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Continuity of Care and Functional Decline among Older Adults with Alzheimer's Disease and Related Dementias

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An abstract of
A thesis submitted to the Faculty of the
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Abstract

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Alzheimer's disease and related dementias (ADRD) are debilitating conditions that impair cognitive and functional health among older adults. As ADRD progresses, older patients with ADRD need increasingly more help with activities of daily living (ADL) and eventually need to depend solely on families and/or caregivers for basic functionality. While current treatment and drugs have foundered, the pattern that a person with ADRD receives care presents potential opportunities in managing functional difficulties and delaying the occurrence of functional decline. Continuity of care (COC) provides a patient with a more concentrated visit pattern with their health care providers. Current literature has examined the relationship between COC and healthcare utilization and expenditures, while few have investigated the association between COC and experiencing functional decline. Furthermore, only one study has examined COC among older adults with ADRD, which is a rapidly growing and vulnerable population. Therefore, this study aims to fill the gap in current literature by looking at the impact of COC on experiencing functional decline within one-year time lag among older adults with ADRD.

This study used the Medicare Current Beneficiary Survey (MCBS) 2006-2012 to examine the impact of COC at baseline on experiencing any functional decline in the subsequent year among older adults with ADRD. COC was measured by the Bice-Boxerman index and categorized into three levels (low, medium, and high) based on its distribution within the study sample, and the outcome variable functional decline was defined as having more difficulties in ADL or instrumental ADL (IADL) within the one-year time lag than at baseline.

This study did not find a statistically significant impact of COC on experiencing functional decline among the complete study sample ($n = 2{,}009$). However, among those without difficulties in ADL at baseline, a higher level of COC was associated with a 7.5% lower incidence of experiencing functional decline in ADL within the one-year time lag. Additionally, the involvement of PCPs in treatment was shown to decrease the likelihood of experiencing functional decline in IADL within one year by 25.8%. The findings of this study highlight the importance of COC during treatment for older adults with ADRD. Better COC is beneficial for older patients without functional difficulties through preventing and/or delaying functional decline. The implication of this study could serve as evidence to motivate Medicare fee-for-service beneficiaries' participation in Medicare Annual Wellness Visit for detections of signs of ADRD and for developing/updating personal prevention plan for diseases and disabilities.

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1 INTRODUCTION

Alzheimer's disease (AD) and related dementia (ADRD) is a progressive and degenerative brain disorder that slowly and irreversibly destroys the cognitive function of the patient.[1] AD is now ranked as the sixth leading cause of death in the United States.[1] There are currently 5.8 million Americans living with AD; one in every eight persons over 65 years old is estimated to have AD,[2] and this number is projected to rise to nearly 14 million by 2050.[1] AD is the most common cause of dementia among older adults. Dementia is defined as the loss of cognitive functioning and behavioral abilities that interferes with a person's thinking, memory, reasoning, and their activities of daily living (ADL).[1] Individuals with ADRD require "significant amounts of health care and intensive long-term services and supports".[3] The severity of dementia ranges from the mildest stage, when it starts to affect a person's functioning, to the most severe stage, when the person must rely solely on others (families and/or caregivers) for basic ADL.

As the disease progresses, older patients with ADRD need increasingly more help with basic ADL, such as bathing, toileting, eating, dressing and etc.[1] Maintaining quality of life and maximizing function in daily activities for as long as possible are two of the primary goals for ADRD treatment.[4] Eventually, the patient will not be able to carry out basic bodily functions and daily activities, such as walking, swallowing and etc.[1,5] ADRD is ultimately fatal and patients in the final stages of ADRD require "around-the-clock care."[5]

The healthcare cost associated with long-term care and treatment for ADRD is also substantial, with functional impairments being a strong predictor of high individual healthcare payments.[6,7] The total payments for all individuals with ADRD or other dementias are estimated at $290 billion in 2019.[6,7] Average per-person Medicare payments for services to beneficiaries age 65 years or older with ADRD and other dementias are more than three times as great as payments for beneficiaries without these conditions.[8] Studies have shown that functional capacity has a significant effect on the patients' quality of life, and Jutkowitz et al. (2017) have estimated that if the rate of functional decline among older adults with ADRD reduces by 10 percent, it would reduce average per-person lifetime costs by $4,122 in 2018 dollars.[9]

Despite the rapid growth of older population with ADRD, the lack of effective treatment for ADRD has posed unique challenges for the patients, families and/or caregivers, and the society.[4] Currently, there is still no cure for ADRD and no treatment that can slow the progression of ADRD.[4] Drug and non-drug treatments may minimally help with both cognitive and behavioral symptoms,[2] but they don't affect the underlying disease.

Older adults with ADRD receive health care services from a wide range of professional care providers during the trajectory of ADRD because of their co-occurring chronic conditions, presenting risks of miscommunication, and duplication of care and interventions.[10,11] It is estimated that an average Medicare beneficiary sees seven physicians in four different practices annually, and communication between physicians is generally poor.[12–15] The impaired communication and discontinued care could potentially threaten the quality of care for ADRD.[16] A higher level of continuity of care (COC) can provide patients with a more concentrated visit pattern across their visits with their health care providers including both primary care physicians (PCPs) and disease-relevant specialists. Therefore, COC at the level of the medical care provider may be particularly important for "building provider-patient-family relationship, addressing goals and expectations of care over time, understanding patients' cognitive conditions and stages of ADRD, and recognizing and appropriately managing acute and chronic conditions."[16] If a patient with ADRD goes to the same physicians repeatedly, the continuity allows the physician to develop and implement an individualized care plan that can better address goals and expectations of care and manage his/her progression of ADRD more appropriately over time.

Because of medical complications that older adults with ADRD have, COC could play a key role in preserving functionality, and thus increasing quality of life and delaying high medical expenses. At the same time, these patients are potentially in need of specialist care, which can disrupt care continuity. Current evidence of the role of COC and functional health is mixed. Three studies have examined the association between COC and functional health status.[17–19] Among these studies, two studies find no significant association[17,18], while one meta-analysis study finds that COC is significantly associated better physical and functional health status among older adults with chronic conditions[19].

In this study I examine whether COC is associated with the preservation of function among older adults with ADRD. In addition, I examine whether disease relevant specialist involvement has an effect on preservation of function. I employ a nationally representative sample of the Medicare fee-for-service (FFS) beneficiaries from the Medicare Current Beneficiary Survey (MCBS) in 2006 – 2012. Additionally, I consider whether these effects differ by functional status at baseline.

2 LITERATURE REVIEW

Patient continuity of care (COC) has been a frequently studied construct in health services research since the 1980s[18], which describes how the encounters between a patient and their physicians are connected over time.[18,20–22] Current researches on COC focuses more on the association between COC and inpatient utilization and/or emergency department visits among people with multiple chronic conditions, while few studies look at the impact of COC on experiencing functional decline and conclusions upon the association are rather mixed.[18,23,24] Studies looking at the association between COC and experiencing functional decline have defined and measured COC differently. Variations in conceptualizing functional health status also contribute to the differences in measurements of functional difficulties in current research. This chapter will provide the background of functional decline and COC among older adults with ADRD, discuss published researches, and present the significance and justification of this study.

2.1 Functional Decline among Older Adults with ADRD

ADRD has been recognized as a major cause of functional impairment.[25] As ADRD progresses, both cognition and functional abilities decline, and the pace of the decline advances from mild to severe.[1] Cognitive deterioration resulting from ADRD also has significant repercussions on a patient's ability to function in activities such as meal preparation and grocery shopping.[5] In more advanced stages of ADRD, patients need increasingly more help with ADLs, lose their ability to communicate, fail to recognize their families, and eventually become completely dependent on "around-the-clock care."[1] When individuals have difficulties in functionality, especially moving, they are shown to be more likely to be vulnerable to infections, causing further complications in treatment.[1]

Beside infections and complications in treatment for patients with ADRD, functional impairment has further been shown to exert a significant effect on the quality of life in several domains. Barbe et al. (2017) assessed the association between functional alterations and/or decline with quality of life among older adults with ADRD and other dementias in seven French hospitals. The study found that there is a significantly positive association between the ability to transfer in home and to use the telephone with an ADRD patient's confidence in themselves, feelings of accomplishment, and capability of making their own decisions.[26] The ability to get dressed without assistance is associated with higher quality of life regarding negative feelings such as loneliness, anger, irritation, and etc.[27] Difficulties and decline in functionality can exert a negative impact on the quality of life among the older adults with ADRD.

