DOES A DEMENTIA DIAGNOSIS INCREASE THE LIKELIHOOD OF EXERCISING?

Introduction

The American population is aging at an accelerated pace. As a consequence, the prevalence of age-associated chronic diseases is also expected to correspondingly surge. Dementia is a progressive, irreversible disease of particular concern because it affects memory and cognition and eventually leads to a loss in independent functioning. Persons with dementia show a high utilization of health services and represent a significant fraction of healthcare costs, in part because they are also likely to have multiple comorbidities, including stroke and depression.[1, 2]

Although the exact mechanisms are still unknown, experimental research in animals and humans indicates that regular physical activity may promote the maintenance of grey matter brain volume, and slow the rate of cognitive decline among older adults with dementia.[3] Previous literature also provides evidence on numerous non-cognitive benefits of exercise among dementia patients, including a reduction in fall risk and positive improvements in mood and anxiety.[4,5] Some studies even find an association between high levels of physical activity and prolonged survival among those with Alzheimer's disease.[6] Despite health benefits, while several studies have investigated the role of physical *in*activity as a risk factor for dementia, very few studies have examined whether receiving a dementia diagnosis alters the future probability of engaging in physical activity.

In this paper, we use seven waves of longitudinal data (2011-2017) from the National Health and Aging Trends Study (NHATS) to investigate whether individuals who received a recent dementia diagnosis are more likely to start walking for exercise purposes than those without such a diagnosis. Conceptually, a dementia diagnosis can modify the likelihood of engaging in physical activity through two channels: First, the American Academy of Neurology guidelines recommend that health care providers counsel patients to walk or engage in other forms of light exercise as a strategy to reduce problem behaviors associated with dementia.[7] Therefore, physician recommendations may serve as a trigger motivating a recently diagnosed older adult to adopt a more active lifestyle. Support for this conceptual premise is found in a study conducted by Keenan (2009), [8] which documented that new diagnoses of diseases such as cancer, stroke, diabetes, heart or lung disease improve the odds of quitting smoking and reducing BMI among adults below 75 years of age.

On the other hand, many people with dementia are prone to wandering behaviors and disorientation even at early stages of the disease.[9] Functional limitations and the presence of other comorbidities can also make vigorous activity difficult and dangerous.[4] Consequently, it is possible that, perceiving safety concerns, caregivers of newly diagnosed dementia patients potentially discourage older adults from going out for walks or practicing other forms of physical activity. Thus, the net impact of a dementia diagnosis on physical activity practice among older adults is theoretically ambiguous, and ultimately an empirical question.

This work makes three contributions. First, from the perspective of successful aging, the results of this study can indicate whether a dementia diagnosis presents a window of opportunity that prompts older adults to modify health habits as they age. This is especially relevant given the large prevalence of sedentary lifestyles among older adults in the U.S.[10]

Second, by examining changes in behavior immediately following a diagnosis, the findings of this study can also encourage subsequent research on consistency in physician recommendations relating to dementia, patient adherence to these recommendations as well as development and provision of physical activity interventions during the time of an adverse event like a disease diagnosis.

Third, in addition to being relatively sparse, existing literature in this area has mainly examined the emotional and financial impacts of receiving a formal dementia diagnosis among patients and their caregivers.[11-14] Though there do exist a few studies focusing on the association between physical activity and mild cognitive impairment, most of these are cross-sectional in nature.[15, 16] To our knowledge, this study is the first to use longitudinal data to examine whether receiving a dementia diagnosis leads to greater engagement in physical activity practice among older adults.

Data and Methods

This study analyzed data from NHATS, a nationally representative, ongoing longitudinal survey of older adults enrolled in Medicare. All respondents are 65 years or older when they enter the survey. The first NHATS survey was conducted in 2011 and has continued annually thereafter. The original NHATS sample was replenished in 2015.

