicz & Kingham, 2006). As per the survey done in USA, about one quarter of adults or one in every three adults above the age of 55 to 60 years have depression (Cembrowicz & Kingham, 2006). The mental illness is missed as the complaints can be confused with those due to physiological process or body pains (Cembrowicz & Kingham, 2006). Weight loss, reduced sleeping hours, changes in appetite and mood swings can all be subtle symptoms of depression but are often underdiagnosed and associated with aging (Cembrowicz & Kingham, 2006). Bereavement is one of the major life event that is associated with depression among older age group adults (Cembrowicz & Kingham, 2006). Loss of loved ones or loss of a partner and poor functioning can be confused with grieving feeling while it can be an episode of major depression (Cembrowicz & Kingham, 2006). Adults who suffer from the first episode of depression are likely to have changes in the brain as body ages such as ischemic or vascular depression which is associated with reduced blood flow in the brain with further aging (NIMH, 2015). Adults age 45 or more have risk factors such as stressful life events, medical illnesses, and genetic factors that make them more vulnerable

towards negative mental health such as depression, anxiety (Fiske et al, 2010). There are differences between the symptoms of depression due to medical conditions such as stroke, or side-effects of medications, and the symptoms of depression due to negative mental health such as Parkinson's disease, dementia and anxiety (Fiske et al, 2010). The latter is often under diagnosed and untreated.

Mental health can directly affect physical health, resulting in increased economic burden on the nation (Wahlbeck & Mcdaid, 2012). The economic burden is further associated with vicious circle leading to low socio-economic status , increased suicidal attempts, and further deterioration in mental health (Wahlbeck & Mcdaid, 2012). There is an unavoidable relationship between economic crisis and negative mental health (WHO, 2011). One of the biggest challenges associated with improving mental health is the high level of stigma associated it which can result in under diagnosis of depression and other mental health issues which can further increase the negative health concerns among adults aged 45 years and above (Jamison, 2006). The increasing number of people with deteriorating mental health and depression have accounted for about 16 % of suicidal deaths in 2004 in United States of America (CDC, 2010). Also, people with more serious mental illness are likely to die at an average age of 64 years, from complications related to unhealthy risk factors such as obesity and alcohol compared to 76 years of age for all Americans (CDC, 2010).With proper and timely diagnosis of depression, it can be treated using effective strategies with the combination of medications and rehabilitation (Beekman et al, 1995).

Signs and symptoms of depression

Depression can have following signs and symptoms (NIMH, 2015): emptiness or sad feeling, feeling hopeless, guilty, irritable, anxious, loss of interest in pleasurable or favorite hobbies, tiredness for the most of the time, lack of concentration or unable to remind things, lack of sleep or too much sleep, changes in appetite- over eating or under-eating, Suicidal attempts, aches, pains, headaches and cramps.

Types of depression

Depression can have multiple variations and presence of manic disorders is one of them. A manic disorder is characterized by elevated, unrestrained and irritable mood, racing thoughts, sleeplessness, tendency to engage in the activities that seem to be pleasurable but have adverse consequences (CDC, 2015). It is also called as bipolar depression due to cyclic mood swings from extremely high side to extremely low side (Djernes, 2006).

There are various types of depression such as:-

1.) Major Depressive Disorder: It is the type of depression that alters individual's ability to eat, work, sleep, read, and enjoy those activities that were once pleasurable (Djernes, 2006). It alters and affects the normal functional ability of the person. Also, called as major depression, it can recur more than once in a person's life (Djernes, 2006). This type of depression is commonly found in adults aged 45 years and above accounting for 3.7 % of all U.S. disability-adjusted life years (DALYs) and 8.3 % of all U.S. years lived with

disability (YLDs) (WHO, 2015). The depression is also common in non-bipolar depressed adults and youth (Kovess-Masfety et al, 2013).

2.) Dysthymic Disorder: It has less severe but prolonged symptoms of more than 2 years (Djernes, 2006). Depression can make the individual feel unwell and inability to work normally (Djernes, 2006). These people have a tendency to suffer from major depressive episode once in their lifetime (Djernes, 2006). The disorder is fairly common in the US general population (3–6%), in primary care (7%), and in mental health settings (Sansone & Sansone, 2009).

3.) Psychotic Depression: depression in combination with psychosis such as delusions, hallucinations or break with the real world (Djernes, 2006). This type of depression is second most commonly found in adults aged 45 years and above (NAMI, 2011). Severity of symptoms of psychotic depression helps in predicting the mental illness associated with depression such as anxiety and schizophrenia and other types of mental illnesses (Naidu et al., 2014).

4.) Postpartum Depression: It is seen in within one month of delivery of baby, among women (Moy, 2009). About 15% of the women develop depression within one month of delivery of the baby (Djernes, 2006). This type is not found in adults aged 45 years and above and is not important for our study.

5.) Seasonal affective Disorder – This disorder represents depressive episodes seen during winter months due to lack of natural light in the environment (Djernes, 2006). The

symptoms are less during spring and summer. This type of depression can be treated by light therapy, psychotherapy and antidepressants (Djernes, 2006).

Causes of depression

There are various causes of depression. Once initiated, there are various physiological, biochemical, psychological and social mechanisms that deteriorate the illness (Cembrowicz & Kingham, 2006).

1.) Genetics: Genetics plays an important role in manic bipolar depressive symptoms as compared with unipolar, which has only mood swings as a symptom of depression (Cembrowicz & Kingham, 2006). The family of individuals with bipolar manic disorder has 20% chances of having depression while with unipolar, there is a 10% chance of having the disease in the family. Similarly, the chance of depression among identical twins is high – about 50% as compared with the non-identical twins- about 20% (Cembrowicz & Kingham, 2006) due to similarity in the genes.

2.) Social Factors: There are certain social factors that can make the individuals more vulnerable to depression. Unemployment, lack of intimate relationship, low income status, feeling of dependency, confiding relationships, low self-esteem and low self-worth are the factors associated with depression (Cembrowicz & Kingham, 2006). Conflict and arguments in the relationships, physical, sexual and emotional abuse by close family or friends can also cause depression (WebMD, 2015).

