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The Association between Participation in Physical Activity and Depressive Symptoms among Older Adults with Arthritis

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An abstract of
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Abstract

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Background
Physical functioning and mental health are critical issues among the aging population. Literature has found a higher prevalence of depression and anxiety in people with arthritis. While evidence has supported the efficacy of participation in physical activity as a protective factor that could delay comorbid chronic diseases and improve mental health among older adults, as well as adults with arthritis, literature also shows that almost half of the adult arthritis patients do not participate in leisure time physical activity. There are sparse studies about the dose-response effect of physical activity on mental health among aging population with arthritis.

Objectives
This study was designed to analyze the association between physical activity participation among older adults with arthritis and psychological distress using secondary data. The study also examined whether there was difference in psychological distress among older adults who participated in light and moderate or vigorous physical activity, or strength activity.

Methods
The study used cross-sectional data from the 2012 National Health Interview Survey, a nationally representative, in-person, household interview survey to estimate the prevalence of being psychologically distressed in adults aged 60 or older with arthritis (n =3,197). The association between psychological distress and demographic factors and participation in physical activity was also examined using multivariable logistic regression.

Result
In the aging population with arthritis, psychological distress was significantly associated with younger age, gender, race, and current activity limitation due to arthritis. After controlling the covariates, those who reported being very actively participated in moderate- and vigorous physical activity were nearly 55 % less likely to report mild or severe psychological distress (AOR=0.45; 95%CI=0.30, 0.69; P<.001), than those who were inactive. Those who reported being active were 50% less likely (AOR=0.50; 95%CI=0.33, 0.76; P<.001), and those who reported being slightly active were 35% less likely (AOR=0.65; 95%CI=0.50,0.84; P<.01) to report mild or severe psychological distress. Respondents who reported doing strength training physical activity 3 to 5 times per week were 53 % less likely to have mild or severe psychological distress (AOR=0.47; 95%CI=0.26, 0.86; P<.05).

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Instruction

In the 21st century, as a result of highly improved health science and technology, the average life expectancy has increased and the aging population has grown, which raises a critical issue in public health. According to a report by the Centers for Disease Control and Prevention (2003), by the year 2030, the people age 65 and older will account for 20 per of the U.S. population(C.D.C, 2003). Thus, to improve the senior population's physical and mental health and maintain their life of quality becomes a critical public health concern.

The epidemiologic transition suggests a shift in leading causes of death from infectious disease and acute illness to chronic disease and degenerative illness(C.D.C, 2003). A three-year study suggested that certain chronic conditions, including gait/balance disorders, depression, coronary artery disease, hypertension, and urinary incontinence were associated with the decline in daily physical functioning in the aging process(Cho et al., 1998). In the United States, arthritis is the most common cause of disability. Approximately 22.7% of U.S. adults reported doctor-diagnosed arthritis. A high arthritis prevalence, 49.7%, was found among adults aged 65 years or older in 2010-2012(C.D.C, 2013).

Studies on adults with arthritis have demonstrated the relationship between physical functioning and psychological distress, particularly depression and anxiety(Covic et al., 2012). While both reduced physical performance and perception of being disabled have been associated with depression and among arthritis patients, perceived disability was more strongly related to depressive symptoms(Becofsky, Baruth, & Wilcox, 2013). A study on adult aged 22 – 64 also suggest that the presence of depression and anxiety has associated with chronic physical conditions after controlling other risk factors, including demographic difference and modifiable health behaviors(Bhattacharya, Shen, & Sambamoorthi, 2014).

It has been shown that physical activity has a positive impact on the aging process among older adults, including mental health. Leisure-time physical activity can lead to a decrease in psychological distress, like depressive symptoms, among non-depressed community-dwelling older adults(Netz, Wu, Becker, & Tenenbaum, 2005; Patel, Keogh, Kolt, & Schofield, 2013). Despite this known benefit of physical activity, only 30.4% of those ages 55 years and above, including 14.3% among those aged 65-74 years, met the 2008 Physical Activity Guideline for Americans(U.S. Department of Healht and Human Services, 2010).

Few studies of physical activity intervention for older adults have considered their chronic conditions and physical limitations, which often occur in aging populations, as well as the diverse subpopulations of the aging. Although depression is one of the major health problems faced by the senior population, the association between physical activity participation level among older and depression symptoms is still unclear. Only a few studies have discussed the effects of different level of exercise among older adults, particularly on depression. One study suggested that greater levels of exercise are related to feeling and functioning better for patients with chronic conditions(Stewart et al., 1994).

According to Transactional Model of Stress and Coping, a framework explaining the processes of coping with stressful events, the stressor leads to a primary and secondary appraisal, which then lead to a coping effort that towards to adaptation(Lazarus & Folkman, 1984). Following this framework, aging and arthritis could be addressed as the stressors. To cope with the stress from unchangeable outcomes like aging and arthritis, emotion regulation is more recommendable(Lazarus & Folkman, 1984). Exercise is one type of response modulation that can achieve emotion regulation; regular physical activity has been shown to

reduce emotional distress and improve emotional control(Oaten & Cheng, 2006). It leads to adaption, a way we can reach emotional well-being, the opposite of psychological distress.

To inform and improve future physical activity intervention programs and prescriptions for seniors with physical limitations, assessing the effect of different levels of physical activity on the mental health of older adults with arthritis would provide essential knowledge for public health. Perhaps public health practitioners can address the mental health of those with arthritis and other chronic conditions by adopting appropriate physical activity intervention to improve health outcomes and delay comorbid chronic diseases in aging populations.

Using national surveillance data and the theoretical framework from Transactional Model of Stress and Coping, this study is designed to determine how different levels of physical activity are associated with psychological distress among adult aged 60 or older who have been diagnosed with arthritis.

Literature Review

Psychological Distress in Older adults

Depression and aging

Late-life depression is reported to be a potentially deteriorating condition for health, producing many adverse outcomes, such as poorer outcome of treatment, a higher rates of dementia, increased risk of suicide, impaired function, and higher risk for nursing home placement(Fiske, Wetherell, & Gatz, 2009; Kohn & Epstein-Lubow, 2006).

In most large-scale epidemiological surveys conducted in United States and other countries the prevalence of major depressive disorder in community samples of adults aged 65 and older ranges from 1-5% (Hasin, Goodwin, Stinson, & Grant, 2005). A review of the prevalence of clinically significant depressive symptoms among community-dwelling older adults suggested a range from 8-16% (Blazer, 2003). Older women appear to be more vulnerable to depression than older men, but in oldest age group, the men reported more depressive symptoms. Depression prevalence in older adults seems differ less across race or ethnicity, although Hispanic older women are more likely than non-Hispanic whites to have depressive symptoms (Blazer, 2003; Swenson, Baxter, Shetterly, Scarbro, & Hamman, 2000)

One key distinguishing point in discussion of mental disorder in older adults is the age of onset. Around half or more of geriatric people with major depression describe a change in mental health during old age, while for half or less it occurred markedly before old age. Early onset depression patients were more commonly found to have a family history of psychiatric illness than those with late onset (Brodaty et al., 2001). Older adults with depression are more likely to display cognitive change, somatic symptoms, and loss of interest than younger adults, and less likely to present affective symptoms. The leading

factors causing late life depression consist of a complex interaction of biological mechanisms including genetic vulnerabilities, age-related neurobiological, and cognitive function change as well as certain types of stressful life events that are more common in late life (Fiske et al., 2009). Research has also supported that depression in late life, even at the syndromic level, is associated with physical impairment(Judd, Schettler, & Akiskal, 2002). Treatments for depression in late life are available and supported by empirical evidence, including behavioral therapy, cognitive behavioral therapy, cognitive bibliotherapy, problem-solving therapy, and brief psychodynamic therapy(Fiske et al., 2009).

