Published in final edited form as:

Aging Ment Health. 2020 November ; 24(11): 1864–1871. doi:10.1080/13607863.2019.1647135.

Examining the temporal associations between self-reported memory problems and depressive symptoms in older adults

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Abstract

Objectives: Older adults commonly report problems with their memory which can elicit sadness and worry about future development of cognitive impairment. Conversely, ongoing depressive symptoms can negatively impact older adults' perceptions of their memory performance. The current study examined the longitudinal associations between self-reported memory problems and depressive symptoms to explore which symptom tends to appear first.

Method: Two datasets from ongoing observational, longitudinal studies of aging (Memory and Aging Project; Minority Aging Research Study) were used for secondary analyses. Older adults (n=1,724; M_{age}=77.03; SD=7.54; 76.80% female; 32.26% Black) completed up to 18 annual assessments of self-reported memory (two items: perceived decline in memory and frequency of memory problems) and depressive symptoms. Multilevel models were used to examine intra-individual variability and time-lagged relationships between self-reported memory and depressive symptoms.

Results: Concurrently, self-reported memory problems and depressive symptoms were significantly related; at times when older adults reported poorer memory, they also reported more depressive symptoms, regardless of the type of memory self-report. Prospectively, perceived memory decline predicted future depressive symptoms, but depressive symptoms did not predict future reports of memory decline. Self-reported frequency of memory problems did not predict future depressive symptoms or vice versa.

Conclusion: The current study's findings suggest a temporal relationship between perceived memory decline and depressive symptoms, such that perceived memory decline can lead to future depressive symptoms. These findings can inform future studies focused on developing a standardized assessment of self-reported memory that is separable from depressive symptoms.

Keywords

memory; depressive symptoms; self-report; temporality

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Disclosure of interest

The authors report no conflict of interest.

Introduction

In recent years, there has been an increased interest in self-reported memory problems as a predictor of subsequent cognitive decline (Kryscio et al., 2014; Rabin, Smart, & Amariglio, 2017). Identifying individuals who are at risk for future cognitive decline or Alzheimer's disease (AD) would support the implementation of preventative interventions earlier in the trajectory. However, isolating specific presentations of self-reported memory problems that are predictive of future cognitive decline has proved challenging. This may be due to the lack of sensitivity or specificity of tools assessing self-reported memory problems (Sperling et al., 2011). Inconsistent results also have been reported in previous studies that examined whether self-reported memory problems are related to one's objective memory performance (Lam, Lui, Tam, & Chiu, 2005; Lenehan et al., 2012; Mol, van Boxtel Willems, & Jolles, 2006; Snitz et al., 2015). For instance, two community-based longitudinal studies found that self-reported memory problems predicted future cognitive impairment (Jorm, Christensen, Korten, Jacomb, & Henderson, 2001; Koppara et al., 2015), whereas other two longitudinal studies by Pearman, Hertzog, and Gerstorf (2014) and Schofield et al. (1997) did not support the relationship. In addition, multiple cross-sectional studies have shown weak associations between self-reported memory and objective memory performance (Alegret et al., 2015; Crumley, Stetler, & Horhota, 2014). These conflicting results may reflect a variety of factors that can influence self-reported memory problems, such as depressive symptoms (Benito-León, Mitchell, Vega, & Bermejo-Pareja, 2010; Chin, Oh, Seo, & Na, 2014; Hohman, Beason-Held, & Resnick, 2011).

Literature has widely supported the co-occurrence of self-reported memory problems and depressive symptoms in older adults (Minett, Da Silva, Ortiz, & Bertolucci, 2008; Schweizer, Kievit, Emery, Cam-CAN, & Henson, 2018). For example, a study conducted by Pusswald et al. (2016) showed that of those who reported memory problems, 43% presented with depressive symptoms, significantly higher than those reporting no memory problems (17.4%). However, much research has relied on cross-sectional data, and whether depressive symptoms precede self-reported memory problems, or vice versa, is unclear (Hill et al., 2016). A close examination of the temporality of self-reported memory problems and depressive symptoms is crucial as multiple studies have shown that depressive symptoms are associated with an increased risk of cognitive decline and dementia over time (González, Bowen, & Fisher, 2008; Verdelho et al., 2013; Wilson et al., 2002; Yaffe et al., 1999; Dotson, Beydoun, & Zonderman, 2010). In addition, possible biological mechanisms such as vascular diseases, changes in glucocorticoid steroids, accumulation of beta-amyloid plaques, inflammatory changes, and lack of nerve growth factors connect depression and subsequent development of dementia (Byers & Yaffe, 2011). Disentangling the temporal association between self-reported memory problems and depressive symptoms may help identify an important target group to intervene earlier in the trajectory of AD.