Sample

The sample created from the NHATS spans seven waves (2011-2017). It includes all individuals who are observed over at least three consecutive waves: first wave (w), second wave (w+1) and third wave (w+2), and is restricted to those who:

1) Responded "no" to the following question in the first wave: "*In the last month, did you ever go walking for exercise?*"
2) Responded "no" to the following question in the first wave: "*Has a doctor ever told you that you had dementia or Alzheimer's disease?"*

Essentially, the unit of observation is person-years; each observation spans three years and the sample includes individuals who report not walking for exercise and no formal dementia diagnosis in the first wave (w).

Because the NHATS is an annual survey, the time period from first wave (w) to third wave (w+2) is a two-year window. An individual can have a maximum of five person-wave observations: the earliest can occur when third wave equals 3 (2013) and the latest can occur when third wave equals 7 (2017).

Outcome and New Dementia Diagnosis

The outcome of interest, change in physical activity practice, was measured as a binary variable defined as "1" if a sample individual in the third wave (w+2) reported that they did go walking for exercise in the last month and "0" otherwise. The main independent variable in the analysis, "*dementia diagnosis*" is also a binary variable that equals "1" if the sample respondent reported a positive dementia diagnosis in the second wave (w+1). We call this the treatment group. *Dementia diagnosis* equals "0" if the sample individual did not receive a formal dementia diagnosis in the second wave (w+1). This is the "comparison group." To ensure that dementia diagnosis is preceded by any change in physical activity among treatment group members, we measure change in physical activity status between the third (w+2) and first waves (w), and the change in dementia status between the second (w+1) and first waves (w).

Other variables included in the analysis: respondent's age at diagnosis, education, race, any other new diagnoses in the second wave (stroke, cancer, lung disease, heart disease or diabetes), difficulties in completing activities of daily living (ADL) and instrumental activities of daily living (IADL), and subjective health status. After deleting cases with incomplete information, there remained 7,767 person-wave observations (3,704 unique observations).

Preliminary Estimation and Results

The analysis compared changes in physical activity status (as measured by whether the respondent went walking for exercise purposes in the last month) in older adults over three years encompassing a new dementia diagnosis in the second wave compared with changes in older adults with no analogous dementia diagnosis in the second wave. Changes in physical activity were assessed relative to changes in individuals without a dementia diagnosis to account for any secular changes in the population at-large. This analysis was run as a logit regression, with coefficients displayed (see Table 1) as odds ratios. In all analyses, standard errors were clustered to account for correlation across multiple observations in the sample.

Overall, 29% of the observations reported walking in the third wave. Approximately 2% of them reported receiving a clinical diagnosis of dementia in the second wave. The mean age in our sample was 80 years. About 74% of the sample was white, 63% was female. While 35% of the observations reported receiving help with IADLs, about 24% reported receiving help with ADLs. About 13% of the sample reported an additional new diagnosis other than dementia in the second wave. The proportions for IADL and ADL needs and new diagnoses other than dementia were significantly higher in the treatment group as compared to the control group.

For the entire sample, though positive, we find no statistically significant effect of receiving a new dementia diagnosis on the odds of engaging in physical activity. However, the odds of engaging in physical activity varied by race and gender. Specifically, in subgroup analysis, we find that, compared with individuals with no new dementia diagnosis, the odds of engaging in physical activity were approximately 1.5 times greater among whites ($P<0.10$) and almost twice as large among white females ($P<0.01$). Among men and non-whites, the odds of engaging in physical activity were generally lower in the treatment group as compared to the control group.

With regard to other covariates we found a similar pattern across all our models. Specifically, age, presence of IADL and ADL needs, and poor health negatively predicted engagement in physical activity. On the other hand, having a graduate education and, in some cases, the presence of a new diagnosis other than dementia positively predicted engagement in physical activity (thus confirming previous analysis by Keenan (2009) that examined the effect of new diagnoses on other healthy behaviours like smoking cessation and reduction in BMI among individuals younger than 75). In additional analysis, we stratified the sample by age categories and by the presence of other new diagnoses. However, in both cases, we did not find a statistically significant effect of a new dementia diagnosis on engagement in physical activity.