2.2 Continuity of Care for Older Adults with ADRD

Health care for older adults with ADRD is often complicated by their co-occurring chronic conditions, preventing a better level of COC. Evidence suggests that there is a higher prevalence and a greater burden of comorbidities (such as diabetes or stroke) among older adults with ADRD than among those without these conditions.[28–30] The majority of older patients with ADRD receive health care for ADRD and their co-occurring conditions in the ambulatory setting, which is often fragmented.[16,31,32] An average Medicare beneficiary is estimated to see seven physicians in four different practices annually, and the communication among physicians and between patients and physicians is generally poor.[12–15] The presence of ADRD complicates the quality of health care they receive. In the moderate stage of ADRD, a patient can start having behavioral and personality change such as suspiciousness, agitation, and aggressive behaviors. Ultimately, older patients with severe stage of ADRD will have limited functional status and constantly present behavioral disturbance.[5] If the behavioral symptoms associated with ADRD are more dominant than their medical comorbidities, it has been shown to contribute to lower quality of care through detracting the clinicians/physicians from managing co-occurring conditions.[28]

Although barriers exist to achieving a better level of COC among older patients with ADRD, previous research found a beneficial impact of COC on alleviating these barriers for higher quality of care in ADRD and other dementias through several mechanisms.[16] First, while the distrust between a patient with ADRD and their physician is one of the barriers towards achieving better quality of care, a patient’s trust in their physicians contributes to the effectiveness of medical care.[33] Mainous et al. (2001) conducted a cross-sectional survey of adult patients in outpatient primary care setting in the US and the UK.[33] They measured COC as the length of time for a patient’s relationship with their physicians and found that COC is associated with a higher level of trust between the patient and the physician.[33] Second, a collaborative and beneficial patient-provider relationship requires good communication, which serves as a key determinant for better quality of care.[34] Katz et al. (2014) found that reduced COC with a PCP can significantly decrease the quality of communication between patients and their physicians in the Veterans Administration (VA) outpatient primary care settings.[34] Third, a patient’s satisfaction with the health care they receive is predictive of the quality of care and their compliance with the care plan, and ultimately clinical outcomes.[35–37] Fan et al. (2005) found that self-reported COC is strongly associated with higher patient’s satisfaction in seven VA medical centers.[38]

2.3 Current Literature

Effectively and efficiently delaying and/or preventing functional decline among older adults is one of the longstanding public health policy goals in the US.[23,39,40] Research focusing on functional health has examined this construct differently over time. In addition, many studies define the construct of COC differently. There have only been two studies directly examining the effects of COC on functionality among the older population with multiple chronic conditions in the US, and both of these studies found no significant association between COC and having functional difficulties or experiencing functional decline.[18,23] Chen et al. (2017) conducted a meta-analysis which concluded that COC intervention is associated with better functional health status, however, the study synthesized data from four different places outside the US (Taiwan, Canada, UK, and Hong Kong), which might not be generalizable and applicable. Up to now (February 2020), only one study has examined COC among the older population with ADRD and other dementias, which assessed the association between patient COC and healthcare utilization and spending.[16]

2.3.1 Measurements of Focal Constructs

Functional health status is conceptualized as a person's "ability to perform self-care, self-maintenance, and physical activities".[41] The Katz index is one of the main and competing ordinal indices for assessing ADL and measuring a person's functional independence.[42] The Katz index is designed to assess the physical functioning of older and chronically ill patients, which includes six dichotomous ratings (dependent or independent) for each of the six ADL functions – bathing, dressing, going to the toilet, transferring from bed to chair, continence, and feeding.[43]

There is a diversity of COC indices in research examining COC as well, with each index defining COC differently. The variation of these indices rely on the definitions of COC that each index entails, such as the duration of provider relationship, density of visits, dispersion of providers, sequence of providers, or subjective estimates.[21] These indices were evaluated through either survey questions or through medical claims data. As the importance of assessing COC is stressed more in the health services research for evaluation of changes in health care reforms and healthcare delivery, multiple measures of COC using claims data have been developed.[44] Among all the indices using medical claims data, Bice-Boxerman COC index (BB index) is a claims-based measure and was found to be feasible to implement comprehensively and efficiently for large populations.[44] The BB index mathematically indicates the dispersion of unique physicians seen by each individual across their total count of Evaluation and Management (E&M) visits.[18,21,45] Based on the validation of the BB index from previous literature, this study utilized the BB index for measuring COC in the care process of older adults with ADRD.

2.3.2 Literature on COC and Functional Health

Wolinsky et al. (2011) studied the extent of long-term (an average of eight years) functional health decline among older Medicare beneficiaries from 1993 to 2007, which involved the impact of patient COC.[23] The study cohort was selected from a nationally representative Medicare beneficiaries participating in the Survey on Assets and Health Dynamics among the Oldest Old (AHEAD) in the US, and the survey data was further linked with Medicare claims data, which included both Medicare Fee-for-service (FFS) beneficiaries and Medicare beneficiaries in Managed Care (MA) plan. Functional health status was assessed through ADL, instrumental ADL (IADL), and mobility limitations, and the authors further defined functional decline as the development of two or more new difficulties in ADL or IADL over the study time period. IADL was defined as the activities related to independent living that are valuable for evaluating a person’s ability to care for themselves. COC was measured as a patient’s continuity with their PCP. If the time interval between a patient’s office visits with the same PCP was less than eight months, this was considered continued care, otherwise the patient was considered to not have COC. The percentage of days between baseline and the final follow-up survey interview for which COC existed was calculated to define extremes of always having COC and never having COC as compared to some level of COC. Multivariable logistic regression was estimated to evaluate the association between COC and functional health decline. However, the study concluded that COC with a PCP was not independently associated with functional decline.

Johnston and Hockenberry (2016) examined the effects of patient COC on the health outcomes of older adults with complex chronic conditions (type 2 diabetes and/or heart failure) who participated in the Medicare Current Beneficiary Survey (MCBS) from 2006 to 2012.[18] The health outcome of functional health status was measured as the count of difficulties in ADL and count of IADL done with difficulties. The study examined the association between COC and functional difficulties, but no statistically significant association was found. However, the involvement of disease-relevant specialist was shown to be associated with 9.7% and 8.6% lower incidence of ADLs and IADLs done with difficulties, respectively.

A meta-analysis conducted in 2017 combined seven studies from four different places – Taiwan, Canada, UK, and Hong Kong among older adults with chronic diseases.[24] The COC intervention was defined as the involvement of medical consultations, rehabilitation programs, home visits, telephone interview and tracking, and a detailed treatment summary covered in the hospital discharging plan services (DPS). Functional health status was measured through the dimensions of physical functioning, role functioning physical, and social functioning in the Quality of Life index. The chronic diseases among the study sample receiving COC interventions include stroke, cardiovascular disease, joint fractures, respiratory disease, and diabetes. The meta-analysis found that COC intervention can significantly improve physical function and social function among the older adults with these chronic conditions.