Two psychological theories, Beck's cognitive theory of depression (Beck, 1967) and the identity process theory (Sneed & Whitbourne, 2003), together provide possible explanations for the bidirectional relationship between memory problems and depressive symptoms. Beck's theory proposes that negative thoughts about the self (e.g., believing oneself to be worthless), one's current life situations or surroundings, and the future, together lead to

depression (Beck, 1967). The identity process theory suggests that an inadequate balance between the self and experiences in the process of aging can contribute to feelings of insecurity, and "negative views of aging and the self" (Sneed & Whitebourn, 2003, p.314). When some older adults perceive that they have memory problems and begin to have doubt about their existing self-identity (i.e., being healthy) and cognitive abilities, they may develop negative thoughts such as fear of developing dementia (Sneed & Whitbourne, 2003). These persistent negative thoughts about their memory problems can negatively influence the way they view themselves, the world, and the future, leading to more depressive symptoms (Beck, 1967, Orth, Robins, & Meier, 2009; Orth, Robins, Trzesniewski, Maes, & Schmitt, 2009).

The two theories also suggest the opposite direction in which depressive symptoms may lead older adults to report memory problems. Beck's theory (1967) posits that people with depression tend to view their personal flaws in a more critical and biased way. Thus, older adults with more depressive symptoms may focus and complain more about their impairments, such as their memory problems, which may not match with their current self-identity such as being healthy. If these older adults continue to have memory issues, the mismatch between their experience and current self-identity may lead them to be more self-conscious, increasing the likelihood of reporting their memory problems (Sneed & Whitbourne, 2005).

Limited longitudinal studies have examined directional prospective relationships between self-reported memory problems and depressive symptoms. Yoon, Charness, Boot, Czaja, and Rogers (2017) found that depressive symptoms predicted subsequent ratings of frequency of memory problems and perceived memory decline over time. Some studies have instead examined self-reported memory as a predictor of future depressive symptoms. For instance, Singh-Manoux et al. (2014) found that older adults who report more memory problems at baseline are at a higher risk for developing depression in the future. In contrast, Mol, van Boxtel, Willems, Verhey, and Jolles (2009) found that self-reported memory problems were not associated with greater depressive symptoms over nine years. However, none of these studies specifically examined the reciprocal prospective associations between self-reported memory problems and depressive symptoms simultaneously.

Given that self-reported memory problems and depressive symptoms are closely associated, clarifying their temporal associations is critical for future examinations of their predictive utility for cognitive decline and AD. Longitudinal studies examining these relationships offer conflicting results, and to our knowledge, do not specifically examine the bidirectional links between self-reported memory problems and depressive symptoms. Therefore, the purpose of this study is to examine whether self-reported memory problems precede depressive symptoms, or vice versa, in older adults without cognitive impairment. Due to limited empirical evidence on the temporal relationship between self-reported memory problems and depressive symptoms, we offer no hypothesis. Based on theoretical underpinnings, self-reported memory problems may precede depressive symptoms, and vice versa.

Methods

A secondary analysis of longitudinal data from the Minority Aging Research Study (MARS; Barnes, Shah, Aggarwal, Bennett & Schneider, 2012) and the Memory and Aging Project (MAP; Bennett et al., 2012) was conducted in this study. MARS and MAP are clinical studies of aging in which community-dwelling older adults complete evaluations annually, including a detailed assessment of risk factors, neurological examination, and comprehensive neuropsychological testing. MARS data collection began in 2004, and up to 11 waves of data are available; MAP data collection began in 1997, and up to 18 waves of data are available. Briefly, MARS enrolls exclusively older adults without known dementia at baseline who identified themselves as African American. Participants of MARS were recruited from various community settings including churches, subsidized senior housing facilities, retirement communities, African American clubs, fraternities and sororities, and social service centers for seniors in the metropolitan Chicago area and its suburbs. Various African American communities in the city were reached to build relationship. With existing community-based advisory groups, outreach efforts were made. Through presentations at community facilities, details of the study and written information were provided for potential participants. Interested individuals completed a Rush Institutional Review Board approved form to described their interest in the study. Those who were interested were contacted to review and sign the written informed consent. A baseline evaluation was performed in the participant's home. Identical annual follow-up evaluations were performed by examiners who were unaware of previously collected data.

MAP recruited community-dwelling older adults from about 40 continuous care retirement communities and subsidized housing facilities in and around the Chicago metropolitan area. Study design and recruitment process were similar to MARS including educational outreach staff, but with two exceptions. All participants in MAP agreed to brain donation at the time of death, and that they did not have to identify themselves as African American. Both studies were approved by the Institutional Review Board of Rush University Medical Center (Bennett et al., 2012).