Our results suggest that, unlike previous findings on other new diagnoses, a new dementia diagnosis does not prompt older adults to engage in self-induced healthy behaviours. However, this effect appears to be moderated by race and gender. It is possible that we find the strongest effects among white women because approximately 40% of the treatment group was comprised of white women. In the next set of estimations, we also plan to construct a more accurate and consistent measure of engaging in physical activity. Specifically, instead of restricting our sample only to those who were not walking for exercise purposes in the first wave, we will now restrict the sample to those were not walking in both the first and the second waves. Change in physical activity engagement will be measured as before in the third wave. In an effort to create a matched comparison groups, we will also consider comparing the treatment group to individuals ascertained by NHATS to have probable dementia. Finally, we will also examine the effect of a new dementia diagnosis on other outcomes like change in BMI and probability of engaging in vigorous activity.

Table 2: Effect of dementia diagnosis on physical activity

Dependent variable: [Walking (w+2) - Walking (w)]

Independent variables	All	Women	Men	White	Non-white	White women	Non-white women	White men	Non-white men
Dementia diag	1.24	1.41	0.96	1.47 +	0.79	1.97 **	0.56	0.81	1.46
	(0.22)	(0.30)	(0.30)	(0.30)	(0.28)	(0.49)	(0.27)	(0.30)	(0.87)
White	1.04	1.14	0.92						
	(0.07)	(0.10)	(0.11)						
Female	0.94			0.99	0.80 +				
	(0.06)			(0.07)	(0.10)				
Age	0.98 ***	0.98 **	0.98 **	0.98 ***	0.98 *	0.98 *	0.98 +	0.98 *	0.97 +
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
High school	0.82 *	0.69 ***	1.10	0.84 +	0.75 +	0.71 **	0.64 *	1.15	0.96
	(0.07)	(0.07)	(0.15)	(0.09)	(0.12)	(0.09)	(0.14)	(0.19)	(0.25)
Some college	0.91	0.91	0.87	0.93	0.87	0.95	0.83	0.87	0.92
	(0.07)	(0.09)	(0.12)	(0.09)	(0.14)	(0.12)	(0.16)	(0.14)	(0.25)
College	1.11	1.03	1.25	1.14	1.10	1.04	1.07	1.33	1.01
	(0.12)	(0.15)	(0.21)	(0.14)	(0.26)	(0.17)	(0.32)	(0.25)	(0.45)
Graduate	1.37 **	1.42 *	1.38 +	1.43 **	1.25	1.37 +	1.65	1.53 *	0.78
	(0.16)	(0.22)	(0.23)	(0.19)	(0.32)	(0.17)	(0.51)	(0.29)	(0.34)
New diagnosis	1.15 +	1.06	1.33 *	1.15	1.16	1.06	1.06	1.32 *	1.41
	(0.09)	(0.11)	(0.15)	(0.10)	(0.18)	(0.13)	(0.22)	(0.17)	(0.36)
IADL	0.85 *	0.74 ***	1.14	0.85 +	0.84	0.71 **	0.81	1.29	0.88
	(0.06)	(0.07)	(0.15)	(0.08)	(0.12)	(0.08)	(0.15)	(0.21)	(0.20)
ADL	0.90	0.99	0.76 +	0.92	0.85	1.06	0.88	0.74 +	0.83
	(0.07)	(0.10)	(0.11)	(0.09)	(0.13)	(0.13)	(0.16)	(0.12)	(0.21)
V. good health	1.25 ***	1.30 **	1.15	1.27 ***	1.19	1.35 **	1.10	1.12	1.36
	(0.08)	(0.11)	(0.12)	(0.09)	(0.17)	(0.13)	(0.20)	(0.13)	(0.34)
Fair health	0.82 **	0.86	0.73 **	0.81 *	0.82	0.85	0.87	0.72 *	0.75
	(0.06)	(0.08)	(0.09)	(0.07)	(0.11)	(0.10)	(0.15)	(0.10)	(0.17)
Poor health	0.59 ***	0.53 ***	0.66 *	0.58 ***	0.62 *	0.48 ***	0.66	0.72	0.58 +
	(0.07)	(0.08)	(0.13)	(0.09)	(0.13)	(0.09)	(0.18)	(0.17)	(0.19)
Constant	1.66	1.50	2.04	1.50	2.82	1.57	2.03	1.66	4.20
	(0.56)	(0.63)	(1.13)	(0.58)	(1.93)	(0.77)	(1.67)	(1.03)	(5.15)
	7,767	4,916	2,852	5,716	2,051	3,554	1,362	2,162	689