Current research examining the association between COC and functional health status have varied in the definitions and measurements of these focal variables. Wolinsky et al. (2011) is the very first research study considering the impact of a patient's continuity with their PCP on a dichotomous measurement of functional decline among older Medicare beneficiaries with multiple chronic conditions.[23] Johnston and Hockenberry (2016) further examined the impact of COC in terms of a patient's concentration of their visit with physicians on the count of difficulties in ADL and IADL. Although their study didn't find a significant association between COC and functionality, their innovation in including the division of physicians' involvement (PCP and disease-relevant specialists) has laid a foundation for further research on COC. The findings from Chen et al. (2017) added new conclusions on the association between COC and functional decline. However, their conclusions may not be applicable to the US based on their different definitions of COC and the systematic difference in healthcare systems providing care and treatment. The current empirical literature has contributed mixed conclusions and insights regarding the association between COC and functional decline, but they also have presented a need for further studies to examine the association among sub-population in the US.

2.3.3 Literature on COC among Older Adults with ADRD

Although there is no current literature looking at the association between COC and functionality among the older population with ADRD, one study has examined the association between patient COC with healthcare utilization and spending in older adults with ADRD.[16] Amjad et al. (2016) evaluated the association among a national sample of Medicare FFS beneficiaries by using the 2012 Medicare claims data. The construct of COC was measured by the BB index and then categorized into three levels – low, medium, and high. They used a multinomial logistic regression model with propensity weighting methods to assess the association between COC and healthcare utilization and spending. Medicare beneficiaries with lower level of COC were found to be younger, have higher income, and have more co-occurring conditions. Among all the Medicare beneficiaries with ADRD, increasing level of COC is associated with lower rates of hospitalization, emergency department visits, CT head scan, urinalysis, and healthcare spending. This study, however, was unable to control for reverse causality that acute events such as hospitalizations could potentially lead to lower level of COC. Although the study by Amjad et al. only focused on the impact of COC on healthcare utilization, the importance of COC among this specific population could be extended beyond health care utilization to the quality of care in ADRD and health outcomes among older adults with ADRD.

2.4 Summary

There is an absence of research on the relationship between COC and experiencing functional decline among older adults with ADRD. Given the lack of current literature in understanding this association between COC and experiencing functional decline among older adults with ADRD, this study aims to bridge the gap in the literature to examine the impact of COC at baseline on experiencing functional decline in the subsequent year among older adults with ADRD.

3 METHODOLOGY

3.1 Conceptual Framework

3.1.1 Theoretical Framework

To examine the association between COC at baseline and experiencing functional decline in the subsequent year among older adults with ADRD in the Medicare FFS plan, this study draws on the Donabedian's tripartite theoretical model (**Error! Reference source not found.**). Donabedian's model captures the *structure*, *process*, and *outcome* of medical care at the level of physician-patient interaction.[46] *Structure* identifies attributes of material resources, human resources, and characteristics of the organizations. *Process* captures a patient's activities in seeking medical care as well as physicians' activities in carrying out medical care. *Outcome* denotes the effects of medical care on both the individual- and population-level.[46,47] The Donabedian's model identifies linkage between *structure* and *process*[47], and between *process* and *outcome*, and the conceptual framework of this study develops on the Donabedian's model to further control for structural characteristics.

3.1.2 Focal Relationship

The focal relationship this study examines is COC at baseline and its association with experiencing functional decline in the subsequent year among older Medicare FFS beneficiaries with ADRD. This relationship can be conceptualized by the connection between *process* (COC) and *outcome* (having any functional decline) in the Donabedian's model. COC is defined as the relative concentration of a patient's visit pattern across the visits with each of his/her health care providers including both PCPs and disease-relevant specialists.[48] Functional health is defined as an individual's ability to perform normal daily activities required to meet basic needs, to maintain independence and well-being, and to further engage in personal care.[49,50] Functional difficulties are the challenges/difficulties of an individual's ability to achieve functional health. An older patient with ADRD is considered to experience functional decline if he/she has more functional difficulties in the subsequent year than at baseline.

3.1.3 Mediators of the Focal Relationship

This study proposes that higher level of COC is negatively correlated with experiencing functional decline through two mechanisms: improved care coordination and better physician-patient relationship (including communication and a patient's trust in their physicians).

Care Coordination

Improving care coordination has emerged as a key strategy for many payers and policymakers in an effort to prevent medical errors and reduce the use of unnecessary services.[51,52] Care coordination involves physicians' efforts to work cooperatively, to deliberately organize patient care activities, and continuously share information concerning a patient's treatment plan to provide safer and more effective care.[53,54] Better coordinated care improves health outcomes (i.e., prevent or delay having difficulties in functionality) by ensuring that care from disparate providers is synchronized.[55] Therefore, higher level of COC could be negatively associated with experiencing functional decline through a better coordinated care process.

Relationship between Provider and Patient: Communication and Trust

A second mechanism through which COC is potentially related to experiencing functional decline among older adults with ADRD is through the relationship between the patient and their physicians. Patient-physician relationship is defined as two sub-constructs: communication between the patient and their physicians and the patient's trust in their physicians. Communication facilitates a physician's ability to gather true and important information for accurate diagnosis, appropriate counsel, and therapeutic instructions.[56] The trust that a patient has in their physician is the belief that their physician will act in their best interest to deliver effective care, which eventually impact the patient's concordance to the physician's treatment plan.[57] A patient with ADRD may become more suspicious of those around them which is caused by confusion and memory loss (including the inability to remember certain people or objects). This suspiciousness presents a huge barrier to effective communication between a patient and their physicians, which might further lead to inappropriate and ineffective treatment.[53] This suspiciousness can lead to an unrealistic distrust among older patients with ADRD. Higher continuity has also been shown to be associated with an increased level of trust between patients and physicians, and improved patient's trust may potentially improve the quality and outcomes of care.[57,58] Therefore, higher level of COC is expected to be negatively associated with experiencing functional decline through more effective communication and a patient's greater trust in their physicians.

3.1.4 Confounders to the Focal Relationship

Structure

The conceptual framework of this study proposes that structural characteristics are correlated with COC, which are defined as the adequacy of facilities and equipment, number of evaluation and management (E&M) visits, and the involvement and division of labor between primary care physicians and disease-relevant specialists. The adequacy of facilities and equipment determines a patient's geographic access to different types of care, and it is positively associated with COC. When there are specialty physicians involved in a patient's care, physicians from different expertise can provide more exhaustive medical care advice. When a patient seeks care from more dispersed pool of physicians with different specialties, however, it is harder to achieve a higher level of COC. There exists a trade-off between specialists' involvement and COC.[15] Therefore, there is a negative association between specialists' involvement and COC (as illustrated in Table 1: Illustration of Association between Specialists' Involvement and COC).

Table 1: Illustration of Association between Specialists' Involvement and COC

$$\text{Continuity of care score} = \frac{(\sum_{i=1}^{N} n_i^2 - N)}{N(N-1)}$$

Total visits	Unique doctors seen	Physician A visits (PCPs)	Physician B visits (specialty physicians)	COC score
8	1	8	0	1
8	2	6	2	0.5714
8	2	4	4	0.4286

Individual patient characteristics

The focal relationship between COC at baseline and experiencing functional decline in the subsequent year is confounded by the individual patient's demographic characteristics including age, gender, marital status, race/ethnicity, socioeconomic status (SES) and urbanicity of residence. Relatively younger age, male gender, and married patients are shown by previous literature to have higher levels of COC.[59,60] Current studies have reported racial/ethnic minorities[53,59] and people with lower SES[53,61] tend to have lower levels of COC and are more likely to experience functional decline.