Anxiety Disorders and aging

In addition to depression, anxiety disorder, including panic disorder, agoraphobia, specific phobia, social phobia, generalized anxiety disorder, posttraumatic stress disorder, is also common among older adults, even more prevailing than depression. In a nationally representative US study, it was found that among people aged 55 and older, the prevalence rate of anxiety disorders based on the DSM-IV criteria is 11.6%(Blay & Marinho, 2012). However, the comorbidity between anxiety and past depression experience has been confirmed among older adults. In a large- scaled cohort study of older adults in the Netherlands, 49.3% of the participants with an anxiety disorder experienced a depressive episode(Hek et al., 2011). Another study reported nationally representative prevalence rates of DSM-IV anxiety disorder across different age groups of noninstitutionalized older adults. Though the decline in the prevalence rate of anxiety disorder is significant in older adults than younger adults, it is still very common in aging population, especially in women(Byers, Yaffe, Covinsky, Friedman, & Bruce, 2010).

In light of the fundamental role of public health interventions in decreasing the

prevalence of late life depression and anxiety, it is critical to address certain protective factors for psychological distress, tailored to the aging population. Psychological distress is the experience of significant emotional upset, such as sadness, anxiety, and distraction, and is usually applied to the undifferentiated combinations of symptoms vary from depression and general anxiety symptoms to behavioral problems (Drapeau, Marchand, & Beaulieu-Prévost, 2014).

Arthritis in U.S. older adults

Other prevalent health problems among aging population include physical limitation and chronic disease. Mobility limitations are prevalent in older adults, affecting their physical, psychological, and social function in late life. One of most frequently identified risk factors for mobility impairment is arthritis and other chronic disease (Brown & Flood, 2013). According to CDC's definition, arthritis includes more than 100 different rheumatic diseases and conditions, including osteoarthritis, rheumatoid arthritis, lupus, fibromyalgia, and gout. Arthritis patients may have the following symptoms: pain, aching, stiffness, and swelling in or around the joint. Some forms of arthritis can affect multiple organs and cause widespread symptoms.

Almost 44% of adults with doctor-diagnosed arthritis report no leisure time physical activity compared with 36% of adults without arthritis(C.D.C., 2013). Physical inactivity is a risk factor for other chronic diseases that are more likely found in older adults, including heart disease, stroke, diabetes mellitus, lung disease, Alzheimer disease, hypertension, and cancer(Elsawy & Higgins, 2010).

It was estimated that 50 million U.S. adults report having doctor-diagnosed arthritis, and it is more commonly seen in senior population(C.D.C., 2013). Arthritis was observed in 49.7% of adults aged 65 and older. After adjusting age, the analyses show a significantly

higher prevalence among women than men in both whites and blacks compared with Hispanics and Asians, among those with less education, those who were obese or overweight, and those not meeting physical activity recommendations (C.D.C, 2013).

Depression and Anxiety among Older Arthritis Patients

Several studies support the fact that depression is prevalent in rheumatoid arthritis patients, and that it is associated with pain, fatigue, and work disability caused by the rheumatoid arthritis (Covic et al., 2012; Robbins, Mehl, Holleran, & Kasle, 2011). Depressive symptoms is one of main factors associated decreased functional disability among osteoarthritis patients, as well as with high body mass index and few social contacts (Rosemann, Laux, & Kuehlein, 2007). Also medical patients with depression may be more likely to have noncompliance behaviors, causing low adherence to treatment (DiMatteo, Lepper, & Croghan, 2000). To date, there is limited research focus on examining the association between depression and arthritis among the aging population, in spite of the fact that arthritis is more common among the aging.

A study comprised of 1793 adults with doctor-diagnosed arthritis aged 45 years and over has reported that one-third of them had anxiety and/or depression. Anxiety was twice as common as depression, and most of those with depression also had anxiety (Murphy, Sacks, Brady, Hootman, & Chapman, 2012). Ignoring the negative impact of mental health among the arthritis population could lead to several consequences affecting their health and quality of life.

Physical activity and health in older adults

There is plenty of scientific evidence that regular physical activity produces major and extensive health benefits in older adults aged 65 and above, as well as in adults aged 18-64.

Since poor health outcomes related to inactivity are more common in the aging population, some cases demonstrated greater health benefits in older adults than other age groups (World Health Organization, 2011). One study summarized data from 44 randomized controlled trials of both genders across various age groups and found that regular physical activity was associated with a reduced incidence of obesity, type 2 diabetes, colon cancer, and osteoporosis (Kesaniemi et al., 2001). However, in terms of functional outcomes, there may be some disagreement about the benefit of physical activity. A study found that physical activity had no association with a lower risk of disability. One explanation could be the different instruments used to measure physical activity (Rosemann et al., 2007). Targeting the community-based older adult population, the World Health Organization has recommended that: (1) adults aged 65 years and older should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week, or do 75 minutes of vigorous–intensity aerobic physical activity, or an equally combination of moderate- and vigorous-intensity activity; (2) muscle-strengthening activities should be done on 2 or more days a week; (3) older adults with poor mobility should participate in physical activity on 3 or more days per week to enhance balance and prevent falls (World Health Organization, 2011).

In terms of different recommendations regarding types, intensity, and volume of physical activity for older adults to achieve the goal of remaining independent, decreasing disability and dependency, and sustaining enhanced quality of life, a systematic review concluded that low morbidity and all-cause mortality is associated with participation in moderate to moderately vigorous activity, specifically including the measure of cardiorespiratory fitness, among adults aged 65 years or older (Paterson, Jones, & Rice, 2007). A positive effect of strength or resistance exercise was also supported by the literature (Lincoln, Shepherd, Johnson, & Castaneda-Sceppa, 2011; Singh, Clements, & Fiatarone,

1997; Singh et al., 2005). For example, a randomized, controlled trial of progressive resistance training (PRT) among 32 older adults with major or minor depression or dysthymia, in which participants received the training three times a week for 10 weeks, found that PRT could reduce depression (Singh et al., 1997). Another randomized, controlled trial examined the effect of high and low intensity PRT on community-dwelling depressed elderly patients. The results showed that high intensity PRT was more effective than low intensity PRT or general practitioner care for the treatment of depression (Singh et al., 2005). Older adults respond to strength training as well as, or better than, young adults, with greater improvement in isometric and dynamic strength, power, and force control (Paterson et al., 2007). However, more studies with larger sample size are needed to testify these findings. A systematic review study of physical activity in depressed older adults concluded that, overall, there were promising findings on the efficacy of physical activity as an adjunct to depression treatment. Unfortunately, evidence of a dose-response effect was frequently lacking, as was evidence of the minimum effective dose (Mura & Carta, 2013).

Though there is consistent evidence that regular physical activity is safe and beneficial to functional ability in older adults with functional limitations, there is less or no experimental evidence studying the effect of physical activity on maintaining daily activity or preventing disability (World Health Organization, 2011). In addition, in spite of the fact that the available evidence supports the association between regular physical activity and both reduced distress and enhanced feelings of well-being regardless of age, sex, race, or medical condition, whether these factors modify the association between physical activity and mental health has not been studied (Physical Activity Guidelines Advisory Committee, 2008).