3.) Life Events: The bigger, greater event that makes us to change in order to cope with them can cause depression such as marital breakdown and loss of job (Cembrowicz & Kingham, 2006). Trauma due to road accidents alone can cause depression. If accidents are followed by strokes, the chances of getting depression are 40% due to loss of functional ability of a part or whole of the body and lack of self-acceptance (CDC, 2015).

4.) Other mental illness: Depression is associated with other mental illnesses such as multiple sclerosis, anxiety, dementia and Parkinson's disease (Cembrowicz & Kingham, 2006). Psychiatric symptoms are found in about 40% of the individuals with multiple sclerosis when they are in remission phase while it is seen in about 90% of the individuals in active phase of illness (Cembrowicz & Kingham, 2006). Depression is also seen in about 40% of the individuals who suffer from Parkinson's disease (Cembrowicz & Kingham, 2006).

5.) Medications: Certain medications such as corticosteroids and interferons can increase the chances of depression (WebMD, 2015). Also, depression is associated with substance abuse, and about 30% of the individuals with substance abuse have chances of getting major depression (WebMD, 2015). Psychotherapy, antidepressants and combination treatments such as positive social networking have been found to be effective in treating depression among adults aged 45 years and above (Djernes, 2006).

Social networks and social groups such as religious groups, exercise groups, rehabilitation groups, and sports groups have been associated with greater levels of mental health among adults aged 45 years and above (Han & Lee, 2013). A study

revealed that adults aged 45 years and above who participated in in two or more groups

for doing rehabilitation had better mental health than those who did not participated in

any group or organization activity (Han & Lee, 2013). There is a positive relationship

between social support and mental health and functional and physical health of adults

aged 45 years and above in nursing homes (Leedahl et al in 2014).

Behavioral factors such as engaging in the activities by depressed adults aged 45

years and above are not related with positive outcomes, as explained in Behavioral

Model of late life Depression. The individual will limit himself and will not engage in

social interactions due to negative social support, marital conflict, perceived family

criticism or deficient social support (Fiske et al, 2010).   This will increase

vulnerability of adults aged 45 years and above towards cognitive and physical illness,

thereby making adults aged 45 years and above more prone to depression and other

types of mental illness.

FIGURE 1: The behavioral model of late life depression (Fiske et al, 2010).

Current treatment for depression

There are physical examinations, lab tests and interviews done by the mental health professionals to diagnose the type and stage of depression (Djernes, 2006).The most common treatments that are being given for depression are medications, psychotherapy and Electro-Convulsive Therapy (Djernes, 2006).

Anti-depressants

Anti-depressants work to balance the flow of neurotransmitters, such as dopamine, which are responsible for regulating mood in the brain (Djernes, 2006). Selective serotonin Uptake inhibitors (SSRIs) and Monoamine oxidase inhibitors (MAOI) are the latest types of anti-depressants which are more popular due to their reduced side effects (Djernes, 2006). These medications are regulated and supervised by a physician, and it takes regular doses of these antidepressants for about three to four weeks to have the therapeutic effect (Djernes, 2006). Some individuals with recurrent depression are advised to take the medicines for indefinite time frame, while those who stop taking them as supervised by physician can have the tendency of relapsing illness (Djernes, 2006). Sometimes, the stimulants or anti-anxiety medications are prescribed by physicians for those individuals with bipolar disorder or major depression (Djernes, 2006).

Side-effects of anti-depressants

There are various side-effects of anti-depressants such as headaches, insomnia, nervousness, and dryness in mouth, lack of sexual drive, erectile dysfunction, agitation, constipation, bladder problems, blurred vision and daytime drowsiness.

Psychotherapy

Talk Therapy or psychotherapy is given to patients for treating depression (Djernes, 2006). The sessions are short term and long terms depending on the type of depression in adults aged 45 years and above (Djernes, 2006).Two types of treatments such as Cognitive Behavioral Therapy (CBT) and Interpersonal Therapy (IPT). Both the therapies are focused to change the negative thinking, mood swings, however, IPT can worsen the symptoms of depression instead of reducing it as depression is associated with personal troubled relationships (Djernes, 2006). Studies have found out that in the treatment of adults aged 45 years and above, anti-depressants and psychotherapy have found to have positive results when given for a period of two years (Djernes, 2006).

Electro-convulsive therapy

This therapy is also called Shock treatment given to treat chronic depressions (Djernes, 2006). Individuals are given anesthesia and muscle relaxant before administering the therapy. A patient needs to undergo several sessions of ECT in a week and there are chances of relapse even after administering the treatment (Djernes, 2006).

As there are no protocols available in terms of exercise protocols, physical activity, social support, or peer relationships or "group-effect", the individuals suffering from depression have to undergo the above mentioned treatments. There are side-effects of medication, chances of relapse with the psychotherapy and ECT resulting in no definitive cure for depression. The recommendation and advice from healthcare providers and public health educators about performing moderate exercise will help in developing the intervention at the local and community level. There are not standard protocols to implement moderate or light intensity exercise along with anti-depressants or ECT to help in reducing depression among adults aged 45 years and above. If this study results in the inverse relationship between depression and performing moderate intensity exercise among adults aged 45 years and above, then standard protocols for treating depression can include performing moderate intensity physical activity.

Moderate exercise and adults aged 45 years and above

Exercise is defined as the physical activity performed to maintain or improve health and physical fitness (CDC, 2015). Exercise can be of light intensity, moderate intensity and vigorous intensity level (CDC, 2015). A moderate level of exercise can be defined as performing one of the following activities (CDC, 2015):

i.) walking at the rate of 3 miles per hour or brisk walking but not running.

ii.) Water exercises and light weight training in water.

iii.) General gardening, ballroom dancing.

iv.) Riding a bicycle with the speed of less than 10 miles per hour.

Physical activity is an important part of aging as various health illnesses can be reduced by performing moderate level of physical activity (CDC, 2015). It is recommended that adults perform 150 minutes of moderate level exercise per week and 2 days of weight training exercise, or 75 minutes of vigorous physical activity and 2 or more days of weight training exercise among adults aged 45 years and above after consultation from their healthcare provider (CDC, 2015). Exercise helps in muscle growth, maintaining the physiological functions of the body, increasing the basic metabolic rate (BMR), improving the overall functioning of the body, and reducing all causes of morbidity such as cardio vascular diseases, arthritis, stroke, and thus reducing the dependency on others (CDC, 2015). It is also advised to increase the physical activity level to 300 minutes per week of moderate intensity or 150 minutes of aerobic vigorous activity for better health benefits (WHO, 2015). Sometimes, due to underlying medical illness or fear of falling, it can be difficult for adults aged 45 years and above to perform vigorous intensity exercise and they prefer performing moderate levels of exercise.