Besides an individual patient's demographic characteristics, health status at baseline is another important set of confounders for the focal relationship. This study defines health status at baseline as the relative level of wellness/illness and includes a patient's comorbidities, negative health behaviors, functional status, and severity and/or stages of ADRD. Patients in more advanced stages of ADRD are more likely to have severe decline of functionalities[1], and their severe cognitive deterioration resulting from ADRD also exacerbates their abilities to function in daily activities[5]. Eventually, they become completely dependent on "around-the-clock care."[1]

For Medicare FFS beneficiaries, other than Part A and Part B coverage for hospital and medical services, Medicare Part D covers outpatient prescription drugs and is optional to purchase for Medicare beneficiaries, however, separate premiums need to be paid in order to enroll in the Medicare Part D plan. A Medicare supplemental insurance is sold by private companies to help pay some of the health care costs that original Medicare doesn't cover. Medicare beneficiaries who are low-income and/or disabled are also eligible for Medicaid, and Medicaid can fill in benefit gaps after Medicare covers the cost of medical care as a primary payer. Therefore, health insurance status in this study is conceptualized as a patient's Medicare Part D coverage, whether he/she has private supplemental insurance, and his/her dual eligibility for Medicaid.

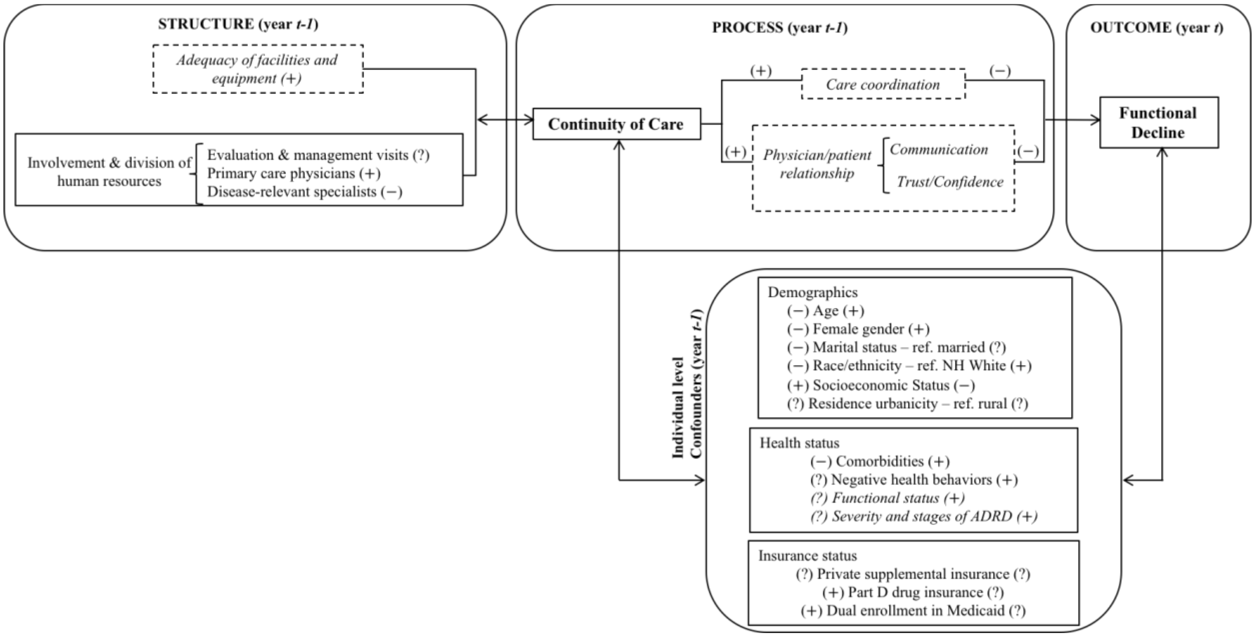

Figure 1: Conceptual Framework

3.2 Hypotheses

The primary hypothesis of this study proposes that higher level of COC at baseline is associated with lower incidence of experiencing functional decline in the subsequent year among Medicare FFS beneficiaries with ADRD, after controlling for other confounders. A secondary hypothesis projects the impact of COC at baseline on experiencing functional decline in the subsequent year to be magnified among this vulnerable population who don't have functional difficulties at baseline.

3.3 Data and Analytic Sample

3.3.1 Data: Medicare Current Beneficiary Survey

This study uses a pooled panel data from the Medicare Current Beneficiary Survey (MCBS) for seven calendar years from 2006 to 2012. The MCBS is a survey of a nationally representative sample of the Medicare FFS beneficiaries, conducted by the Centers for Medicare & Medicaid Services (CMS).[62] The MCBS collects data from a stratified random sample by age and zip code clusters, and its participants are interviewed in three distinct rounds annually and are followed over four calendar years to form a continuous profile of their health care experience.[62] Therefore, under the rotating panel design of MCBS, respondents remain in the sample for up to a four-year time period of data collection. Because of their special health care needs, the oldest old (age 85 years and older) are oversampled.[63] The MCBS contains both Medicare FFS claims data and survey-reported events in the Access to Care survey.[62] The Access to Care survey and Medicare FFS claims are merged and linked during each calendar year based on the unique personal level identifier.

3.3.2 Analytic Sample

This study employed a pooled MCBS panel data from 2006 to 2012, creating an unbalanced panel sample of unique person-year observations among Medicare FFS beneficiaries with ADRD. I appended all the available panels over the seven-year time span between 2006 and 2012. Due to the survey design of MCBS, each participant in the MCBS could be present in the appended MCBS data for one to four consecutive years. The selection of analytic sample is shown in Figure 2: Flowchart for the Selection of Analytic Sample. The analytic sample was first limited to the population with ADRD using the ICD9-CM codes (based on the CMS Chronic Conditions Data Warehouse) as well as survey questions ("whether the respondent has ever been told by a doctor that they have AD") to identify patients with ADRD. I further limited the study population to older adults (ages 65 years or older) who have reported available address zip codes, have not changed address, have enrolled in the Medicare FFS plan for 12 months and were not institutionalized at baseline. Since I allowed for a one-year time lag between independent variables and functional outcomes in the following year, the analytic sample was further limited to participants with at least two consecutive years of enrollment in the MCBS. Due to the survey design of MCBS, study members could have two, three, or even four years of data in the analytic sample. The calculation for COC requires that the patient has made at least two evaluation and management (E&M) visits, Medicare FFS claims data was utilized to further exclude those who had less than two E&M visits. Finally, study members with missing confounders were excluded from the analytic sample, and the final analytic sample is 2,009 observations.

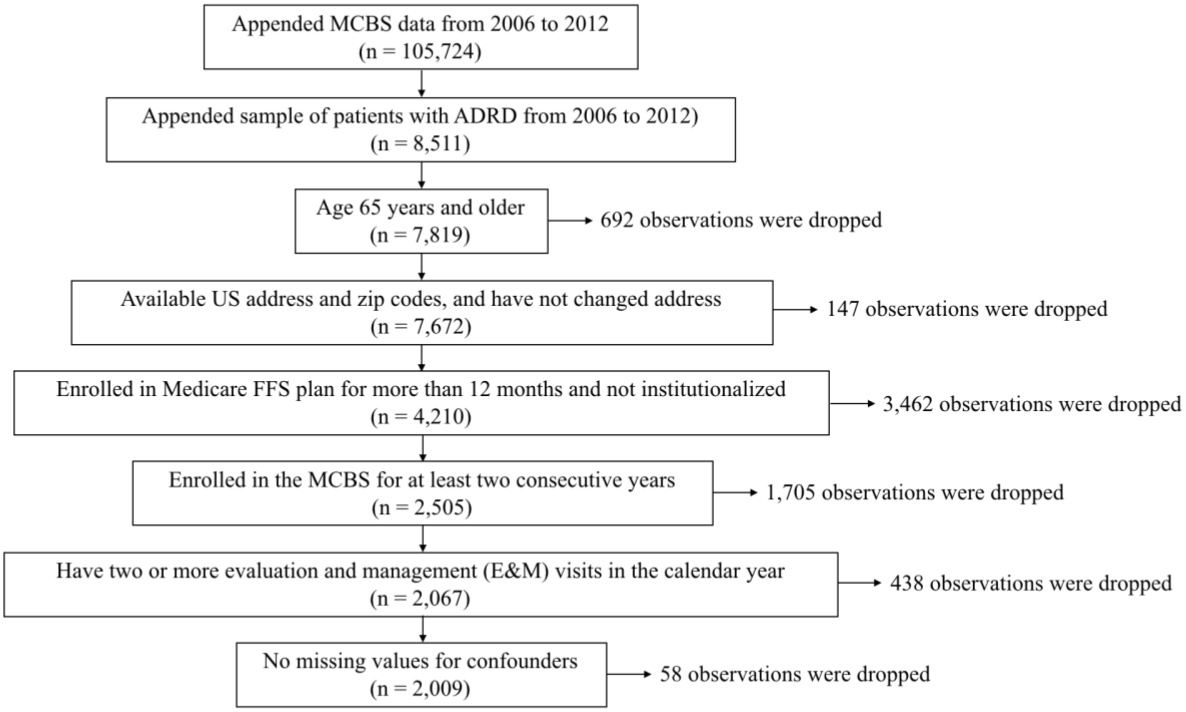

Figure 2: Flowchart for the Selection of Analytic Sample

3.4 Measurement

Table 2: Measurements of Constructs presents the measurement of all the variables included in the regression analysis.