Physical activity, depression, and anxiety among older adults

One review study summarized several randomized controlled trials, observational studies, and consensus panel judgments and pointed out that there is consistent evidence from observational studies showing that occupational and leisure time physical activities, as well as both resistance and aerobic exercise are associated with reductions in symptoms of depression and anxiety, and both moderate and vigorous physical activity can reduce depression symptoms(Dunn, Trivedi, & O'Neal, 2001).

Although there is sufficient evidence of the relationship between physical activity participation and reduced depression or anxiety in different populations (Brown, Pearson, Braithwaite, Brown, & Biddle, 2013; Larun et al., 2006; McKercher et al., 2013; van Uffelen et al., 2013), fewer studies discuss the effect of physical activity on depression among older adults in the U.S.. One study suggested that adults age 65 and older who adopt light-intensity or moderate-to-vigorous physical activity are less likely to report depressive symptoms (Loprinzi, 2013). Based on previous studies' results, the positive association between physical activity and depression might be expected in future studies. However, given the fact that chronic diseases are prevalent in senior populations, further research should take existing physical limitations into consideration. Also, the effect of physical activity participation on depression may differ by the intensity level of physical activity, especially among those with chronic diseases.

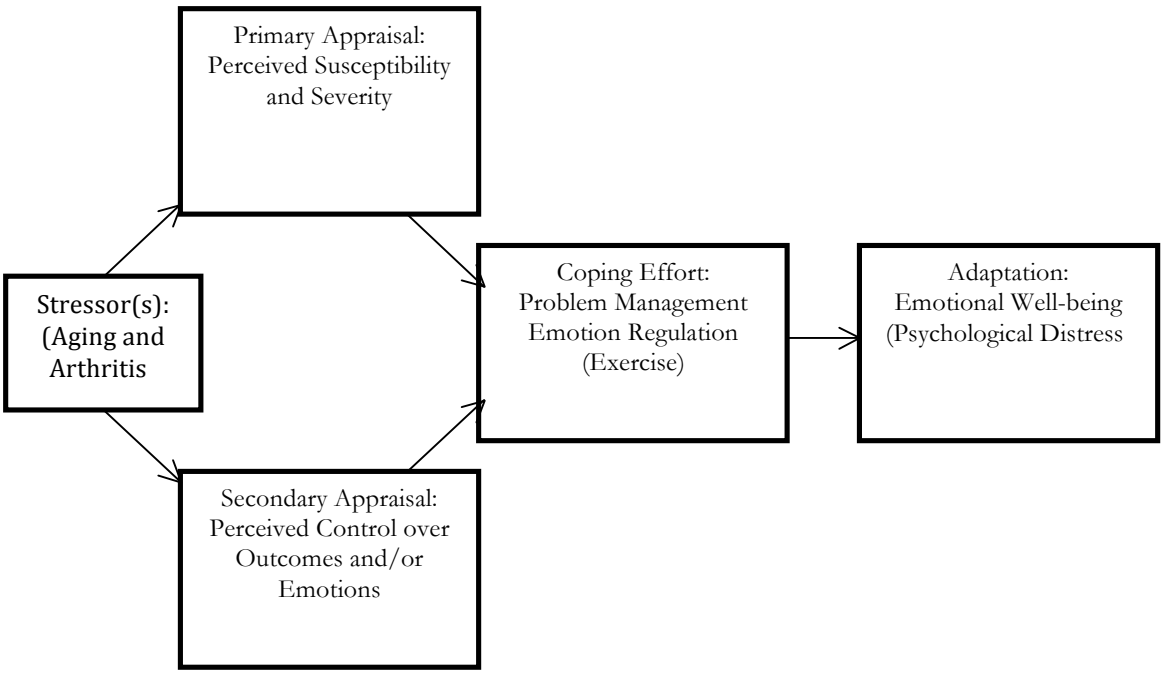
Transactional Model of Stress and Coping

The Transactional Model of Stress and Coping provides a framework explaining the person-environment relation in the process of coping with stress, involving cognitive appraisals and coping responses(Lazarus & Folkman, 1987). Stressful experiences are first

mediated by the person's primary appraisal, evaluating the significance of a stressor. Secondary appraisal was assessing available resource and coping options about the stress event. Coping effort was made to make the situation more manageable, as the actions resulted from primary and secondary appraisal. Adaption is the status of well being that has been reached after effective coping strategies to mitigate stress(Glanz, Rimer, & Lewis, 2002) (see Figure 1).

In this study, our hypothesis is based on the transactional model, where aging and arthritis can be perceived as stressors, and physical activity is the coping effort that we are interested in. Based on the theory, the decrease in non-specific serious psychological distress represents the emotional well-being.

Figure 1.



Rationale of present study

Reports and studies have emphasized that depression in late life is frequently linked to medical comorbidity, functional impairment, and other chronic disease, such as diabetes and cardiovascular disease. Recognizing the complications associated with comorbidity, this study was designed to analyze the association between physical activity participation among older adults with arthritis (including osteoarthritis, rheumatoid arthritis, lupus, fibromyalgia, and gout) and depressive symptoms using secondary data. The hypothesis was that after controlling gender, race, history of depression in past 12 months and BMI (Body Mass Index), older adults with arthritis who have regularly participated in physical activity participation would have fewer depressive symptoms of depression than those who did not. The present study also examined whether there was difference in depressive symptoms among older adults who participate in light and moderate, vigorous physical activity, or strength activity.

Method

Data Source

This study used the adult sample of the 2012 National Health Interview Survey (NHIS). NHIS is a source of information on the health of the non-institutionalized population of the United States conducted annually by the National Center for Health Statistics. NHIS is an ongoing, nationwide, in-person household interview survey about the overall health and health-related behaviors of a representative sample of community-

dwelling civilians in United States. In 2012, one adult in each household was randomly selected to complete the "sample adult" questionnaire through face-to-face interview.

The Sample Adult questionnaire collects information from participants about their health status, health care services, and health behaviors. The response rate for the 2012 sample adult component has 79.7% of 43,323 total eligible sample adults. The sample adult data used in this study include the 3197 citizens from the sample who were age 60 or older, were not using equipment for daily activities, and had completed all questions that we are interested, not including "don't know" or "unascertained" answer.

Variables

Arthritis. Respondents who reported doctor-diagnosed arthritis, were identified by the question "Have you ever been told by a doctor or other health professional that you have some form of arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia?"
For the remainder of this thesis, "arthritis" will be used as a general term to refer to the above diseases. Participants age 60 or older who answered "yes" to this question were included in our sample; and those who answered "no" were categorized as the non-arthritis group. Information about specific type of arthritis is not available.

Physical Activity. Respondents' physical activity participation was assessed by questions about the frequency and duration of light/moderate, vigorous, and strength activity. In this study we used the weekly frequency question as a measure of respondents' level of physical activity participation. The question for vigorous activity was, "How often do you do VIGOROUS leisure-time physical activities for AT LEAST 10 MINUTES that cause HEAVY sweating or

LARGE increases in breathing or heart rate?" The other two types of physical activity (moderate and strength) were also asked in a similar way. For vigorous and moderate activity, we created three categories based on the weekly frequency: inactive, low, medium and high. Respondents who reported "never" or "unable to do" for strength physical activity, were coded as "inactive." Respondents who reported doing physical activity "0 to 2 times per week" were coded as "low," those who reported "3 to 4 times per week" were coded as "medium," and those who reported "equal to or more than 5 times a week" were coded as "high". For strength activity, respondents who reported "never" or "unable to do" strength physical activity, were coded as "inactive." Respondents who reported doing strength training "0 to 2 times per week" were coded as "low," those who reported "3 to 5 times per week" were coded as "medium," and those who reported "more than 5 times per week" were coded as "high."