Physiological effects of exercise

Physiological effect of exercise depends on the duration and intensity of performing physical activity (Burton et al, 2004). It affects various systems of the body such as cardiovascular systems, respiratory systems, skeletal muscles, metabolic rate, and endocrine system (CDC, 2000). The positive effects of exercise on various systems of the body help in improving overall function, independence and also give

feeling of confidence. Thus performing light, moderate or vigorous intensity exercise helps in reducing depression and mental illness. The effects of exercise on various systems are explained below:

Cardiovascular system and exercise

The cardiovascular system is made up of heart, blood vessels and blood. The cardiovascular reaction to exercise has strong positive relationship with skeletal muscles oxygen demand as there is more need of oxygen with increasing levels of exercise (Booher and Smith, 2003). With increasing oxygen demand due to physical activity and exercise, the cardiac output, stroke volume and heart rate also increases to meet the demand. Similarly, the pattern of blood flow also changes as the person starts performing exercise (Booher and Smith, 2003). The blood flow is about 20% in the resting phase and it increases as the person starts exercising, resulting in more blood distribution to active skeletal muscles. This increased blood flow raises the body temperature resulting and more blood flow to the skin for heat dissipation (CDC, 2000). Exercise also increases mean arterial blood pressure (CDC, 2000). The systolic blood pressure increases in response to oxygen demand, however, diastolic blood pressure remains almost same. To perform the normal functioning during exercise and to meet the increased demand for oxygen, the body oxidizes glucose (Booher and Smith, 2009). Thus the glucose is metabolized due to increase cardiovascular functioning, helping in increasing the basic metabolic rate and improving the health.

Respiratory system and exercise

Respiratory system also responds to increased demands for oxygen by increasing pulmonary ventilation, respiratory rates and tidal volume (CDC, 2000). In an average adult, the pulmonary ventilation increases from 10 liters/minutes at rest to more than 100 liters/minute while performing moderate intensity exercise (CDC, 2000). The alveoli in the lungs expand to encourage exchange of oxygen and carbon dioxide (CDC, 2000). Also, with the increased flow of air in the air tracts, the mucous mobilizes to clear the airways (CDC, 2000). The result of increased respiratory function results in better airway breathing, improved lung capacities, increased strength of respiratory muscles and reduces the changes of emphysema or other bacterial infections especially seen among adults aged 45 years and above who have sedentary lifestyle (CDC, 2000). Thus the improved respiratory functions can help in adults aged 45 years and above stay healthy, reducing the burden of diseases on society and increasing confidence levels among the older population due to improved mental health.

Endocrine system and exercise

There are various complex changes seen in endocrine hormones due to aging (Chahal and Drake, 2007). The levels of testosterone, estrogen, insulin, growth hormone declines with aging (Chahal and Drake, 2007) while increase in luteinizing hormone and, follicle stimulating hormone, The changes in one endocrine gland affect the functioning and hormone production of other glands resulting in menopause, andropause and somatopause (Chahal and Drake, 2007). The overall result of the

changes in endocrine system results in decreased muscle mass and strength, reduced metabolism while increasing the fat mass (Chahal and Drake, 2007). Exercise improves the hormone circulation in body which further improved the function of vital organs, brain functioning and physical appearance (Capodaglio et al, 2000). Exercise also has positive effect on the mental state. As the effect of exercise, the pituitary gland produced endorphins that help in reducing anxiety and stress by blocking pain receptors (Capodaglio et al, 2000). Thus exercise help in reducing pain, stress and improving mental health.

Skeletal muscles and exercise

The skeletal muscles help in performing coordinated movements and giving shape to the body (CDC, 2000). During exercise, the skeletal muscles adapts to the stress by contracting and relaxing to meet the energy requirement (Magaudda et al, 2004). These muscular adaptations improve structural adaptations of muscle fibers and strengthen those (Magaudda et al, 2004). Thus the decreasing muscle strength and atrophy seen in skeletal muscles with aging can be reduced or delayed helping in improving the functional independence of adults aged 45 years and above.

There are long term benefits of exercise such as improving immune functions, reducing the chances of stroke, arthritis and diabetes, improving the metabolic adaptations and increasing BMR (CDC, 2000) resulting in healthy functioning of the body. If adults aged 45 years and above are able to perform daily minutes of moderate exercise, then their physical health and independence can be maintained or improved

which will further reduce the morbidities. Adults aged 45 years and above can continue to do things that they like to do with functional independence, thus reducing the stress and improving the mental health.

Effects of exercise on depression

Exercise has inverse relationship with depression (CDC, 2000). As the intensity and duration of exercise increases, depression and mental illnesses decreases. Studies have suggested that better treatment outcomes have been seen in the patients that performed exercise along with pharmacologic therapy than among patients that only followed drug therapy without exercise for treatment of depression (Craft and Perna, 2004). Research has shown that 80% of the depressed adults aged 45 years and above have reduced physical work capacity and fitness levels (Morgan, 1968). The reduced physical work capacity and fitness levels further deteriorates the physiological functions of the body resulting in poor health outcomes and increased dependency. Due to physiological effects of exercise endorphins are released in the body that helps in reducing stress and improving mental health. The improved mental health can help in reducing symptoms of depression, anxiety or mental illness thus improving cognitive function and overall health of adults aged 45 years and above. A study was done that demonstrated decreased depression among experimental group who were given 6 weeks of aerobic exercises as compared to the control group who were given the existing treatment protocol for depression (Doyne et al, 1983). Studies have demonstrated the direct relationship between osteoarthritis and depression (Eh, 2008).

Symptoms of pain and joint discomfort in osteoarthritis among adults aged 45 years and above alter the physical functioning of the body and resulting in stress and depression (Eh, 2008).

