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Title

**The Association between Physical Activity Levels and Neurodegenerative
Disease among Elderly in the United States**

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Abstract

Objective: The aim of this study was investigating the relationship between participating in Vigorous, Moderate, and Mild Physical Activity and the risk of dementia and Alzheimer's among older adults.

Methods: The survey data from the years 2020 of Health and Retirement Study Consumption and Activities Mail Survey (HRS CAMS) was used. The HRS CAMS includes some information of demographic characteristics, frequency and intensity of physical activity, and medical background including dementia and Alzheimer's diseases. A regression model was used to test whether vigorous, moderate, and mild physical activity was associated with dementia and Alzheimer's.

Results: The sample (n = 8806) was predominantly female (54.7%) and white (60.8%) with a mean age (SD) of 70.4 years old. When controlled for covariates, the findings showed Vigorous PA were more likely to have 18 percent higher Alzheimer's. Similarly, those who did not participate in Vigorous PA was associated with 15 percent higher chance of dementia.

Conclusions: We observed a significant association between vigorous, moderate, and mild physical activity and dementia and Alzheimer among older adults. Moreover, we figured out that those people who are not active physically are more likely to get Alzheimer's and dementia. Based on the results of this study, promotion of PA might reduce the risk of dementia and Alzheimer's in older adults.

Key Words: Physical Activity, Neurodegenerative Disease, Alzheimer's, Dementia

Introduction

Over the past few years, as the population ages, the percentage of people with mild cognitive impairment (MCI) or dementia has steadily increased. Recent data has shown, more than 46 million people are suffering from dementia and Alzheimer's worldwide and it is predicted this number will be reached 131.5 million by 2050 (Prince et al., 2015). Social and economic implications of this rapid increase are expected to be significant not only on individual patients and their families but also on health systems worldwide (Radak et al., 2010; Winblad et al., 2016). There are some protective factors including physical activity that can reduce the risk of degenerative diseases.

The importance of being active during aging has been expressed by many and the WHO has developed physical activity guidelines specific to elderly (WHO, 2020). As we age, physical activity can prevent physical and cognitive impairment and improve control (Olsen, et al. 2015). Individuals with dementia or Alzheimer's are active physically less than their cognitive-healthy peers. Reasons for this are multifaceted, and are thought to be social, psychological, and physiological. Usually, Individuals with dementia or Alzheimer's are supposed to use some

services such as home care, day care centers and nursing homes, and depending on the stage of the disease, they have less or more dependence on others to participate in activities. To develop suitable services for people with dementia or Alzheimer's, their physical activity needs, and preferences must be recognized (Telenius et al, 2022).

Physical activity is one potential prevention factor for dementia and Alzheimer's and in several epidemiological studies has been demonstrated to have an inverse association with dementia incidence (Verdelho, Madureira, Ferro; 2012). Jia, et. al, 2019 & Forbes, et. al, 2015 also have shown that physical activity can be particularly important for individuals with dementia and Alzheimer's. While to some extent unclear, the literature suggests that physical exercise can affect balance, gait functioning, and the symptoms of cognition and behavioral and psychological experiences by this group of patients. It has been found that outdoor activities contribute to the well-being and self-esteem of dementia or Alzheimer's patients (Olsson et al, 2013). Also, the social aspect of physical activity is important to many for instance Surr in 2006 showed that social relationships play an important role in self-maintenance. Some reviews have also shown that in older adults, an increased physical activity level, including a low amount of light-intensity of physical activity (LPA), was associated with a reduced risk of dementia (Minijae, et al. 2021).

Although existing research has shown a significant relationship between PA and dementia and Alzheimer's, limited studies focus on how level physical activity can affect neurodegenerative diseases. This study assesses how vigorous, moderate, and mild physical activity can impact the risk of dementia and Alzheimer's. It is expected older adults who have more moderate and vigorous PA activity are less likely to report dementia and Alzheimer's.

Method

For this study Health and Retirement Study (HRS) data was used which is a longitudinal survey of households with at least one adult over 50 years of age which is nationally representative. The survey is supported by the National Institute on Aging (NIA U01AG009740) and has been led by the University of Michigan since 1992. Every two years, survey components are completed (in person or by telephone), resulting in a sample of approximately 20,000 respondents with an overall response rate of more than 80%. First, the study looked at the effects of health, family, and economic variables during the transition to retirement. Demographics, health care utilization, work situation, family structure, mental and physical health and finances are all included in the survey. Deidentified data are available for download from the HRS website (<https://hrs.isr.umich.edu/data-products>). In the present study, we used data from the biennial core survey in 2020, and we included people over 65.