Light/moderate- and vigorous- physical activity. Combining the frequency of weekly participation in vigorous and moderate physical activity, four levels from 0 to 3 were defined in this study, as new a variable "vigmod". Respondents who reported that "never" or "unable to do" for light/moderate or vigorous physical activity were coded as "inactive" (coded as 0). Respondents who reported "never" or "unable to do" for vigorous physical activity but who reported doing light/moderate physical activity per week, regardless of the frequency were coded as "slightly active" (coded as 1). Respondents who reported participation in vigorous activity "3 times or less per week," regardless of how often they did light/moderate physical activity, were coded as "active" (coded as 2), as were those who reported doing vigorous physical activity "3 to 5 times per week" but reported doing light/moderate activity "never" or "less than 3 times". Respondents who reported doing vigorous physical activity "more than 5 times a week", regardless of their frequency of light/moderate physical activity, were

called "very active" (coded as 3). Those who reported more than 2 times per week of light/moderate and 3 to 5 times per week of vigorous physical activities, were also called "very active".

Strength physical activity. Three levels of strength physical activity, coded from 0 to 2, were also determined in this study, based on respondents' weekly frequency. Respondents who reported that they "never" or were "unable to do" strength exercise were coded as "0, inactive". Those who did strength training 5 times or less per week were coded as "1, active". Respondents who reported strength training more than 5 times per week were coded as "2, very active".

Non-specific Psychological Distress (NSPD). NHIS data include The Kessler 6 (K6) as a standardized and validated measure of non-specific psychological distress (Shih, Hootman, Strine, Chapman, & Brady, 2006). K6 is composed of 6 questions asking respondents during the past 30 days how often he/she felt, "so sad that nothing can cheer up," "nervous," "restless," "hopeless," "worthless," or that "everything was an effort." Respondents scored each question from 1 (ALL of the time) to 5 (None of the time) and the question scores were summed to produce a total K6 score as the outcome variable in this study. The study includes only respondents who completed all 6 questions without answering "Refused to answer", "Not ascertained", or "Don't know". Higher scores indicate better mental health. After reverse coding, the total scores of the six questions ranged from 6 (indicating no distress) to 30 (indicating severe distress). For interpretation of scores, the literature has categorized total score into three ranges: (1) people who score low range (6-11) are likely to be well; (2) people who score mild to moderate range (12-19) are likely to have a mild or moderate mental health disorder; (3) people who score in the high range (20-30) are likely to have a severe mental health disorder (Andrews & Slade, 2001; Kessler et al., 2003;

MindHealthConnect, 2014). In this study, respondents who scored 12 or above were coded "1", psychologically distressed. Respondents who scored 11 or less, were coded as "0", non-psychologically distressed.

Covariates. Several independent variables that have been reported to be associated with depression or anxiety disorders were included in the logistic regression model. These variables are age, gender, race or ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, non-Hispanic other/multiple race), current physical limitation due to arthritis, and BMI (=weight[kg2]/height[m2]; <19 underweight; 19 -25 normal; 25-30 overweight; 30+ obese).

Statistical Analysis

Descriptive statistic analysis was first conducted to summarize the characteristics of the sample population. Crude prevalence rates and odds ratios of psychological distress were calculated by sample population characteristics. Chi-square tests were conducted to examine the differences between subgroups, including levels of moderate- to vigorous- activity, levels of strength activity, BMI groups, sex, race/ethnicity, and current physical limitation due to arthritis. Multivariable logistic regression analyses were performed to test the association between different levels of participation in physical activity and psychological distress. A significance level of $\alpha = 0.05$ was used.

Results

Respondents' Characteristic

Respondents' characteristics are presented in Table 1. Among the older adults with diagnosed arthritis who were not using equipment for walking, the majority (53.6 %) were

aged 60 to 69 years. More than half (63.0%) of the participants were female. Most of the sample (73.1%) was non-Hispanic white. The largest proportion of the respondents (38.7%) was overweight (38.7%), followed by obese (32.1%). Almost two-thirds (65.4 %) of the respondents reported no limitation of their usual activities because of arthritis or joint symptoms.

Participation in physical activity

Light/moderate physical activity. Around 42.6% of the respondents (n=1363) reported they never did or were unable to do light/moderate physical activity, but the majority (57.4%) did at least some light/moderate physical activity.

Vigorous activity. More than half of respondents (72.2%) were unable to do or never did vigorous leisure-time physical activity. Among the remaining respondents, doing vigorous physical activity more than 4 times per week was reported most frequently (10.5%).

Strength activity. A large majority (78.8%) of the respondents reported being unable to do or never doing strength physical activity. Among the rest of the respondents, strength physical activity 3 to 4 times per week was most frequent.

Table1. Demographics and physical participation characteristics of respondents.(N=3197)

Characteristic	Frequency #(%)/Mean (SD)
Independent Variable	
Age(y)	
60-69	1770 (53.6)
70+	1534 (46.4)
Gender	
Male	1221 (37.0)
Female	2083 (63.0)
Race	
White, non-Hispanic	2416 (73.12)
Black, non-Hispanic	439 (13.29)
Hispanic	293 (8.9)
Other/multiple race, non-Hispanic	156 (4.7)
BMI	
Normal/Underweight	934 (29.2)
Overweight	1237 (38.7)
Obese	1026 (32.1)
Activity Limitation	
Yes	1143 (34.6)
No	2161 (65.4)
Moderate/Light Activity (times per week)	
High (5+ times)	850 (26.6)
Medium (3-4 times)	475 (14.9)
Low (0-2 times)	510(16.0)
Never or Unable to do	1362(42.6)
Vigorous activity freq. (times per week)	
High (5+ times)	335 (10.5)
Medium (3-4 times)	246 (7.7)
Low (0-2 times)	309 (9.7)
Never or Unable to do	2307 (72.2)
Strength activity freq. (times per week)	
High (5+ times)	178 (5.6)
Medium (3-4 times)	262 (8.2)
Low (0-2 times)	237 (7.4)
Never or Unable to do	2520(78.8)
Level of Moderate-Vigorous activity freq.	
Inactive	1198 (37.5)
Slightly active	1109 (34.7)
Active	399 (12.5)
Very active	491 (15.4)

Table1 continued. Demographics and physical participation characteristics of respondents.(N=3197)

Characteristic	Frequency #(%)/Mean (SD)
Independent Variable	
Level of Strength activity freq.	
Inactive	2520(78.8)
Slightly active	237(7.4)
Active	262(8.2)
Very active	178(5.6)
Dependent Variable	
Psychological Distressed	402 (12.6)
Non-Psychological Distressed	2795(87.43)

After grouping level of leisure-time physical activity, the greatest proportion (37.5%) of the respondents were in the inactive group (n=1198), followed by 34.7% who were slightly active. For the level of strength activity, the vast majority (78.9%) were inactive.