This study focuses on analyzing the effects of moderate exercise among adults aged 45 years and above. Exercise releases neurotransmitters and endorphins in the body that help in improving the mood by reducing stress (CDC, 2000). It also helps in gaining confidence by helping in meeting small goals and challenges of exercise protocol. Group exercises are more likely to help in increasing social interactions and social support thus helping in reducing feeling of loneliness which is one of the biggest causes of depression. Adults aged 45 years and above sometimes have reduced exercise intention due to fear of falling, or they think exercise would harm their joints and increase the pain, especially when using complex equipment. However, there are variety of moderate intensity exercises that can be fun while doing them such as gardening, walking on the trails, hydrotherapies and water exercises. These moderate intensity exercises will help in reducing depression while improving functional independence among adults aged 45 years and above.

Self-efficacy

Self-efficacy is defined as the individual's belief in his or her capacity to execute behaviors necessary to produce specific performance attainments (Bandura, 1977, 1986, 1997). There has been a direct relationship between self-efficacy and behavioral

change (Bandura, 1986). The individuals who have high self-efficacy are more likely to perform the moderate intensity exercises to reduce depression.

The purpose of this study is to find out the relationship moderate exercise and depression among adults aged 45 years and above. As positive mental health is the key to overall functional health, cognitive health and wellbeing (CDC, 2010), the intervention and programs can be planned to have the direct positive effect on the mental health of adults aged 45 years and above. Furthermore, the positive mental health will result in better health outcomes and help us in reducing the economic burden of adults aged 45 years and above who have lost their independence due to depression. The cost of treatment of depression can be reduced significantly if depression can be diagnosed and treated as the symptoms gets worst when left undiagnosed or untreated.

Summary

OAI initiative database is archived for public use to help in performing scientific research and thus helping to reduce the burden of osteoarthritis-related disability among adults aged 45 years and above. At present, 35 million people in United States (13% of the population) are expected to suffer from osteoarthritis and this number is expected to double by 2030, making about 20% of the population that will be suffering from the disease and becoming disabled. The physical symptoms of osteoarthritis can lead to mental conditions such as depression, increasing the economic and social burden, morbidity and mortality. It is estimated that about 30% of patients who suffer

from osteoarthritis suffer from depression (CDC, 2000). The OAI initiative has the

aim of reducing osteoarthritis among adults aged 45 years and above which will help

in reducing depression among adults aged 45 years and above.

CHAPTER 3

METHODOLOGY

Overview

This study addresses the relationship between moderate exercise and depression among adults aged 45 years and above. In addition, the underlying mechanism that can influence the cause and severity of depression will be investigated.

The data for this study is from osteoarthritis initiative database. The OAI database is funded by National Institute of Health (NIH) and is a longitudinal prospective cohort study with publically accessible data to facilitate research on the osteoarthritis disease and progression. The database aims to providing biochemical measures, imaging such as X-rays and MRI, and biomarkers that will help in understanding the osteoarthritis onset and progression.

The OAI study began by recruiting participants from February 2004 to May 2006. They recruited about 1,992 men and 2,804 women (total numbers of participants were 4,796), aged 45-79 years who have or are at the risk of developing symptomatic osteoarthritis. Among the recruited participants, 75.8% were white and 24.2% were non-white. OAI is the seven year project and collects data at baseline and every 12 months, until 84 months. This study will use the database at baseline and 12 months to study relationship between moderate exercise and depression among adults aged 45 years and

above. The database has various questionnaires based on the variables associated with osteoarthritis. Some of the variables include the participants activity level, pace and intensity of physical activity such as light intensity, moderate and vigorous intensity activity. The variable list and database can be accessed at their website with registration and agreement of terms and conditions

(Website: https://oai.epiucsf.org/datarelease/DataClinical.asp).

Variables

The following are the variables that will be studied using the OAI database.

Moderate intensity activity

Moderate intensity activity was measured by measuring hours of walking per day in last 7 days. The data was collected using data collection form at baseline and 12 month visit. The walking hours were coded as i- less than 1 hour, ii- 1 hour but less than 2 hour, iii- as 2-4 hours, iv- as more than 4 hours.

This measurement question is valid as CDC recommends 150 minutes 2.5 hours per week of moderate intensity exercise in the form of walking, riding bicycle or gardening.

CES-D depression score

The Center for Epidemiologic Studies Depression Scale (CES-D) is the screening tool for depression and measures symptoms as defined by American Psychiatric Association's Diagnostic and Statistical Manual. The tool has the self-report set of 20 questions based

on the symptoms of depression occurred in past week and the score range is 0 to 3 based on the answer option selected by the participants. Individuals with the score of 16 or higher are more likely to have symptoms of depression and are recommended to visit healthcare provider for screening and check-up. If more than 4 responses are missing, the questionnaire is not scored. Studies have suggested that the CES-D is reliable and valid instrument. It has been used among various population groups such as African American (Torres, 2012), Asians (Mackinnon et al., 1998), French & Greek (Van et al., 2009), Hispanics (Reuland et al., 2009) and Japanese (Wada et al., 2007). The CES-D score was measured at baseline and then at subsequent follow-up visits till 84 months. In this study, we will use baseline and 12 month depression scores.

Age

The age of each participant as measured at every visit.

Gender

The participant's gender was coded as men and women.

Race

Race was coded as white, black and Asians.

Education

Education was coded into a categorical variable using 0 as less than high school graduate, 1 as high school graduate, 2 as some college, 3 as college graduate, 4 as some college graduate school and 5 as graduate degree.

Marital status

Marital status was categorized as married, widowed, divorced, separated and never married.

Access to social support

It will be measured by the following questions such as i.) How often how often physical health/emotional problems interfered with social activities (visiting with friends), past 4 weeks- This question was coded into 5 categories in OAI database as 1: all of the time, 2: most of the time, 3: some of the time, 4: a little of the time 5: none of the time. This variable was reverse coded and collapsed into three categories for this study. It was recoded as 'none to little' category for categories from 1-3, 'some' for category 4 and 'high' for category 5.

Research question

When controlling for baseline depression, age, gender, race, education, marital status and access to social support what is the relationship between moderate exercise and depression at 12 months among adults aged 45 years and above.