3.4.1 Focal Relationship

Independent Variable: Continuity of Care (in the baseline calendar year)

The construct of COC was assessed using the *Bice-Boxerman COC index (COC BB index)*, which mathematically characterizes the dispersion of unique physicians seen by an individual across their total count of E&M visits (including both PCPs and disease-relevant specialists).[45] The BB index is calculated using the Medicare FFS claims data. It is calculated as

$$BB\ index = \frac{(\sum_{i=1}^{N} n_i^2 - N)}{N(N-1)},$$

where n_i represents the number of E&M visits to provider i, and N represents the total number of E&M visits.[45] Information on E&M visits was obtained from Medicare FFS claims data linked to the survey data in MCBS. The BB index is a continuous variable in the range from 0 to 1, with a higher index indicating a higher level of COC. The calculated BB index was then classified into a categorical variable indicating the level of COC as high, medium, and low based on the distribution of the BB index scores within the analytic sample.

Dependent Variables: Functional Decline (in the subsequent year)

Information on functional decline was derived from the MCBS survey file. Two measures of functional difficulties among Medicare FFS beneficiaries with ADRD in the subsequent year assessed the *difficulties in ADL* and *difficulties in IADL*, and these two measures were evaluated both at baseline and in the subsequent year, respectively. Medicare FFS beneficiaries were asked a dichotomous question of whether they have experienced any difficulty in each of the six tasks including bathing, dressing, eating, transferring, walking, and toileting. A count variable was then created to indicate whether the patient has any difficulties in ADLs at baseline and in the subsequent year, respectively. In MCBS, Medicare FFS beneficiaries were also asked about their difficulties in IADL including using telephone, managing communications, doing light housework, doing heavy housework, managing finances, preparing meals, and shopping. Therefore, a second count measure of difficulties in IADL was calculated by adding the number of affirmative ("yes") responses to having difficulty completing or not doing the above seven IADLs included in MCBS at baseline and in the subsequent year, respectively. The dichotomous dependent variable *functional decline* was created based on the change of difficulties in ADL or IADL from baseline to subsequent year. A patient is considered to experience functional decline in the subsequent year if he/she reports to have more difficulties in functionality in the subsequent year than at baseline.

3.4.2 Confounders

Individual patient characteristics

E&M visits are identified using Berenson-Eggers Type of Services (BETOS) codes in the Medicare Part B physician claims as face-to-face office visits for new or established patients (M1A, M1B), home visits (M4A, M4B), specialist visits (M5B, M5C, M5D), and consultations (M6). The number of E&M visits presented the total number of E&M visits that a study member has in the study calendar year at baseline.

Two binary indicators were created as indicators for any involvement of PCPs and disease-relevant specialist. The specialty type of physicians seen by the patient were identified by using the Health Care Financing Administration (HCFA) specialty codes on the Medicare Part B physician claims. PCPs are identified as general practice, internal medicine, nurse practitioner, physician assistant, geriatric medicine, preventive medicine, or obstetrics/gynecology/certified nurse midwife. Disease-relevant specialists are defined based on the recommendations from the Alzheimer's Association as neurologist, psychiatrist, and psychologist.[64]

Demographic information on respondents' *age, gender, marital status, race/ethnicity, socioeconomic status (SES),* as well as *urbanicity of residence* could be measured in the MCBS. Respondents' *age* was measured as the age at the time of the survey and then categorized into six categories: 65 – 69 years old, 70 – 74 years old, 75 – 79 years old, 80 – 84 years old, 85 – 89 years old, and 90 years and older. *Gender* wa measured as a dichotomous variable indicating female gender as 1 and male as 0. *Marital status* was measured by categorical variables indicating whether the respondent is married, widowed, divorced, separated, or never married. To assess *race/ethnicity*, Medicare FFS beneficiaries were classified into five different racial/ethnic groups: Hispanic, Non-Hispanic White, Non-Hispanic Black, Non-Hispanic Asian, and Non-Hispanic other. Respondents' *SES* was measured in terms of their *level of education* and *income*. *Education* was categorized as one of four different groups based on their self-response of their highest grade completed: less than high school, high school graduate, some college, and college and more. Using their self-reported income, *income level* was categorized following the MCBS questionnaire as shown in

Table 2: Measurements of Constructs.

Comorbidities, *obesity*, and *tobacco use* were measured to assess respondents' health status. The Charlson comorbidity index includes a range of 22 comorbid conditions and predicts the one-year mortality for a patient. Each condition is assigned a score of 1 to 6, depending on the risk of dying associated with each one, and scores are then summed to provide a total score to predict mortality.[65] This index has been validated for its ability to predict mortality in various disease subgroups, including cancer, renal disease, stroke, liver disease, etc.[65] The body mass index (BMI) was calculated for each respondent based on their self-reported weight and height. Respondents were then be categorized into two groups – obesity and not obesity. The MCBS participants were also asked about their history of tobacco use, which was categorized into current smoker and non-current smoker. *Functional status* and *stage and severity of ADRD* were unmeasurable in the MCBS, which are italicized in Figure 2: Flowchart for the Selection of Analytic SampleFigure 1: Conceptual Framework.

Since the participants interviewed in the MCBS are all Medicare FFS beneficiaries, their *health insurance status* was measured in terms of their Medicare and Medicaid insurance status. A dichotomous variable indicates whether the study member has supplemental private insurance. Two other dichotomous indicators will also be created: (1) whether the respondent has Part D coverage (yes/no) and (2) whether they have dual enrollment in Medicaid (yes/no).

Table 2: Measurements of Constructs

Construct	Measures Available	Source
Continuity of care (COC) at baseline	A continuous variable *BB index of COC* is calculated as $\frac{(\sum_{i=1}^{N} n_i^2 - N)}{N(N-1)}$, where n_i represents the number of E&M visits to provider i, and N represents the total number of E&M visits. The calculated BB index is then classified into a categorical variable indicating the level of COC as high, medium, and low based on the distribution of the BB index scores within the analytic sample: ***COC level:*** • ***High*** • ***Medium*** • ***Low***	Claims
Functional decline in the subsequent year	A count variable of difficulties in ADL is calculated to measure the number of difficulties that Medicare FFS beneficiaries encounter with basic self-care tasks, including: Bathing Dressing Eating Transferring Walking Toileting A dichotomous variable ***functional decline in ADL*** is further defined based on the count variable of difficulties in ADL: • ***1 – having more difficulty in ADL in the subsequent year than at baseline*** • ***0 – not having more difficulty in ADL in the subsequent year than at baseline***	Survey
	Another count variable of difficulties in IADL is calculated to further measure the number of difficulties that Medicare FFS beneficiaries encounter with personal care tasks and maintenance of well-being, including: Using telephone Managing finances Doing light housework Preparing meals Doing heavy housework Shopping A dichotomous variable ***functional decline in IADL*** is further defined based on the count variable of difficulties in IADL: • ***1 – having more difficulty in ADL in the subsequent year than at baseline*** • ***0 – not having more difficulty in ADL in the subsequent year than at baseline***	Survey
Number of E&M visits	A count variable of the number of E&M visits that each study member has during the calendar year at baseline.	Claims
Involvement of PCP	A dichotomous variable for the involvement of PCPs based on the CMS Provider Specialty Code (general practice, family practice, nurse practitioner, physician assistant, preventive medicine, or obstetrics/gynecology/certified nurse midwife): • ***1 – there's PCP involvement*** • ***0 – there's no PCP involvement***	Claims