Bivariate Analysis Results

Covariates. Bivariate analyses were conducted to examine how the variables of interest and the covariates were associated with the mental health indicator, i.e., the K6 score. The results can be found in Table2. Results of Chi-square tests of independence showed associations between psychological distress and the following covariates: age, gender, race/ethnicity, and current physical limitation or sprain. Respondents aged 60 to 69 years were significantly more likely to have psychological distress than those aged 70 years or more (OR=2.13, CI=1.7-2.67). Male respondents were less likely than female respondents to report psychological distress (OR=0.69, CI=0.55- 0.86). Compared to non-Hispanic White respondents, Hispanic respondents were more significantly more likely to have psychological distress (OR=2.29, CI=1.69 to 3.11), but non-Hispanic African Americans (OR=1.22, CI=0.89 to 1.65), and those of other/multiple races (OR=1.07, CI=0.64 to 1.78) did not

significantly differ. There was no significant difference in mental health across different BMI groups (X2=5.39, p>0.05). Perceived limitation in usual activities due to arthritis was significantly associated with psychological distress. Respondents who were limited in any of their usual activities due to arthritis or joint symptoms were more likely to report psychological distress (OR=3.43, CI=2.76 to 4.25).

Psychological Distress and Participation in Physical Activity. Participation in leisure-time moderate and vigorous physical was significantly associated with psychological distress, as was leisure-time strength physical activity. Respondents who were very active (OR=0.33, CI=0.23 to 0.49), those who were active (OR=0.42, CI=0.28 to 0.61), and those who were slightly active (OR=0.50, CI=0.31 to 0.82) were all less likely to have psychological distress than those who were inactive. In addition, there is a dose relationship between activity level and reduction in psychological distress.

Table2. Frequency of people with psychological distress by sample characteristics(N=3197)

	Psychological distress	No psychological distress			
	n(%)	n(%)	Crude Odds ratio	Chi-Square statistics (X^2)	p-value
Age(y)					
60-69	277(68.9)	1424(51.0)	2.13 (1.71 to2.67)***	45.5	<0.0001
70+	125(31.1)	1371(49.1)	1.00		
Gender					
Male	123(30.6)	1092(39.1)	0.69(0.55 to 0.86)**	10.7	0.0011
Female	279(69.4)	1703(60.9)	1.00		
Race					
White, non-Hispanic	262(65.2)	2068(74.0)	1.00	29.9	<0.0001
Black, non-Hispanic	57(14.2)	370(13.2)	1.22 (0.89 to 1.65)		
Hispanic	65(16.2)	224(8.0)	2.29 (1.69 to 3.11)***		
Other/multiple race, non-Hispanic	18(4.5)	133(4.8)	1.07 (0.64 to 1.78)		
BMI					
Obese	149(37.1)	1096(39.2)	1.25 (0.96 to 1.62)	5.39	0.0677
Overweight	141(35.1)	877(31.4)	0.94 (0.73 to 1.23)		
Normal/Underweight	112(27.9)	822(29.4)	1.00		

Activity limitation					
Yes	244(60.7)	868(31.1)	3.43(2.76 to 4.25)***	136.1	<0.0001
No	158(39.3)	1927(69.0)	1.00		
Level of Moderate Activity					
High	87(21.6)	763(27.3)	0.58 (0.45 to 0.75)*	35.7	<0.0001
Medium	35(8.7)	440(15.7)	0.40 (0.28 to 0.59)**		
Low	56(13.9)	454(16.2)	0.63 (0.46 to 0.86)*		
Never/Unable to do	224(55.7)	1138(40.7)	1.00		
Level of Vigorous Activity					
High	22(5.5)	313(11.2)	0.41 (0.26 to 0.65)*	30.6	<0.0001
Medium	17(4.2)	229(8.2)	0.56 (0.37 to 0.85)*		
Low	27(6.7)	282(10.1)	0.44 (0.26 to 0.72)*		
Never/Unable to do	336(83.6)	1971(70.5)	1.00		
Level of Moderate-Vigorous Activity freq.					
Very active	33(8.2)	458 (16.4)	0.33 (0.23 to 0.49)***	55.0	<0.0001
Active	33(8.2)	366(13.1)	0.42 (0.28 to 0.61)***		
Slightly active	122(30.4)	987 (35.3)	0.57 (0.45 to 0.72)***		
Inactive	214(53.2)	984 (35.2)	1.00		
Level of Strength Activity freq.					
Very active	17 (4.2)	161 (5.8)	0.65 (0.39 to 1.08)	25.6	<0.0001
Active	13 (3.2)	249 (8.9)	0.32 (0.18 to 0.57)***		
Slightly active	18 (4.5)	219 (7.8)	0.50 (0.31 to 0.82)**		
Inactive	354(88.1)	2166 (77.5)	1.00		

*= p <0.05; **= p <0.01; ***= p<0.001

Logistic Regression Analysis. Multivariable logistic regression results suggest that, after controlling age, race, BMI, and perceived limitation in daily activities, those who reported very active participation in moderate- and vigorous physical activity were nearly 55 % less likely to report mild or severe psychological distress (AOR=0.45; 95%CI=0.30, 0.69; P<.001), than those who were inactive. Those who reported an active level of participation were 50% less likely (AOR=0.50; 95%CI=0.33, 0.76; P<.001), and those who reported a slightly active level of participation were 35% less likely (AOR=0.65; 95%CI=0.50,0.84; P<.01) to report mild or severe psychological distress. Respondents who reported doing strength training physical activity 3 to 5 times per week were 53 % less likely to have mild or

severe psychological distress (AOR=0.47; 95%CI=0.26, 0.86; P<.05). Considering the covariates, male respondents were 31% less likely than females to report psychological distress. Compared to non-Hispanic White respondents, Hispanic respondents were nearly 2 times more likely to report psychological distress. For each year of increase in age, the odds of reporting psychological distress decreased by 5% (AOR=0.95; 95%CI=0.94, 0.97; P<.0001). Respondents who reported any kind of limitation in their usual activities were almost 3 times more likely to have psychological distress (AOR=3.00; 95%CI=2.40, 3.74; P<.0001).

Table3. Logistic Regression of psychological distress and physical activity adjusted by covariates (N=3197)

	Coefficient	Standard Error	Wald Chi-Square	[a]Adjusted OR	[b]95% CI
Level of Moderate-vigorous activity					
Very active	-0.769	0.215	12.7931	0.452	(0.296-0.689)**
Active	-0.692	0.211	10.72	0.501	(0.331-0.757)**
Slightly active	-0.4306	0.1301	10.96	0.650	(0.504-0.839)**
Inactive	1.0000			1.000	
Level of Strength activity					
Very active	-0.1045	0.278	0.14	0.901	(0.522-1.554)
Active	-0.752	0.3064	6.02	0.472	(0.259-0.860)*
Slightly active	-0.3577	0.2663	1.80	0.699	(0.415-1.179)
Inactive	1.0000			1.000	
Age(y)	-0.049	0.008	34.64	0.952	(0.937-0.968)***
Gender					
Male	-0.183	0.060	9.21	0.694	(0.548-0.879)**
Female	1.0000			1.000	
Race					
Black, non-Hispanic	-0.143	0.136	1.115	1.021	(0.740-1.408)
Hispanic	0.507	0.136	13.999	1.957	(1.419-2.699)**
Other/multiple race, non-Hispanic	-0.200	0.2037	0.963	0.965	(0.569-1.637)
White, non-Hispanic	1.0000			1.000	
BMI	-0.013	0.00971	1.6563	0.988	(0.969-1.007)
Activity limitation					
Yes	0.5488	0.0570	92.701	2.997	(2.397-3.747)***
No	1.0000			1.000	

a. Adjusted OR=adjusted odds ratio; b. 95% CI=95% confidence interval; *<0.05; **<0.01; ***<0.001

Discussion

Conclusion

Overall, this study demonstrates a positive association between participation in leisure-time physical activity and better mental health among older adults with arthritis, despite activity limitations due to arthritis or joint symptoms. The results suggest that the more frequent the participation in moderate- and vigorous- physical activity by older adults with arthritis, the less psychological distress they have. Participating three to five times per week in strength or resistance training per week is also significantly associated with less psychological distress.