Hypothesis

When controlling for baseline depression scores, age, gender, race, education, marital status and access to social support, participants who perform moderate exercise have lower depression scores than those who did not perform moderate exercise.

Participants

This study will use existing OAI database. The OAI website has list of variables, questionnaires and database from 4,796 men and women who had or were at the risk of developing symptomatic osteoarthritis. The prospective cohort research design was made to create a public accessible resource for research to evaluate the osteoarthritis onset and progression.

Threats to internal and external validity

This is a longitudinal cohort study design, so the data have been collected over months and years. The threats to internal validity would be maturation, testing, instrumentation and statistical regression. Threats to external validity would be reactive or interactive effects of testing. There are also missing data from race, education, marital status and access to social support variables which are threats to internal validity as missing data can affect the generalizability of the results among the population.

Analysis

The study will use SPSS and Analysis of Covariance (ANCOVA) test for data analysis. In the analysis, the categorical variables will be those mentioned in methodology section. The baseline and 12 month scores for moderate exercise and

depression will be measured as continuous variables to study the relationship between them. The covariate is the baseline depression. Interaction between moderate exercise score and control variables will be evaluated. The study will use IBM SPSS version 22.0 and the significance level will be at 0.001.

Limitations of the study

The study has various limitations such as

1.) The OAI database has been created from the patients who have severe or are at risk for developing symptomatic osteoarthritis. Depression score and other variables such as pain can vary across individuals who have mild to moderate symptoms of osteoarthritis or who do not have symptomatic osteoarthritis. Osteoarthritis is one of the most common degenerative diseases which is seen in adults aged 45 years and above. Depending on the joint and bone damage its symptoms can vary from mild to moderate and severe forms.

2.) There are various causes of depression other than environmental causes such as hereditary and genetics causes that can cause chemical and neuro transmitter changes in the brain. The database does not have access to study and analyze these factors to reduce depression among adults aged 45 years and above.

3.) As this is a longitudinal study, there are threats to internal validity such as maturation. Individuals grow old physically and intellectually and the physiological changes are seen in the body with aging. Another threat to internal validity would be history as unexpected events can occur with aging. Adults aged 45 years and above can have multiple health

issues with aging such as severe osteoarthritis, which can results in join pains and reduced mobility which can further deteriorate cardiovascular and respiratory health. There can be multiple medications adults aged 45 years and above might be taking for multiple problems that can reduce the pain sensation or can alter cognition. The database does not mention if the participants have only severe arthritis and no other health problems. Experimental mortality can also be a threat to internal validity of the study as with aging and osteoarthritis, adults aged 45 years and above can suffer multiple health issues that can alter the results. Also, the OAI website has not mentioned if the accelerometer was calibrated and checked on regular basis, which can also be a threat to internal validity.

4.) The social support and social networking theories have detailed constructs than those used in the study. The database does not have access to all the aspects of social support.

5.) Some of the variables such as age, race, education status, weight were measured on the self-report scale and participants might not have reported the variables correctly.

CHAPTER 4

RESULTS

Introduction

The purpose of the study was to study the relationship between moderate exercise and depression among adults aged 45 years and older while controlling for baseline depression, age, gender, race, marital status, education and access to social support. In examining the effects, the hypothesis is that participants aged 45 years and above who perform moderate exercise have lower depression scores than those who did not perform moderate exercise.

Descriptive data

Data from 4,796 participants were used from the OAI's existing database. The OAI recruitment goal was to recruit equal number of men and women in their database, however, the majority of participants, 58.47% were women. The minimum age of the recruited participants was 45 years and maximum age was 79 years of age, who were at high risk for developing significant osteoarthritis. The mean age (M) of the sample was 61.16 years with the standard deviation (SD) of 9.19 years.

As increased weight is one of the major risk factors that can lead to significant osteoarthritis, 70.8% of men between age 45-69 years weighed more than 205 lbs. and 85.1% of the men between age 70-79 years weighed more than 215 lbs. Similarly, 70.3% of the women between ages 45-69 years weighed more than 170 lbs. and 85.8% of the

women between the ages 70-79 years weighed more than 180 lbs. Of the sample collected, 79.11% of the participants reported themselves as Caucasians, 18.24% were African Americans. Almost one-third (30.20%) of the participants had graduate degrees, while 24.10% completed some college. Most of the participants, 83% were married. Depression was measured at the baseline level and after 12 months by using Center for Epidemiologic Studies Depression Scale (CES-D) score. As shown in table 1, the mean depression score at baseline was 6.61 with the standard deviation of 6.99 and at the end of 12 months, the mean depression score was 6.65 with standard deviation of 7.15. Research instrument known as Physical Activity Scale for Elderly (PASE) developed by Washburn et al (1993) was used to measure the overall physical activity intensity, frequency and duration. Mean score for physical activity by using PASE scale was 160.84 hours with the standard deviation of 82.48 with maximum hours of physical activity of about 531 hours at baseline for 4796 participants as remaining participants refused to answer. At the end of 12 months, overall mean score for physical activity was 157.02 hours with standard deviation of 82.09 and maximum hours of physical activity increased to 580 hours for 4331 participants as remaining participants either refused to answer or the data was missing. See Table 1 for details.

Table 1

Characteristics of participants, OAI (N = 4796)

Characteristics	M	SD	N
Age in years	61.16	9.19	4796
Baseline depression score	6.61	6.99	4731
Depression score at 12 months	6.65	7.15	4303
PASE at baseline	160.84	82.48	4056
PASE at 12 months	157.02	82.09	3565

Table 1 (cont.)

Indicator	*n*	*%*
Gender		
Men	1,992	41.53
Women	2,804	58.47
Race		
Asians or other race	127	2.65
Caucasians	3,790	79.11
African American	874	18.24
Education		
Less than high school graduate	168	3.53
High school graduate	607	12.77
Some college	1,146	24.10
College graduate	1,001	21.05
Some graduate school	397	8.35
Graduate degree	1,436	30.20
Marital status		
Married	3,178	66.83
Widowed	384	8.08
Divorced	679	14.28
Separated	86	1.81
Never married	428	9.00

Moderate exercise

Research instrument known as Physical Activity Scale for Elderly (PASE) was developed and evaluated by Washburn et al (1993). It is a self-reported set of 12 questionnaires based on frequency and duration of occupational, leisure and household activities in past 7 days. PASE can be used in designing exercise interventions and for epidemiologic studies (Washburn et al, 1993). See table 1 for details about mean PASE scores. As this study is measuring the moderate intensity exercise, so the question that measured hours of moderate intensity physical activity in past 7 days was selected. See table 2 for the question that was included in the final model for this study.