Statistical Analysis

For the statistical analysis, table 1 shows the descriptive results which is the combination of mean and average of variables in the study. Additionally, logistic regression was used to measure the associations between PA variables and outcome variables (i.e., ALZAND DEM). The odds ratios for each explanatory variable with the P-value were presented at the 95% confidence interval to estimate the precision of the odds ratios.

Measures

Independent Variables

The independent variables of this study were vigorous, moderate, and mild physical activity and their different levels which including high, low, medium, no. Vigorous physical activity was defined by the question "How often do you take part in sports or activities that are vigorous, such running or Jogging, swimming, cycling, aerobics or gym workout, tennis, or digging with a spade or shovel? "And more than once a week coded as High, once a week coded as Medium, one to month coded as Low, or hardly ever or never coded as No". Moderate physical activity was defined by the question "How often do you take part in sports or activities that are moderately energetic such as, gardening, cleaning the car, walking at a moderate pace, dancing, floor or stretching exercises? "And more than once a week coded as High, once a week coded as Medium, one to month coded as Low, or hardly ever or never coded as No". Mild physical activity was defined by the question "How often do you take part in sports or activities that are mildly energetic, such as vacuuming] laundry, home repairs?" "And more than once a week coded as High, once a week coded as Medium, one to month coded as Low, or hardly ever or never coded as No".

Dependent Variables

This study has two main independent variables. First, is Alzheimer's Disease (AD) diagnosis. The respondents were asked, "Since we last asked you has a doctor told you that you have Alzheimer's Disease?". Those who answered "yes" were coded for ADs patients. For dementia, they were asked, "Since we last asked you, has a doctor told you that you have dementia, senility or any other serious memory impairment?". Patients who answered "yes" were coded as having dementia.

Covariates

Potential confounding variables related to frequency of physical activity and demographic variables and important health-related factors. Demographic variables are age, sex, race, and years of education. Health-related factors confounders were self-reported eyesight, smoking status self-rated health.

Finally, the survey asked a more general question for the memory problem, which was "Are you taking any medication prescribed by a doctor to help with your [Alzheimer's disease/dementia, senility or memory impairment/memory problems]?". People who answered "yes" to the question were also coded using a memory prescription.

Results

Among 8806 participants in this study, just 1.5% has Alzheimer's, and 2.5% were with dementia. Nearly 60 percent of the whole sample reported did not take part in sports or activities that are vigorous, and 37 percent participated in high moderate PA, and almost 41 percent participated in high mild PA. In terms of neurodegenerative disorder, 2.5, and 1.5 percent of the participants, had dementia and Alzheimer's respectively, and less than 2 percent of the sample reported using medicine for neurodegenerative diseases. The mean age was 70.4 with 54.7 percent females, mostly White (60.7 percent) with 44.6 percent high school education.

Table 1: Descriptive Analysis

	Overall (N=8806)
Dementia	
No	8587 (97.5%)
Yes	219 (2.5%)
Alzheimer's	
No	8678 (98.5%)
Yes	128 (1.5%)
Vigorous PA	
High	1752 (19.9%)
low	871 (9.9%)
Med	957 (10.9%)
No	5226 (59.3%)
Moderate PA	
High	3291 (37.4%)
low	1074 (12.2%)
Med	1392 (15.8%)
No	3049 (34.6%)
Mild PA	
High	3626 (41.2%)
low	769 (8.7%)
Med	2234 (25.4%)
No	2177 (24.7%)
Prescription for Alzheimer's Disease	
No	8725 (99.1%)
Yes	81 (0.9%)
Prescription for Neurodegenerative Disease	
No	8633 (98.0%)
Yes	173 (2.0%)
Age	
Mean (SD)	70.4 (10.1)
Median [Min, Max]	68.0 [37.0, 106]
Gender	
Female	4818 (54.7%)
Male	3988 (45.3%)
Race	
Black	2286 (26.0%)
Other	1170 (13.3%)
White	5350 (60.8%)
Educational Levels	
College and more	3508 (39.8%)
High School	3932 (44.7%)
Less than High School	1366 (15.5%)