The above findings support previous literature indicating that physical activity can improve mental health, including reducing depression and increasing well-being in the aging population. The results further suggest that different levels of intensity and frequency of participation in leisure-time physical activity are associated with different levels of impact on mental health in the aging population with arthritis. This result also supports CDC's recommendation of physical activity for the seniors with mobility limitation: " older adults with poor mobility should participate in physical activity on 3 or more days per week to enhance balance and prevent falls (World Health Organization, 2011, p.1).

Current recommendations for strength training for the senior population encourage the elderly to do strength exercise at least 2 or more days in a week. While there may be other health benefits of strength training, this recommendation was not fully supported by the results of this study for reducing psychological distress. Compared to the inactive group, only participation in strength exercise at the medium level, i.e., 3 to 5 times per week, significantly lowered psychological distress. Neither low (0 to 2 times) nor high (>5 times) levels of strength exercise were associated with a change in psychological distress.

The descriptive results also reflected and corresponded to epidemiologic data and other facts about arthritis. It was reported that nearly 44% of adults with arthritis do not participate in leisure time physical activity (CDC, 2013). In this study, 43% of participants were unable to participate or never participated in light/moderate physical activity. Even fewer participate in vigorous or strength activity; fully 72% were inactive in vigorous physical activity, and 79% were inactive in strength exercise. Arthritis has been reported to be higher among women (24.3%) than men (18.7%), according to a CDC report (CDC, 2013). Our results were compatible with this report in that more than half of the older adults in the study with arthritis were female.

As expected, some of the covariates had a significant association with psychological distress, including gender, age, Hispanic, and self-reported activity limitation due to arthritis or joint symptoms. In this study, male respondents were less likely to report mild or severe psychological distress compared to female respondents. Consistent evidence has found that women have higher rates of emotional distress than men. Gender difference in psychological distress has been found among specific populations such as non-European immigrants, cancer patients with underage children, and implantable cardioverter defibrillator patients (Ernst et al., 2013; Kosidou et al., 2012; Starrenburg et al., 2014). Clinical research has demonstrated that the sex differences modify the effect of aging on brain function, as well as age-related decline in cognitive and emotion processing (Gur & Gur, 2002).

This study also found that the older a respondent was, the less the chance he/she would have psychological distress. One previous study from a community survey of 7485 persons aged 20-24, 40-44, or 60-64 years, suggested that psychological distress generally

decreased across the age range 20-64 years, while some of these age differences could be explained by other risk factors (Jorm et al., 2005). However, another study of older adults demonstrated that the oldest age group (80-100 years) included more anxiety cases with comorbid depression than the youngest age group, aged 58-70(Hek et al., 2011). More research is needed to understand the association of age to psychological distress, and to identify the mechanisms or risk factors behind those differences.

In this study, Hispanic respondents were more likely to report psychological distress, while controlling the effect of other covariates and participation in physical activity. Literature has also supported a racial/ethnic difference in the prevalence of serious psychological distress and mental health needs among older adults in the United States. The ethnic minority aging population has a higher prevalence of mental disorders compared to the majority population, and depression is the most prevalent disorder (Fuentes & Aranda, 2012). Hispanic older adults seem to have higher prevalence of depression than other ethnic groups. One study found that, after adjusting for sociodemographic and health risk factors, Hispanic older women were more likely to report depressive symptoms than non-Hispanic whites (Swenson et al., 2000). A population-representative study, The Aging, Demographics and Memory Study (ADMAS) also found that Hispanic, older females had the highest rates of depression, and Hispanic and white older adults had an almost three times higher prevalence of depression than African-Americans (Steffens, Fisher, Langa, Potter, & Plassman, 2009). One California study concluded that the prevalence of serous psychological disorder differ racially/ethnically, with American Indians/Alaska Natives having the highest prevalence, and Asians having the lowest prevalence (Kim, Bryant, & Parmelee, 2012).

Limitations

Several limitations of the study need to be addressed in future studies, in order to achieve more convincing results. First, the cross-sectional design of the study could only test the association between physical activity and mental health, instead of examining the causal relation between these measures. As a result, we cannot determine whether poor mental health reduces physical activity, or whether low levels of physical activity reduce mental health.

A second limitation is that the standard to determine the levels of participation in light/moderate and vigorous physical activity and the overall levels from combined light/moderate- and vigorous- physical activity may be arguable. Furthermore, the selected measure of physical activity might not capture the actual amount of respondents' participation in physical activity. Compared to asking respondents to recall the exact units and duration of their weekly exercise, it would appear that self-reported frequency questions would result in more accurate and easier responses. However, collecting only the frequency of physical activity may not fully capture the amount of physical activity. On the other hand, an advantage of using frequency of strength exercise rather than calculating units and duration is that it is comparable with the amount that has been officially recommended and encouraged; The C.D.C. and Department of Human Services have recommended strength training on 2 or more days a week for older adults.

A third limitation is that many factors may contribute to or be related to depression and anxiety. These include comorbidity of chronic diseases, socioeconomic status, education level, and others (Fiske et al., 2009; Nayak & Rajpura, 2013). Unfortunately, it was not possible to include in this study all possible confounding variables, or to assess their

potential relevance to physical activity participation. This limits the degree to which this study can correctly determine the impact of physical activity on mental health status.

Implications of the Study

The large sample size in the present study provides solid evidence with relevance for clinic practice and public health programs. Even though the older adults in this study were affected by current physical limitations, the higher their level of physical activity participation, the lower their reported psychological distress compared to those in inactive group. Therefore, regular participation in leisure-time physical activity has the potential to benefit the mental health of the senior population. This study found that the majority of the senior population with arthritis is physically inactive, which may lead to worsening of their health outcomes. Primary care and clinic practitioners should proactively provide recommendations for physical activity and strength training for senior arthritis patients, especially because prior research has suggested that adults with arthritis who received recommendations for physical activity from their health care providers were more likely to comply with the physical activity guidelines (Austin, Qu, & Shewchuk, 2013).

Different levels and types of physical activity were associated with different effects upon mental health among these older arthritis patients. As a result, it is important to provide customized exercise plans for each individual treatment or community program. The findings suggest that physical therapy and rehabilitation for senior arthritis patients should also include an individualized physical activity evaluation and exercise prescription, to better achieve treatment adherence and patient well-being.

Direction for Future Study

In the future, conducting experimental studies would help researchers to understand the causal relation between psychological distress and physical activity among seniors with arthritis. In addition, collecting the actual times of the participant's weekly participation in light/moderate and vigorous physical activity in minutes of total duration, instead of simple frequencies, may improve the accuracy of the measurement of physical activity.

Although this study has controlled self-reported activity limitation, the available question about respondents' perceived physical limitation due to disability is lacking of details. For example, it is not clear in what way and why participants felt constrained in doing daily activity, and in what kinds of activity most people felt constrained. To address these questions, a pilot qualitative study may be required to better understand and explore the health behaviors relevant to participation in leisure-time physical activity among older adults with arthritis. More studies are also need to identify their perceived barriers and perceived control over their outcomes.