Involvement of disease-relevant specialists	A dichotomous variable for the involvement of disease-relevant specialists based on the recommendation from Alzheimer's Association using the CMS Provider Specialty Code (neurologist, psychiatrist, psychologist, or geriatrician): • ***1 – there's involvement of disease-relevant specialist*** • ***0 – there's no involvement of disease-relevant specialist***	Claims
Age	A categorical measure of age at the time of the survey. ***Age categories:*** • ***65 – 69 years old*** • ***70 – 74 years old*** • ***75 – 79 years old*** • ***80 – 84 years old*** • ***85 – 89 years old*** • ***90 years old +***	Survey
Gender	A dichotomous variable measuring the respondent's ***gender***, indicating: • ***1 – female*** • ***0 – male***	Survey
Marital Status	Medicare FFS beneficiaries will be classified into the following categories of ***marital status***: • ***Married (reference)*** • ***Widowed*** • ***Divorced*** • ***Separated*** • ***Never married***	Survey
Race/Ethnicity	Medicare FFS beneficiaries will be classified into the following 5 categories of ***race/ethnicity***: • ***Non-Hispanic, White (reference)*** • ***Non-Hispanic, Black Hispanic*** • ***Non-Hispanic, Asian*** • ***Non-Hispanic, other***	Survey
SES	***Education***: a categorical variable The highest education that the Medicare FFS beneficiaries have completed is categorized into the following groups: • ***Less than high school*** • ***High school graduate*** • ***Some college*** • ***College and more***	Survey
	Family income: a categorical variable The family income of the Medicare FFS beneficiaries is grouped into the following income ranges: • ***Annual income < $25,000 or missing*** • ***Annual income >= $25,000***	Survey
Residence Urbanicity	County of residence urbanicity measures (residence urbanicity) are grouped into the following categories:	Survey

	• ***Metropolitan*** • ***Non-metropolitan***	
Health Insurance Status	***Medicare Part D coverage*** (a dichotomous variable indicating whether the respondent has Part D coverage): • ***1 – have Medicare Part D plan*** • ***0 – do not have Medicare Part D plan***	Claims
	A dichotomous variable indicating whether the study member has ***supplemental private insurance***: • ***1 – have supplemental private insurance*** • ***0 – do not have supplemental private insurance***	Survey
	Dual enrollment in Medicaid (a dichotomous variable indicating whether the respondent has dual enrollment in Medicaid): • ***1 – have Medicaid*** • ***0 – do not have Medicaid***	Claims
Health Status	***Tobacco use*** is a categorical variable measuring the respondent's smoking behavior: • ***1 – Current smoker*** • ***0 – Not a current smoker***	Survey
	BMI will be calculated from self-reported height and weight, and will be categorized as a dichotomous variable for ***obesity***: • ***1 – Obese (BMI >= 30.0 kg/m2)*** • ***0 – Not obese (BMI <30.0 kg/m2)***	Survey
	A continuous variable ***Charlson index*** predicts the one-year mortality for a patient, including a range of 22 comorbid conditions.	Claims

3.5 Analytic Strategy

3.5.1 Main Logistic Regression

This study utilized a logistic regression model to examine the focal relationship between patient i's COC at baseline $(t-1)$ with their experience of functional decline in the subsequent year t.

$$FD_{it} = \beta_0 + \beta_1 COC_{it-1} + \beta_2 E\&M_{it-1} + \beta_3 P_{it-1} + \beta_4 D_{it-1} + \beta_5 X_{it-1} + Y_t + \varepsilon_{it}$$

FD_{it} represents the outcome variables of functional decline in the subsequent year t, and COC_{it-1} represents the level of COC the patient experiences at baseline. $E\&M_{it-1}$ is the count variable for the number of E&M visits a patient has at baseline, and P_{it-1} and D_{it-1} are indicator for involvement of PCP and disease-relevant specialists at baseline, respectively. A year fixed effect is included in the regression model as well to account for any development of new clinical trials for ADRD and any changes in the healthcare delivery patterns for this population. This study reported the marginal effects, measuring the probability/incidence of experiencing functional decline in ADL and IADL with one level change of COC. Longitudinal weights were applied since the MCBS' oversample of the oldest old.

3.5.2 Effect Analysis by Level of Functional Health Status at Baseline

I also examined whether these effects of COC on functional decline differed for individuals with ADRD who had no documented functional decline at baseline and those who already had functional limitations. The purpose here was to ascertain whether there might be evidence that patterns of care and whether their effect varies by disease progression.

4 RESULTS

4.1 Description of the Study Population and Their Functional Health Status

Weighted descriptive statistics for older Medicare FFS beneficiaries with ADRD at baseline during 2006-2012 are presented in Table 3: Descriptive Statistics on MCBS Study Sample. The unweighted panel analytic sample size is 2,009 observations. I stratified results based on the level of COC into high, medium, and low. The column labeled “p-value” displays the p-value for chi-square testing the association between the level of COC and other confounders. The mean age of the study sample of older adults with ADRD is around 81.6 years old, with 61.8% female, 79.0% Non-Hispanic White, and 71.3% living in the Metropolitan area. These demographic distributions are consistent with current literature on older population with ADRD and other dementia.[16] These demographic distributions are consistent with current literature on older population with ADRD and other dementia.[59] Among the 2,009 Medicare FFS beneficiaries with ADRD, 63.5% of them have private supplemental insurance, 53.8% have Medicare Part D coverage, and 18.3% are dual enrolled in the Medicaid program. 48.8% and 62.4% of the study sample report having difficulties in ADL and IADL at baseline, respectively. In the subsequent year, 32.9% and 41.4% are measured to experience functional decline, respectively. On average, an older patient with ADRD has 12.2 E&M visits in one calendar year, and 93.5% have seen PCPs, while 33.6% have seen disease-relevant specialists.

It is worth noting that there is a statistically significant association/trade-off between the involvement of disease-relevant specialist and a patient’s level of COC. Among Medicare FFS beneficiaries with ADRD who have high level of COC, there are fewer patients having disease-relevant specialists involved in their care at baseline compared to those with medium or low level of COC. A patient is more likely to experience lower level of COC if he/she has disease-relevant specialists involved. Medicare FFS beneficiaries who are female, having Medicare Part D plan, and being dual eligible for Medicaid are more likely to have higher level of COC. Additionally, there is a greater proportion of widowed patients in the high level of COC (48.8%) than those in the low level of COC (34.7%), indicating patients who lost their spouse experience relatively better continuum of care.