Table 2. Logistic regression models

	Alzheimer's		Dementia	
	Model 1	Model 2	Model 1	Model 2
Vigorous High (Ref)				
low	1.00	1.00	1.01	1.00
Med	0.99	1.00	0.99	1.00
No	1.18 ***	1.13 *	1.15 ***	1.12 *
Moderate High (Ref)				
low	1.02	1.01	1.00	1.00
Med	0.99	1.00	0.99	1.00
No	1.12 ***	1.09 *	1.11 ***	1.08 *
Mild High (Ref)				
low	1.01	0.99	1.00	1.00
Med	0.99	1.00	0.99	1.00
No	1.07 ***	1.14 *	1.11 ***	1.09 *
Prescription for Alzheimer's Disease No (Ref)				
Yes	0.99	2.70 ***	1.04	0.36 ***
Prescription for Neurodegenerative Disease No (Ref)				
Yes	0.99	0.98 *	1.03	2.64 ***
Age				
Median [Min, Max]	1.01	1.00	0.97	1.00
GENDER, Female (Ref)				
Male	0.97	1.04	0.98	0.99
RACE, White (Ref)				
Black	0.98	0.99	1.00	0.98
Other	0.99	0.95	0.99	0.97
Educational Levels, College and more (Ref)				
High School	1.02	0.97	0.99	0.97
Less than High School	0.98	0.99	1.02	0.99

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'

In the adjusted model for Alzheimer's, the findings indicated that those who did not have a Vigorous PA were more likely to have 18 percent higher Alzheimer's. Similarly, those who did not participate in Vigorous PA was associated with 15 percent higher chance of dementia. And also, those participants who did not take part in Moderate PA had higher likelihood of Alzheimer's and dementia respectively 12 percent and 11 percent. The unadjusted model for Alzheimer's showed that participants without Mild PA had 14 percent higher chance of getting Alzheimer's and this rate for dementia was reported by 0.09 percent. Those who took medication for Alzheimer's reported that they had 170 percent higher risk of Alzheimer's while using Alzheimer perception as a protective factor to reduce the likelihood of dementia 64 percent.

Discussion

The aim of this study was investigating the relationship between participating in Vigorous, Moderate, and Mild PA and dementia and Alzheimer's among older adults. The result showed no participation in PA increases the likelihood of dementia and Alzheimer's among older people with neurodegenerative diseases. Nearly 60 percent of the whole sample reported did not take part in sports or activities that are vigorous, and 37 percent participated in high moderate PA, and almost 41 percent participated in high mild PA. Approximately 2% of the sample was diagnosed with dementia and Alzheimer's, and only 1% of them took medicines for neurogenerative conditions. Individuals with dementia and Alzheimer's face additional barriers to being physically active. Examples are confusion and memory problems, dependence on others and lack of access to dementia-focused exercise programs (Telenius, 2020). Since physical inactivity is one of the main risk factors for frailty and mortality, it is essential to reduce barriers and facilitate their participation in physical activities (Hoogendijk et al, 2019). Similar to the results of previous studies this study has shown that not participating in Vigorous, Moderate, and Mild PA increase the likelihood of getting dementia and Alzheimer's among older adults. These results are in line with previous studies which said in older adults, an increased physical activity level, including a low amount of light-intensity of physical activity (LPA), was associated with a reduced risk of dementia (Minijae, et al. 2021). Moreover Kouloutbani, et al. 2021, have demonstrated that there is clear evidence that physical activity and especially aerobic exercise may be effective in the management of neuropsychiatric symptoms (NPS). In terms of medications, this study showed Alzheimer's medications were significant for protection to decrease likelihood of dementia.

The advantages of this study include a well-characterized sample of older adults and information on neurodegenerative medications. This study is limited to one homogeneous sample. This sample of the elderly was mainly white and well-educated. Another possible limitation of the study is the use of self-reported measures of participating in PA. Even though all participants were cognitively normal (CDR 0) and doing PA ascertainment methods were intensive, underreporting of participating in PA cannot be ruled out. Although strategies were used to aid in recalling participating in PA and sports events, underreporting of doing sports is more likely with recurrent participation in PA. The last point that can be mentioned as the limitation of this study is related to the education of participants since most of our participants were those with lower educational levels.

Despite limitations, this study points to the importance of understanding neurodegenerative diseases were associated with participating in Vigorous, Moderate, and Mild PA. It is necessary to conduct additional research to determine the association between prescription for neurodegenerative disease among younger adults to determine the mechanism that causes being inactive physically in each group. Continuing research could provide a better understanding of how dementia and Alzheimer's present clinically and of underlying mechanisms that cause

being inactive physically. Moreover, in the future studies can be done in the individuals with higher levels of education.

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