Reference

Andrews, G., & Slade, T. (2001). Interpreting scores on the Kessler Psychological Distress Scale (K10). Aust N Z J Public Health, 25(6), 494-497.

Austin, S., Qu, H., & Shewchuk, R. M. (2013). Health care providers' recommendations for physical activity and adherence to physical activity guidelines among adults with arthritis. Prev Chronic Dis, 10, E182. doi: 10.5888/pcd10.130077

Becofsky, K., Baruth, M., & Wilcox, S. (2013). Physical functioning, perceived disability, and depressive symptoms in adults with arthritis. Arthritis, 2013, 525761. doi: 10.1155/2013/525761

Bhattacharya, R., Shen, C., & Sambamoorthi, U. (2014). Excess risk of chronic physical conditions associated with depression and anxiety. BMC Psychiatry, 14(1), 10. doi: 10.1186/1471-244x-14-10

Blay, Sergio L., & Marinho, Valeska. (2012). Anxiety disorders in old age. Current Opinion in Psychiatry, 25(6), 462-467.

Blazer, D. G. (2003). Depression in late life: review and commentary. J Gerontol A Biol Sci Med Sci, 58(3), 249-265.

Brodaty, H., Luscombe, G., Parker, G., Wilhelm, K., Hickie, I., Austin, M. P., & Mitchell, P. (2001). Early and late onset depression in old age: different aetiologies, same phenomenology. J Affect Disord, 66(2-3), 225-236.

Brown, H. E., Pearson, N., Braithwaite, R. E., Brown, W. J., & Biddle, S. J. (2013). Physical activity interventions and depression in children and adolescents : a systematic review and meta-analysis. Sports Med, 43(3), 195-206. doi: 10.1007/s40279-012-0015-8

Byers, A. L., Yaffe, K., Covinsky, K. E., Friedman, M. B., & Bruce, M. L. (2010). High occurrence of mood and anxiety disorders among older adults: The National Comorbidity Survey Replication. Arch Gen Psychiatry, 67(5), 489-496. doi: 10.1001/archgenpsychiatry.2010.35

C.D.C. (2003). Public Helaht and Aging: Trend in Aging---Unitied States and Worldwide. Morbidity and Mortality Weekly Report, 52(6), 101-106.

C.D.C. (2013). Prevalence of Doctor-Diagnosed Arthritis and Arthritis-Attributable Activity Limitation — United States, 2010–2012. Morbidity and Mortality Weekly Report, 62(44), 869-873.

C.D.C. (2013). Arthritis-Meeting The Challenge of Living Well: At a Glance. Naitonal Center for Chronic Disease Prevention and Health Promotion,.

Cho, C. Y., Alessi, C. A., Cho, M., Aronow, H. U., Stuck, A. E., Rubenstein, L. Z., & Beck, J. C. (1998). The association between chronic illness and functional change among participants in a comprehensive geriatric assessment program. J Am Geriatr Soc, 46(6), 677-682.

Covic, Tanya, Cumming, Steven R., Pallant, Julie F., Manolios, Nick, Emery, Paul, Conaghan, Philip G., & Tennant, Alan. (2012). Depression and anxiety in patients with rheumatoid arthritis: Prevalence rates based on a comparison of the Depression, Anxiety and Stress Scale (DASS) and the Hospital, Anxiety and Depression Scale (HADS). BMC Psychiatry, 12. doi: 10.1186/1471-244X-12-6

DiMatteo, M. R., Lepper, H. S., & Croghan, T. W. (2000). Depression is a risk factor for noncompliance with medical treatment: meta-analysis of the effects of anxiety and depression on patient adherence. Arch Intern Med, 160(14), 2101-2107.

Drapeau, Aline , Marchand, Alain, & Beaulieu-Prévost, Dominic (2014). Epidemiology of Psychological Distress. Retrieved February 13, 2014, from http://www.intechopen.com/download/get/type/pdfs/id/25512

Dunn, A. L., Trivedi, M. H., & O'Neal, H. A. (2001). Physical activity dose-response effects on outcomes of depression and anxiety. Med Sci Sports Exerc, 33(6 Suppl), S587-597; discussion 609-510.

Elsawy, Bassem, & Higgins, KIM E. (2010). Physical Activity Guidelines for Older Adults. Am Fam Physician, 81(1).

Ernst, J., Gotze, H., Krauel, K., Romer, G., Bergelt, C., Flechtner, H. H., . . . von Klitzing, K. (2013). Psychological distress in cancer patients with underage children: gender-specific differences. Psychooncology, 22(4), 823-828. doi: 10.1002/pon.3070

Fiske, A., Wetherell, J. L., & Gatz, M. (2009). Depression in older adults. Annu Rev Clin Psychol, 5, 363-389. doi: 10.1146/annurev.clinpsy.032408.153621

Fuentes, D., & Aranda, M. P. (2012). Depression interventions among racial and ethnic minority older adults: a systematic review across 20 years. Am J Geriatr Psychiatry, 20(11), 915-931. doi: 10.1097/JGP.0b013e31825d091a

Glanz, K., Rimer, B.K., & Lewis, F.M. (2002). Health Behavior and Health Education.Theory, Research, and Practice. San Fransisco: Wiley & Sons.

Gur, R. E., & Gur, R. C. (2002). Gender differences in aging: cognition, emotions, and neuroimaging studies. Dialogues Clin Neurosci, 4(2), 197-210.

Hasin, D. S., Goodwin, R. D., Stinson, F. S., & Grant, B. F. (2005). Epidemiology of major depressive disorder: results from the National Epidemiologic Survey on Alcoholism and Related Conditions. Arch Gen Psychiatry, 62(10), 1097-1106. doi: 10.1001/archpsyc.62.10.1097

Hek, K., Tiemeier, H., Newson, R. S., Luijendijk, H. J., Hofman, A., & Mulder, C. L. (2011). Anxiety disorders and comorbid depression in community dwelling older adults. Int J Methods Psychiatr Res, 20(3), 157-168. doi: 10.1002/mpr.344

Jorm, A. F., Windsor, T. D., Dear, K. B., Anstey, K. J., Christensen, H., & Rodgers, B. (2005). Age group differences in psychological distress: the role of psychosocial risk factors that vary with age. Psychol Med, 35(9), 1253-1263. doi: 10.1017/s0033291705004976

Judd, L. L., Schettler, P. J., & Akiskal, H. S. (2002). The prevalence, clinical relevance, and public health significance of subthreshold depressions. Psychiatr Clin North Am, 25(4), 685-698.

Kesaniemi, Y. K., Danforth, E., Jr., Jensen, M. D., Kopelman, P. G., Lefebvre, P., & Reeder, B. A. (2001). Dose-response issues concerning physical activity and health: an evidence-based symposium. Med Sci Sports Exerc, 33(6 Suppl), S351-358.

Kessler, R. C., Barker, P. R., Colpe, L. J., Epstein, J. F., Gfroerer, J. C., Hiripi, E., . . . Zaslavsky, A. M. (2003). Screening for serious mental illness in the general population. Arch Gen Psychiatry, 60(2), 184-189.