Table 3: Descriptive Statistics on MCBS Study Sample

	Total sample	**Level of Continuity of Care**			**p-value**
		Low	Medium	High	
Outcomes in the subsequent year, %					
Functional decline in ADL	32.9	33.4	30.4	33.7	0.307
Functional decline in IADL	41.4	40.6	41.4	41.4	0.937
Functional difficulties at baseline, %					
Having difficulties in ADL	48.8	48.7	49.1	48.0	0.941
Having difficulties in IADL	62.4	60.6	61.5	62.6	0.781
Evaluation & management (E&M) visits in the baseline year					
Total E&M visits, mean (sd)	12.2 (9.7)	15.4 (11.4)	12.9 (8.5)	9.5 (7.2)	
Primary care physicians, %	93.5	96.2	95.9	92.6	0.008
Disease-relevant specialists, %	33.6	49.9	38.9	14.8	0.000
Age, %					
Mean age (sd)	81.6 (7.3)	80.8 (7.2)	81.6 (6.9)	82.3 (6.9)	
65-69 years old	5.3	6.6	4.8	5.1	0.018
70-74 years old	12.7	14.1	10.1	12.5	
75-79 years old	19.7	23.2	21.3	15.7	
80-84 years old	24.4	21.4	29.1	25.0	
85-89 years old	23.5	23.5	22.5	24.5	
90 years old+	14.4	11.3	12.3	17.2	
Female, %	61.8	54.0	61.6	68.4	0.000
Race/ethnicity, %					
Non-Hispanic White	79.0	85.6	78.1	74.7	0.002
Non-Hispanic Black	10.6	8.2	10.7	12.5	
Hispanic	7.1	4.7	8.2	7.4	
Non-Hispanic other	3.2	1.5	3.0	5.4	
Marital status, %					
Married	46.3	55.5	49.2	40.6	0.000
Widowed	44.1	34.7	43.1	48.8	

Divorced	6.2	6.1	4.3	7.7	
Separated	1.1	1.3	1.0	1.4	
Never married	2.4	2.4	2.4	1.5	
Education level, %					
Less than high school	31.8	21.0	31.1	42.5	0.000
High school graduate	29.7	30.4	29.6	28.2	
Some college	21.0	25.1	20.9	17.3	
College and more	17.5	23.5	18.3	11.9	
Income level, %					
Annual income<$25,000	63.6	46.3	56.2	68.1	0.000
Annual income>=$25,000	36.4	53.7	43.8	31.9	
Live in Metropolitan area, %	71.3	78.9	70.2	65.0	0.000
Health insurance status, %					
Supplemental private insurance	63.5	71.5	68.9	58.5	0.000
Medicare Part D plan	53.8	47.4	53.7	57.2	0.010
Medicaid	18.3	13.3	17.6	23.6	0.002
Health conditions					
Current smoker, %	7.3	6.8	6.8	7.7	0.830
Obesity, %	17.4	20.2	17.5	17.0	0.432
Charlson index, mean (sd)	2.1 (2.4)	2.7 (2.8)	2.2 (2.4)	1.8 (2.1)	
Self-reported respondent, %	73.2	76.7	76.2	72.5	0.258
Observations (unweighted)	2,009	674	665	670	

Note: All the estimates are weighted by analytical weights in the MCBS.

4.2 Results from the Main Logistic Regression

The weighted marginal effects of patient COC and other confounders at baseline from the main logistic regression are presented in Table 4: Effects of Patient COC on Experiencing Functional Decline in the Subsequent Year, and the statistics presented in the table are the percentage effect on the dependent variable. The marginal effects presented in the tables represent the impact of each independent variable on the percentage point change in the probability of experiencing functional decline in the subsequent year. The first row of the table shows that in the subsequent year 32.9% and 41.4% of the study sample experienced functional decline in ADL and IADL, respectively. I didn’t find a statistically significant impact of COC at baseline at experiencing functional decline in the subsequent year. When measuring functionality and functional decline in ADL, among the older adults with ADRD, the oldest old are more likely to experience functional decline – comparing to older patients in the age range of 65-69, 85-89-year-old and 90-and-older are 26.2% and 25.7% more likely to experience functional decline, respectively. Currently smoking status and obesity are associated with 8.28% and 8.24% higher incidence of experiencing functional decline among older adults with ADRD. When functionality and functional decline are measured in IADL, comparing to older patients in the age range of 65-69, 85-to-89-year-old and 90-and-older are 14.3% and 16.0% more likely to experience functional decline, respectively.

Table 4: Effects of Patient COC on Experiencing Functional Decline in the Subsequent Year

	Experiencing functional decline in ADL	Experiencing functional decline in IADL
Percentage of the study sample experiencing functional decline in the subsequent year	32.9%	41.4%
Continuity of Care (ref. Low)		
Medium	-4.09 (0.090)	0.36 (0.894)
High	-1.62 (0.565)	0.64 (0.834)
Evaluation and Management (E&M) Visits		
Number of E&M visits	0.18 (0.117)	0.07 (0.597)
Involvement of primary care physician	-1.16 (0.836)	-7.96 (0.159)
Involvement of disease-relevant specialist	-1.80 (0.449)	3.04 (0.264)
Age (ref. 65-69 years old)		
70-74 years old	10.4 (0.174)	2.16 (0.776)
75-79 years old	14.5* (0.046)	9.73 (0.182)
80-84 years old	18.7** (0.006)	13.4 (0.052)
85-89 years old	26.2*** (0.000)	14.3* (0.046)
90 years old+	25.7*** (0.001)	16.0* (0.025)
Female (ref. male)	-0.24 (0.924)	-3.10 (0.199)
Marital Status (ref. married)		
Widowed	0.87 (0.721)	0.71 (0.782)
Divorced	1.82 (0.679)	4.57 (0.406)

Separated	-7.01 (0.460)	11.3 (0.350)
Never married	10.8 (0.124)	-6.00 (0.451)
Race (ref. Non-Hispanic White)		
Non-Hispanic Black	6.39 (0.079)	-6.97 (0.066)
Hispanic	-2.85 (0.488)	-1.68 (0.719)
Non-Hispanic other	5.70 (0.484)	0.31 (0.969)
Education (ref. less than high school)		
High school graduate	1.36 (0.618)	-1.98 (0.568)
Some college	0.96 (0.762)	-8.71** (0.006)
College and more	-1.58 (0.636)	-3.91 (0.289)
Income level (ref. annual income <$25,000 or missing)		
Annual income >=$25,000	1.19 (0.660)	-0.08 (0.976)
Live in metro area	-1.31 (0.615)	-2.83 (0.329)
Health insurance status		
Have supplemental private insurance	-2.19 (0.363)	-2.62 (0.350)
Have Medicare Part D plan	2.59 (0.192)	-2.28 (0.358)
Medicaid	-3.39 (0.316)	-1.94 (0.633)
Health conditions		
Current smoker	8.28* (0.046)	1.48 (0.754)
Obesity	8.24** (0.005)	3.05 (0.335)
Charlson index	0.54 (0.236)	0.19 (0.706)
Self-reported	-6.20* (0.015)	6.27* (0.021)
Observations	2,009	2,009

Notes: p-values for the coefficients are presented in the parenthesis.

4.3 Secondary Logistic Regression

I further limited the study sample to those reported having no documented difficulties in functionality at baseline and conducted a secondary logistic regression (sample sizes for measuring ADL and IADL are 1,012 observations and 744 observations, respectively) using the sub-sample. The weighted marginal effects of patient COC and other confounders at baseline from the main logistic regression are presented in Table 5: Effects of Patient COC on Functional Decline Within One Year among Patients with No Reported Functional Difficulties at Baseline, and the statistics presented in the table are the percentage effect on the dependent variable. When examining the outcome measure of functional decline in ADL, compared to low level of COC, medium level of COC is associated with a 7.51% ($p < 0.05$) lower incidence of experiencing functional decline in the subsequent year, after controlling for other confounders at baseline. However, the results didn't show a statistically significant impact of high level of COC on experiencing functional decline in the subsequent year, compared to low level of COC. Among the older adults with ADRD, the oldest old are more likely to experience functional decline – comparing to older patients in the age range of 65-69, 85-89-year-old and 90-and-older are 32.0% and 34.7% more likely to experience functional decline, respectively. The impact of older age is magnified when limiting the study sample to those without functional difficulties at baseline. Currently smoking status and obesity are associated with 8.28% and 8.24% higher incidence of experiencing functional decline among older adults with ADRD. When the outcome measure of functional decline is evaluated through IADL, I didn't find a statistically effect of COC at baseline on functional decline in the subsequent year. However, the involvement of PCP in a patient's E&M visits is associated with 25.8% lower incidence of experiencing functional decline in the subsequent year.