Table 2

Moderate exercise at baseline and twelve months (N = 4796)

Indicator	*n*	*%*
Leisure activities: walking, hours per day, past 7 days		
Baseline level		
Less than 1 hour	1,979	48.80
1 hour but less than 2 hours	1,408	34.71
2-4 hours	514	12.67
More than 4 hours	155	3.82
Twelve months		
Less than 1 hour	1,835	51.48
1 hour but less than 2 hours	1,262	35.40
2-4 hours	362	10.15
More than 4 hours	106	2.97

Depression

Depression score was measured at baseline and at the end of 12 months by using

Center for Epidemiologic Studies Depression Scale (CES-D). The baseline score was

measured by self-administered questionnaire. This study has used baseline depression

score as the covariate for analysis. Mean baseline depression score was 6.61 with

standard deviation of 6.99. At the end of 12 months, the mean depression was 6.65 with

standard deviation of 7.15 for 4,303 participants. This depression score was measured by

take home questionnaire during the follow-up visit at the end of 12 months. See table 1 for details.

Access to social support

Access to social support was measured at baseline level and at the end of 12 months by administering self-reported, take home questionnaire on how often physical health or emotional problems interfered with social activities like visiting friends in past 4 weeks. As shown in table 3, the majority of participants, 74.28% reported that none of the time in past 4 weeks did their physical health or emotional problems interfered with social activities like visiting friends while rest of them reported that their physical or emotional health interfered visiting their friends. See table 3 for details.

Table 3

Access to social support at baseline and twelve months (N = 4796)

Indicator	*n*	*%*
How often physical health or emotional problems interfered with social activities like visiting friends in past 4 weeks.		
Baseline level		
None of the time	3,529	74.28
A little of the time	727	15.30
Some of the time	372	7.83
Most of the time	101	2.13
All of the time	22	0.46
Twelve months		
None of the time	3,179	73.70
A little of the time	637	14.77
Some of the time	391	9.07
Most of the time	88	2.04
All of the time	18	0.42

Control variables and depression

Several control variables and their interaction was analyzed to study their effect on depression at 12 months. The variables included baseline depression score, baseline moderate exercise, age, gender, race, education, marital status and access to social

support both at baseline and 12 months. Baseline depression score and access to social

support at 12 months were found to be significant predictor of depression at 12 months.

Gender, education, race and marital status were not found to be statistically significant in

predicting depression at 12 months. Main effect ANCOVA results showed that corrected

model as a whole was statistically significant, $F_{(23, 3057)} = 157.484$, $p < 0.001$,

explaining 54.2% of the variation in depression at 12 months.

Race was not found to be helpful variable in predicting depression at the end of 12

months in the main effect model. However, interaction effect of race and moderate

exercise at baseline was significant predictor of depression at 12 months. Thus, the effect

of moderate exercise at baseline on 12 month depression scores differs among race and

ethnic groups [$F_{(6, 3051)} = 2.812$, $p = 0.001$]. In subsequent analysis, we do not

consider this interaction term to be important as this study is based on effect of moderate

exercise on depression at 12 months.

Baseline depression score

Baseline depression score, [$F_{(1, 3057)} = 898.698$, $p < 0.001$] was found to be a

statistically significant predictor of depression at the end of 12 months. Thus, depression

score at baseline is positively related to depression score at the end of 12 month.

Access to social support

Access to social support at 12 months [$F_{(2, 3057)} = 336.256$, $p < 0.001$] was found to

be statistically significant in predicting depression at 12 months. Also, access to social

support at baseline was not statistically significant in predicting depression at 12 months.

Thus individuals who have high social support at 12 months have lower depression

scores at 12 months (M = 4.98, SE = 0.326) than those individuals who have none to little access to social support (M = 13.45, SE = 0.41).

Moderate exercise and depression at 12 months

When controlling for depression and moderate exercise both at baseline level, age, gender, race, education, marital status and access to social support at baseline and 12 months, moderate exercise at 12 months was not statistically significant in predicting depression at 12 months. Thus adults aged 45 years and above who perform moderate exercise at 12 months do not have lower depression score than those who do not perform moderate exercise. Additionally, results showed that moderate exercise at baseline is also not statistically significant variable in predicting depression at 12 months.

Table 4

Analysis of covariance for depression at 12 months: OAI (Weighted n = 4,796)

	Tests of Between-Subjects Effects				
Source	*MS*	*df*	*F*	*p*	η2
Model: Interaction model	2795.354	29	125.928	<.001	.545
Continuous covariates:					
Baseline depression score	19877.919	1	895.478	<.001	.227
Factors:					
Gender	36.375	1	1.639	>.001	.001
Race/Ethnicity	21.741	2	0.979	.376	.001
Education	28.121	5	1.267	>.001	.002
Marital status	25.147	4	1.133	>.001	.001
Social support at baseline	18.898	2	0.851	>.001	.001
Social support at twelve month	7543.560	2	339.829	<.001	.182
Moderate exercise at baseline	51.079	3	2.301	<.001	.002
Moderate exercise at 12 months	3.743	3	0.169	>.001	.000
Interactions:					
Race X moderate exercise at baseline	62.428	6	2.812	.001	.006
Error	3051	22.198			

Table 5

Analysis of covariance for depression at 12 months: Main effect results, OAI (n - 4,796)

Source	M	SE	n	df	F	p
					Between subjects	
Source: Main effect model				23	157.484	0.000
Moderate Exercise at twelve months				3	0.298	0.827
less than one hour per day	8.95	0.32	1835			
one hour to less than 2 hour per day	8.82	0.33	1262			
2 to 4 hours per day	8.94	0.39	362			
More than 4 hours per day	8.86	0.56	106			
Race				2	1.17	0.311
Black or African Americans	8.51	0.30	874			
Asians or other race	9.38	0.63	127			
White or Caucasian	8.79	0.29	3790			
Gender				1	1.426	0.232
Men	8.783	0.338	1992			
Women	8.997	0.322	2804			

Table 5 (contd.)