Kim, G., Bryant, A. N., & Parmelee, P. (2012). Racial/ethnic differences in serious psychological distress among older adults in California. Int J Geriatr Psychiatry, 27(10), 1070-1077. doi: 10.1002/gps.2825

Kohn, R., & Epstein-Lubow, G. (2006). Course and outcomes of depression in the elderly. Curr Psychiatry Rep, 8(1), 34-40.

Kosidou, K., Hellner-Gumpert, C., Fredlund, P., Dalman, C., Hallqvist, J., Isacsson, G., & Magnusson, C. (2012). Immigration, transition into adult life and social adversity in

relation to psychological distress and suicide attempts among young adults. PLoS One, 7(10), e46284. doi: 10.1371/journal.pone.0046284

Larun, L., Nordheim, L. V., Ekeland, E., Hagen, K. B., & Heian, F. (2006). Exercise in prevention and treatment of anxiety and depression among children and young people. Cochrane Database Syst Rev(3), CD004691. doi: 10.1002/14651858.CD004691.pub2

Lazarus, Richard S., & Folkman, Susan. (1984). Stress, Appraisal and Coping. New York: Springer Publishing Company.

Lazarus, Richard S., & Folkman, Susan. (1987). Transactional theory and research on emotions and coping. European Journal of Personality, 1(3), 141-169.

Lincoln, A. K., Shepherd, A., Johnson, P. L., & Castaneda-Sceppa, C. (2011). The impact of resistance exercise training on the mental health of older Puerto Rican adults with type 2 diabetes. J Gerontol B Psychol Sci Soc Sci, 66(5), 567-570. doi: 10.1093/geronb/gbr034

Loprinzi, Paul D. (2013). Objectively measured light and moderate-to-vigorous physical activity is associated with lower depression levels among older US adults. Aging & Mental Health, 17(7), 801-805. doi: 10.1080/13607863.2013.801066

McKercher, Charlotte, Patton, George C., Schmidt, Michael D., Venn, Alison J., Dwyer, Terence, & Sanderson, Kristy. (2013). Physical activity and depression symptom profiles in young men and women with major depression. Psychosomatic Medicine, 75(4), 366-374. doi: 10.1097/PSY.0b013e31828c4d53

MindHealthConnect. (2014). Guide to Kessler-6. Retrieved March 30, 2014, from http://www.mindhealthconnect.org.au/guide-to-kessler-6

Mura, G., & Carta, M. G. (2013). Physical activity in depressed elderly. A systematic review. Clin Pract Epidemiol Ment Health, 9, 125-135. doi: 10.2174/1745017901309010125

Murphy, L. B., Sacks, J. J., Brady, T. J., Hootman, J. M., & Chapman, D. P. (2012). Anxiety and depression among US adults with arthritis: prevalence and correlates. Arthritis Care Res (Hoboken), 64(7), 968-976. doi: 10.1002/acr.21685

Nayak, R., & Rajpura, J. (2013). Assessing Depression among Older Persons with Arthritis: A Nationwide Health Status Survey. ISRN Rheumatol, 2013, 968343. doi: 10.1155/2013/968343

Netz, Yael, Wu, Meng-Jia, Becker, Betsy Jane, & Tenenbaum, Gershon. (2005). Physical Activity and Psychological Well-Being in Advanced Age: A Meta-Analysis of Intervention Studies. Psychology and Aging, 20(2), 272-284. doi: 10.1037/0882-7974.20.2.272

Oaten, M., & Cheng, K. (2006). Longitudinal gains in self-regulation from regular physical exercise. Br J Health Psychol, 11(Pt 4), 717-733. doi: 10.1348/135910706x96481

Patel, Asmita, Keogh, Justin W. L., Kolt, Gregory S., & Schofield, Grant M. (2013). The long-term effects of a primary care physical activity intervention on mental health in low-active, community-dwelling older adults. Aging & Mental Health, 17(6), 766-772.

Paterson, D. H., Jones, G. R., & Rice, C. L. (2007). Ageing and physical activity: evidence to develop exercise recommendations for older adults. Can J Public Health, 98 Suppl 2, S69-108.

Physical Activity Guidelines Advisory Committee. (2008). Physical Activity Guidelines Advisory Committee Report. (1753-4887 (Electronic)0029-6643 (Linking)). Washington, DC.

Robbins, Megan L., Mehl, Matthias R., Holleran, Shannon E., & Kasle, Shelley. (2011). Naturalistically observed sighing and depression in rheumatoid arthritis patients: A preliminary study. Health Psychology, 30(1), 129-133. doi: 10.1037/a0021558

Rosemann, T., Laux, G., & Kuehlein, T. (2007). Osteoarthritis and functional disability: results of a cross sectional study among primary care patients in Germany. BMC Musculoskelet Disord, 8, 79. doi: 10.1186/1471-2474-8-79

Shih, M., Hootman, J. M., Strine, T. W., Chapman, D. P., & Brady, T. J. (2006). Serious psychological distress in U.S. adults with arthritis. J Gen Intern Med, 21(11), 1160-1166. doi: 10.1111/j.1525-1497.2006.00573.x

Singh, N. A., Clements, K. M., & Fiatarone, M. A. (1997). A randomized controlled trial of progressive resistance training in depressed elders. J Gerontol A Biol Sci Med Sci, 52(1), M27-35.

Singh, N. A., Stavrinos, T. M., Scarbek, Y., Galambos, G., Liber, C., & Fiatarone Singh, M. A. (2005). A randomized controlled trial of high versus low intensity weight training versus general practitioner care for clinical depression in older adults. J Gerontol A Biol Sci Med Sci, 60(6), 768-776.

Starrenburg, A., Pedersen, S., van den Broek, K., Kraaier, K., Scholten, M., & J, Van Der Palen. (2014). Gender Differences in Psychological Distress and Quality of Life in Patients with an ICD 1-Year Postimplant. Pacing Clin Electrophysiol. doi: 10.1111/pace.12357

Steffens, D. C., Fisher, G. G., Langa, K. M., Potter, G. G., & Plassman, B. L. (2009). Prevalence of depression among older Americans: the Aging, Demographics and Memory Study. Int Psychogeriatr, 21(5), 879-888. doi: 10.1017/s1041610209990044

Stewart, A. L., Hays, R. D., Wells, K. B., Rogers, W. H., Spritzer, K. L., & Greenfield, S. (1994). Long-term functioning and well-being outcomes associated with physical activity and exercise in patients with chronic conditions in the Medical Outcomes Study. J Clin Epidemiol, 47(7), 719-730.

Swenson, C. J., Baxter, J., Shetterly, S. M., Scarbro, S. L., & Hamman, R. F. (2000). Depressive symptoms in Hispanic and non-Hispanic White rural elderly: the San Luis Valley Health and Aging Study. Am J Epidemiol, 152(11), 1048-1055.

U.S. Department of Healht and Human Services. (2010). Healthy People 2020. Washington, DC.: Retrieved from http://www.healthypeople.gov/2020/topicsobjectives2020/nationaldata.aspx?topicId=33.

van Uffelen, Jannique G. Z., van Gellecum, Yolanda R., Burton, Nicola W., Peeters, Geeske, Heesch, Kristiann C., & Brown, Wendy J. (2013). Sitting-time, physical activity, and depressive symptoms in mid-aged women. American Journal of Preventive Medicine, 45(3), 276-281. doi: 10.1016/j.amepre.2013.04.009

World Health Organization. (2011). Global Recommendations on Physical Activity for Health. Retrieved March 13, 2014, from http://whqlibdoc.who.int/publications/2010/9789241599979_eng.pdf?ua=1