Table 5: Effects of Patient COC on Functional Decline Within One Year among Patients with No Reported Functional Difficulties at Baseline

	Experiencing functional decline in ADL	Experiencing functional decline in IADL
Percentage of the study sample experiencing functional decline in the subsequent year	31.3%	43.8%
Continuity of Care (ref. Low)		
Medium	-7.51* (0.019)	-3.75 (0.450)
High	-4.54 (0.181)	1.64 (0.736)
Evaluation and Management (E&M) Visits		
Number of E&M visits	0.21 (0.233)	0.46 (0.070)
Involvement of primary care physician	-3.08 (0.671)	-25.80** (0.007)
Involvement of disease-relevant specialist	-0.06 (0.988)	4.97 (0.189)

Age (ref. 65-69 years old)		
70-74 years old	7.16 (0.490)	-3.42 (0.780)
75-79 years old	16.10 (0.119)	8.51 (0.467)
80-84 years old	18.70 (0.059)	13.80 (0.236)
85-89 years old	32.00** (0.001)	22.30 (0.059)
90 years old+	34.70** (0.001)	19.10 (0.108)
Female (ref. male)	-1.13 (0.734)	-0.16 (0.966)
Marital Status (ref. married)		
Widowed	8.19* (0.011)	1.74 (0.683)
Divorced	10.90* (0.040)	-4.88 (0.635)
Separated	-0.55 (0.964)	2.62 (0.865)
Never married	25.40* (0.042)	11.90 (0.373)
Race (ref. Non-Hispanic White)		
Non-Hispanic Black	3.15 (0.544)	-12.20 (0.127)
Hispanic	-0.07 (0.992)	0.70 (0.931)
Non-Hispanic other	24.80* (0.027)	6.72 (0.706)
Education (ref. less than high school)		
High school graduate	-2.58 (0.511)	-8.51 (0.103)
Some college	-1.42 (0.767)	-13.40** (0.008)
College and more	-7.07 (0.084)	-17.50** (0.007)
Income level (ref. annual income <$25,000 or missing)		
Annual income >=$25,000	0.57(0.867)	0.81 (0.830)
Live in metro area	-2.09 (0.684)	-2.88 (0.575)
Health insurance status		
Have supplemental private insurance	-5.66 (0.131)	-7.13 (0.075)
Have Medicare Part D plan	2.52 (0.341)	3.07 (0.459)
Medicaid	-5.54 (0.311)	2.34 (0.744)
Health conditions		
Current smoker	14.40* (0.020)	15.00 (0.101)
Obesity	22.80*** (0.000)	6.05 (0.315)
Charlson index	2.82*** (0.000)	1.38 (0.175)
Self-reported	11.40** (0.007)	6.18 (0.429)
Observations	1,012	744

Notes: p-values for the coefficients are presented in the parenthesis.

5 DISCUSSION

5.1 Key Findings and Conclusions

This study examined the impact of COC at baseline on experiencing functional decline in the subsequent year among the older adults with ADRD using a logistic regression, and further examined the marginal effects among a limited study sample of older patients without functional difficulties at baseline. Although I didn't find a statistically significant effect of COC at baseline on experiencing functional decline in the subsequent year among the complete study sample, this agrees with current literature. Higher level of COC, however, was found to be associated with 7.51% lower incidence of functional decline (measured in ADL) in the subsequent year among those without functional difficulties. Additionally, when evaluating functionality using IADL categories, the involvement of PCP is associated with 25.8% lower chance of experiencing functional decline in the subsequent year.

COC for older adults with ADRD was found to be statistically significant beneficial in preventing and/or delaying short-term functional decline (within one-year time lag) among those without difficulties in functionality at baseline. Beyond survival, patients value most their functional health, the preservation of functionality is shown to be highly correlated with their quality of life.[26,66] Additionally, for the patients' families and/or caregivers, they would face less burden of assisting the patients with ADL on top of their memory loss and cognitive deterioration. On a societal level, studies have shown that functional capacity has a significant effect on the patients' quality of life, and Jutkowitz et al. (2017) have estimated that if the rate of functional decline among older adults with ADRD reduces by 10 percent, it would reduce average per-person lifetime costs by $4,122 in 2018 dollars.[9]

5.2 Strengths and Limitations

Several limitations of this study should be noted. First, the study sample is not representative of the complete population with ADRD. It is only limited to Medicare FFS beneficiaries with more than two E&M visits, therefore around 16-25% of the Medicare population enrolled in Medicare Advantage (MA) plans were excluded during the study period. In addition, younger patients (age less than 65 years old) with early-onset ADRD were not included in the analytic sample, which accounts for 5-6% of all the ADRD cases. Second, individual patient's severity of AD at baseline is unmeasured in the conceptual framework, which serves as a confounder for the focal relationship. Older patients with more severe stages of ADRD are less likely to have higher levels of COC and are more likely to have functional difficulties and experience functional decline. Consequently, the impact of COC on experiencing functional decline could be over-estimated because the unmeasured confounder can cause spuriousness in the focal relationship, biasing the estimate away from the null. The omission of severity of ADRD in the regression can cause endogeneity, which limits my ability to make causal claims on the relationship between COC at baseline and experiencing functional decline in the subsequent year. Third, the study sample is identified using both Medicare claims data for and survey answers. However, the Medicare claims data capture the population with diagnosis of ADRD while survey answers only includes population self-reporting that they have been told by a doctor that they have AD. Forth, due to study design of MCBS and its response rate, I was only able to measure functional decline within one-year time lag. Therefore, I failed to measure the long-term functional decline in ADL or IADL, which would be of great research interests.

Despite the limitations discussed above, this study also has several strengths. This study addresses the key gap in the current literature by providing the first evidence on the impact of

COC on experiencing functional decline among older adults with ADRD. Additionally, the MCBS dataset has rich information on individual patient level health conditions from survey reported events as well as medical claims data on healthcare utilization which facilitate structuring the relationship between COC at baseline and functional decline in the subsequent year. Moreover, this study uses an unbalanced panel data to control for reverse causality that a patient's functional health status can affect their level of COC, so as to better make casual claims about the impact of COC on experiencing functional decline.

5.3 Policy Implications

The findings of this study underscore the importance of COC and involvement of PCP in preventing short-term (one-year) functional decline among older adults with ADRD in the Medicare FFS plan. It is estimated that around 50% of the patients with ADRD do not receive a formal diagnosis, and even when they receive the diagnosis, their ADRD condition has progressed significantly and is in more severe stage.[67] Under the Affordable Care Act, Medicare began covering for an Annual Wellness Visit (AWV) every 12 months in 2011, which includes the assessment and potentially early detection of cognitive impairment (such as ADRD or other dementias) and the creation of a personalized prevention plan.[68] The AWV is promoted by the Alzheimer's Association as an effective effort in increasing early detection and diagnosis of ADRD.[67] Patients in early stage of ADRD are less likely to have functional difficulties, and with early diagnosis and personalized plan ensuring continuity of care through AWV, short-term functional decline (within one-year time lag) could be prevented and/or delayed. Additionally, the findings of this study suggest the physician or practitioner performing AWV for the Medicare FFS beneficiaries take continuity of care into consideration while creating and developing personalized plan.

5.4 Recommendations for Further Research

Based on the findings as well as limitations of this study, future research and datasets need to further measures and examine the severity/stage of ADRD among this population to have it controlled in the analysis. Longer time span for measuring functional decline would provide more meaningful implications for measuring the impact of COC on functional decline in the long term. Similar research question could also be analyzed and examined among Medicare beneficiaries in the Medicare Advantage plans. The time span of this study is between 2006 and 2012, while AWV was introduced in 2011. There are not enough information/data in the study sample that this study utilized. Therefore, future research could further include the AWV in the analysis using later available datasets and examine the impact of AWV on a patient's COC with their physicians.

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