Source	M	SE	n	df	F	p
						Between subjects
Marital status				4	1.111	0.349
Married	9.002	0.297	3178			
widowed	9.266	0.417	384			
Divorced	9.306	0.355	679			
Separated	8.045	0.747	86			
Never married	8.831	0.391	428			
Education				5	1.198	0.31
Less than high school graduate	9.782	0.593	168			
High school graduate	8.65	0.404	607			
Some college	8.964	0.344	1,146			
College graduate	8.746	0.355	1,001			
Some graduate school	8.574	0.421	397			
Graduate degree	8.624	0.34	1,436			
Moderate exercise at baseline				3	0.285	0.837
Less than one hour per day	13.634	0.582	1979			
One hour to less than 2 hour per day	13.714	0.585	1408			
2 to 4 hours per day	13.375	0.598	514			
More than 4 hours per day	13.574	0.706	155			

Table 5 (contd.)

Source	M	SE	n	df	F	p
				Between subjects		
Social support at baseline				2	0.904	0.405
None to little	8.565	0.435	495			
Some	9.085	0.365	727			
High	9.021	0.323	3529			
Social support at twelve months				2	336.256	0.000
None to little	13.454	0.41	497.00			
Some	8.241	0.37	637			
High	4.976	0.33	3179			
Main effect (depression at baseline)				1	898.70	0.000
Within-group error				3,057	(22.28)	

Note: Values enclosed in parentheses represent mean square errors.

$\text{eta}^2 = .542$ for main effects ($p < .001$)

Conclusion

A total of 4796 participants, aged 45-79 years were studied using OAI database. These participants were at the risk of developing symptomatic osteoarthritis or were suffering from significant osteoarthritis. Results of this study did not supported research hypothesis that adults aged 45 years and above who performed moderate exercise have lower depression scores than those who did not performed moderate exercise. Additionally, result showed that 12 month depression score can be predicted from baseline depression scores. Access to social support at 12 months was a statistically significant variable in predicting depression at 12 months. No other significant relationships were found.

CHAPTER 5

DISCUSSION

Introduction

The OAI database provided an excellent opportunity to study the effect of moderate exercise on depression among adults aged 45 years and above. The hypothesis is that when controlling for baseline depression scores, age, gender, race, education, marital status and access to social support, participants who perform moderate exercise have lower depression scores than those who did not perform moderate exercise. This study used variables that were measured at baseline and 12 months.

Control variables and depression

Control variables such as age, gender, education and marital status were not found to be statistically significant predictor of depression at 12 months. Access to social support at 12 months and baseline depression score were found to be significant predictors of depression at 12 months. The baseline depression score is a significant predictor of depression at 12 months. This is consistent with the results of previous studies (Kilford et al., 2015; Regier et al., 2015). The results that gender and marital status are not predictive of depression at 12 months were not consistent with results of other studies (Jackson et al, 2011; Panagiotakos et al, 2008; Whitton et al, 2010). This may be due to the reason that previous studies were done mostly among women who were either hospitalized due to

acute coronary disease or were emotionally not satisfied in their marriage due to instability in relationship, or belonged to low SES and suffered health disparity. The results of this study were also not consistent with the other studies that demonstrated an effect of education on depression (Sander et al, 2005; Steiger et al, 2014). This may be because other studies were done on adolescents and young adults who were easily influenced by peer pressure at school, college or work. This study of the relationship between moderate exercise and depression was done among adults aged 45 years and above who are not easily influenced by peer pressure as compared with adolescents.

Access to social support and depression

This study indicates that access to social support at 12 months is a significant factor in predicting depression. Results of this study are consistent with other studies that showed effect of access to social support on depression (Johnson et al., 2000; Rutledge et al., 2003). Individuals with good social support feel more protected, have high self-esteem, greater self-efficacy and are more motivated to perform the advised positive behavior. Future research can be done based on these constructs and can be applied to different population groups across different ethnicity to understand the relationship in different settings.

Moderate exercise and depression

In this study, moderate exercise was found to be not statistically significant predictor of depression. The results are in contrast with some of the previous studies mentioned in the literature review. The participants who performed moderate exercise do not have lower

depression scores than those who did not performed moderate exercise, at the end of 12 months. One reason can be that participants in this study are suffering from significant osteoarthritis, painful knee and ankle joints, stiffness and joint discomfort. Due to fear of increasing pain and joint discomfort after performing exercise, participants might not have been motivated to perform moderate exercise which would not have further reduced depression. Access to social support at 12 months has been much stronger predictor of depression in this study.

Limitations

This study had various limitations. First, it only gives information from the individuals who suffered significant osteoarthritis or were at risk for developing symptomatic knee osteoarthritis and does not have information about other major chronic illness such as diabetes, cancer and long term chronic illnesses. Second, there are various causes of depression other than environmental causes such as brain chemistry, hereditary and genetics. OAI database does not provide access to the relationship between depression, brain chemistry, genetics and effect of moderate exercise on them. Third, database has collected data from individuals aged 45 to 79 years who are at the risk of developing significant osteoarthritis. There are individuals who do not fall in this age category and are still at the risk of developing osteoarthritis. We do not have access to data from those individuals. Fourth, access to social support is more complex than what was used in this study. OAI database does not have access to all the aspects of social support at baseline and 12 months. Lastly, some of the variables such as age, race, education status, weight

were measured on the self-report scale and participants might not have reported the variables correctly. There is possibility of them either under reporting or over-reporting these variables.

Future research

This study provides ideas and variables for the future research. First, the study used existing data from OAI database. The future studies can focus on other sources of data. Secondly, questionnaires and research instruments used to measure moderate intensity exercise in this study were less than ideal as the original instruments such as PASE did not measured moderate intensity activity exclusively but measured physical activity as a whole. Better research tools that measure physical activity specifically at various intensities can be used to predict the relationship between moderate exercise and depression. Thirdly, social support is a wide and deep topic with various constructs. As OAI database did not had access to all those constructs, developing a better research instrument for measuring social support and social networking will help in understanding their effect on depression.