Cluster robust standard errors (CRSE) in parentheses. + p <0.10, * p<0.05, **p<0.01, *** p<0.001. Coefficients represent Odds Ratios

1. Hurd MD, Martorell P, Langa KM. Monetary costs of dementia in the United States. N Engl J Med. 2013 Aug 1;369(5):489-90.
2. Barnes DE, Yaffe K. The projected impact of risk factor reduction on Alzheimer's disease prevalence. Lancet Neurol. 2011;10:819-828
3. Heyn P, Abreu BC, Ottenbacher KJ. The effects of exercise training on elderly persons with cognitive impairment and dementia: a meta-analysis. Archives of Physical Medicine and Rehabilitation 2004;85(10):1694-1704.
4. Ahlskog JE, Geda YE, Graff-Radford NR, Petersen RC. Physical exercise as a preventive or disease-modifying treatment of dementia and brain aging. Mayo Clin Proc. 2011 Sep;86(9):876-84.
5. Potter R, Ellard D, Rees K, Thorogood M. A systematic review of the effects of physical activity on physical functioning, quality of life and depression in older people with dementia. International Journal of Geriatric Psychiatry 2011;26(10):1000-11.
6. Scarmeas N, Luchsinger JA, Brickman AM, et. al. Physical activity and Alzheimer disease course. American Journal of Geriatric Psychiatry 2011; 19(5):471-81.
7. American Academy of Neurology. Detection, diagnosis and management of dementia. AAN guideline summary for clinicians [cited 2018 Sep 14]. Available from: http://tools.aan.com/professionals/practice/pdfs/dementia_guideline.pdf
8. Keenan PS. Smoking and weight change after new health diagnoses in older adults. Archives of Internal Medicine. 2009;169(3):238-42.
9. Alzheimer's Association. Wandering [cited 2018 Sep 18]. Available from: https://www.alz.org/help-support/caregiving/stages-behaviors/wandering
10. Harvey JA, Chastin SF, Skelton DA. Prevalence of sedentary behavior in older adults: a systematic review. Int J Environ Res Public Health. 2013 Dec 2;10(12):6645-61.
11. Aminzadeh F, Byszewski A, Molnar FJ, Eisner M. Emotional impact of dementia diagnosis: exploring persons with dementia and caregivers' perspectives. Aging Ment Health. 2007 May;11(3):281-90.
12. Boustani M. Dementia Screening in Primary Care: Not Too Fast!. J Am Geriatr Soc. 2013 Jul; 61(7): 1205–1207.
13. Arora K. How does dementia onset in parents influence unmarried adult children's wealth. Soc Sci Med. 2016 Mar;152:156-65.
14. Carpenter B, Dave J. Disclosing a dementia diagnosis: a review of opinion and practice, and a proposed research agenda. Gerontologist. 2004 Apr;44(2):149-58.
15. Morgan et al. Self initiated health behaviors following a diagnosis of mild cognitive impairment. Res Gerontol Nursing. 2012;5(2):94-100
16. Chao S. Health behavior changes after genetic risk assessment for Alzheimer disease: the REVEAL study. Alzheimer Dis Assoc Disord. 2008;22(1):94-7