Overall more research needs to be done to strengthen findings of this study. This future research would also help in developing and evaluating more effective interventions that can help in reducing depression and its effects among adults aged 45 years and above or may be in other populations as well.

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APPENDICES

APPENDIX A

IRB exempt letter

IRB

INSTITUTIONAL REVIEW BOARD

Office of Research Compliance,

010A Sam Ingram Building,

2269 Middle Tennessee Blvd

Murfreesboro, TN 37129

IRBN005 Version 1.0 Revision Date 06.03.2015

EXEMPT APPROVAL NOTICE

7/16/2015

Investigator(s): Gavita Therja

Department: Health and Human Performance

Investigator(s) Email: gt2g@mtmail.mtsu.edu

Protocol Title: "The Relationship between average daily minutes of moderate activity and depression among older adults"

Protocol ID: 15-355

Dear Investigator(s),

The MTSU Institutional Review Board, or a representative of the IRB, has reviewed the research proposal identified above and this study has been designated to be EXEMPT. The exemption is pursuant to 45 CFR 46.101(b) (4) Collection or Study of Existing Data

The following changes to this protocol must be reported prior to implementation:

☐ Addition of new subject population or exclusion of currently approved demographics

☐ Addition/removal of investigators

☐ Addition of new procedures

☐ Other changes that may make this study to be no longer be considered exempt

The following changes do not have to be reported:

☐ Editorial/administrative revisions to the consent of other study documents

☐ Changes to the number of subjects from the original proposal

All research materials must be retained by the PI or the faculty advisor (if the PI is a student) for at least three (3) years after study completion. Subsequently, the researcher may destroy the data in a manner that maintains confidentiality and anonymity. IRB reserves the right to modify, change or cancel the terms of this letter without prior notice. Be advised that IRB also reserves the right to inspect or audit your records if needed.

Sincerely,

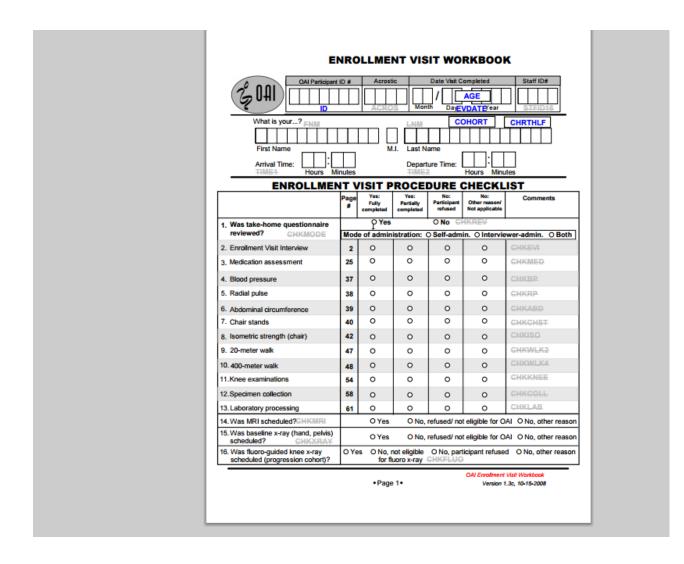Institutional Review Board

Middle Tennessee State University

NOTE: All necessary forms can be obtained from www.mtsu.edu/irb.

Institutional Review Board Office of Compliance Middle Tennessee State University

IRBN005-Exemptio Notice Version 1.0 Page 2 of 2.

APPENDIX B

Demographic information via self-administered questionnaire for age, gender, race, education and marital status (OAI database).

APPENDIX C

CES-D depression scale

Section 1: self-administered questionnaire (Fisher, 2009)

Center for Epidemiologic Studies Depression Scale (CES-D)

Date: _____

Below is a list of some of the ways you may have felt or behaved. Please indicate how often you've felt this way during the **past week**. Respond to all items.

Place a check mark (✓) in the appropriate column. During the past week...	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	All of the time (5-7 days)
1. I was bothered by things that usually don't bother me.				
2. I did not feel like eating; my appetite was poor.				
3. I felt that I could not shake off the blues even with help from my family.				
4. I felt that I was just as good as other people.				
5. I had trouble keeping my mind on what I was doing.				
6. I felt depressed.				
7. I felt that everything I did was an effort.				
8. I felt hopeful about the future.				
9. I thought my life had been a failure.				
10. I felt fearful.				
11. My sleep was restless.				
12. I was happy.				
13. I talked less than usual.				
14. I felt lonely.				
15. People were unfriendly.				
16. I enjoyed life.				
17. I had crying spells.				
18. I felt sad.				
19. I felt that people disliked me.				
20. I could not "get going."				

Section 2: Scoring scheme for CES-D scale (Fisher, 2009)

Scoring for Center for Epidemiologic Studies Depression Scale (CES-D)

Directions: Do not score if missing more than 4 responses. 1) For each item, look up your response and corresponding score (0-3). 2) Fill in the score for each item under the last column labeled "Score." 3) Calculate your Total Score by adding up all 20 scores.

During the past week...	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	All of the time (5-7 days)	Score
1. I was bothered by things that usually don't bother me.	0	1	2	3	
2. I did not feel like eating; my appetite was poor.	0	1	2	3	
3. I felt that I could not shake off the blues even with help from my family.	0	1	2	3	
4. I felt that I was just as good as other people.	3	2	1	0	
5. I had trouble keeping my mind on what I was doing.	0	1	2	3	
6. I felt depressed.	0	1	2	3	
7. I felt that everything I did was an effort.	0	1	2	3	
8. I felt hopeful about the future.	3	2	1	0	
9. I thought my life had been a failure.	0	1	2	3	
10. I felt fearful.	0	1	2	3	
11. My sleep was restless.	0	1	2	3	
12. I was happy.	3	2	1	0	
13. I talked less than usual.	0	1	2	3	
14. I felt lonely.	0	1	2	3	
15. People were unfriendly.	0	1	2	3	
16. I enjoyed life.	3	2	1	0	
17. I had crying spells.	0	1	2	3	
18. I felt sad.	0	1	2	3	
19. I felt that people disliked me.	0	1	2	3	
20. I could not "get going."	0	1	2	3	
				Total Score:	