Demographic variables such as age, sex, education and income were obtained through a demographic questionnaire at baseline. Income was reported on a 10-point scale ranging from 1($0-$4,999) to 10 ($75,000 and over) which was recoded to a 3-point scale (−1 = $0–$19,999; 0 = $20,000–$49,999; 1 = $50,000 and over). Clinical evaluation made by a neuropsychologist and a clinician, cognitive performance tests, self-report, and medication inspection were used to make clinical diagnoses of dementia, AD, and MCI (Bennett et al., 2012). First, a decision tree that mimics clinical judgment was implemented by computer to make presumptive diagnoses of dementia and AD (Bennett et al., 2012). The clinician was asked to agree or disagree with these decisions which were then used to provide diagnoses of MCI and amnestic MCI by an algorithm. For instance, those participants who had cognitive impairment as indicated on cognitive performance tests but do not have a diagnosis of dementia by clinician were labeled MCI. A battery of eleven cognitive tests were used for diagnostic classification (Bennett et al., 2012). In this study, to describe the cognitive status of the participants, the Mini-Mental State Exam (MMSE; Folstein, Folstein, & McHugh,

1975) was used. The scores of MMSE range from 0 to 30. Higher scores suggest better cognitive performance (Mean = 28.38, SD = 1.61).

Sample

Eligible participants for this study were 65 years or older, had no prior diagnosis of dementia, and were not taking medications typically prescribed for AD. Those with probable mild cognitive impairment (MCI) were excluded. The eligible participants completed at least two of the annual follow-up clinical evaluations. The overall follow-up clinical evaluations among survivors is 90.5% for MARS (Barnes et al., 2012), and for MAP, the rate is close to 95% (Bennett et al., 2012). Among 2,470 older adults who had data available for the current study, 744 older adults received a diagnosis of MCI or dementia at some point during the study (n=562 MAP; n=182 MARS). There were missing data on diagnoses for two older adults and thus, they were excluded. The remaining 1,724 older adults (M_{age}=77.03; SD=7.54; 76.80% female; 32.26% Black; 67.74% White) were included in the current study. Participants in this study had, on average, 14.70 (SD = 3.39) years of education, and most (41.59%) had an annual income between $20,000 and $49,999; 30.51% of the sample had an annual income higher than $50,000, and 27.90% earned less than $20,000. For analyses, 13 individuals were further excluded as they did not provide information about their race (<1%). Two other individuals were excluded for missing data on primary measures. The sample for our primary analyses consisted of 1,709 older adults.

Measures

Self-reported memory problems—Two self-reported memory items were used in this analysis (Arvanitakis et al., 2018; Barnes, Schneider, Boyle, Bienias, & Bennett, 2006). The first question asked about *frequency* of memory problems: “About how often do you have trouble remembering things? Would you say it is very often, often, sometimes, rarely, or never?” The rating scale ranged from 1 (very often) to 5 (never). The second question asked about *perceived memory decline* over 10 years: “Compared to 10 years ago, would you say that your memory is much worse, a little worse, the same, a little better, or much better?” The rating scale for this question ranged from 1 (much worse) to 5 (much better). Higher scores on both items indicated fewer memory problems.

Depressive symptoms—A ten-item version of the Center for Epidemiologic Studies Depression scale (CES-D; Radloff, 1977) was used to assess depressive symptoms. The participants were asked whether they had experienced each of 10 symptoms (e.g., “I felt sad,” “I felt lonely”) in the past week (i.e., yes or no). The number of symptoms reported indicates the total depressive symptom score, ranging from 1 to 10; higher scores indicate more depressive symptoms. The CES-D has been established as a valid and reliable measure of depression (α = 0.90; Cosco, Prina, Stubbs, & Wu, 2017).

Analysis

Prior to the substantive analyses, descriptive analyses were conducted to examine demographics and distributions of variables. To test whether variables followed a normal distribution, we calculated skew and kurtosis (age skewness = −0.136, kurtosis = −0.424; education skewness = 0.176, kurtosis = 2.050; MMSE skewness = −3.724, kurtosis =

21.429; depressive symptoms skewness = 1.730, kurtosis = 2.927; frequency of memory problems skewness = −0.247, kurtosis = −0.315; perceived memory decline skewness = 0.395, kurtosis = 0.783). Only the MMSE had values above accepted cut offs for skew (Kline, 2015), and this was a predictor rather than an outcome variable. Then, correlational analyses were performed to explore the direction and strength of relationships among key variables.

Multilevel modeling (MLM) as implemented in SAS PROC MIXED was used for substantive analyses in this study to model intra-individual variability and to examine the time-lagged relationships. MLM is appropriate when annual observations are nested within individuals. MLM allows the use of maximum likelihood estimation to compute robust estimates when individuals have unequal amounts of follow up that results in some individuals missing data at later waves. First, intra-class correlations (ICC) for both self-reported memory problems and depressive symptoms were examined from empty models to identify the proportion of variance due to change over time. The first models examined whether individuals' depressive symptom scores predicted their concurrent reported frequency of memory problems and perceived memory decline, and vice versa. Next, we added time-lagged variables to examine the temporal sequence of depressive symptoms and self-reported memory problems. Using the time-lagged variables, these models tested whether individuals' current depressive symptoms scores predicted their future reported frequency of memory problems and/or perceived memory decline, and vice versa. Reported frequency of memory problems, perceived memory decline, and depressive symptoms scores were within-person centered to reflect changes within individuals over time. For all models, age at baseline, income, race, sex, and education were included as covariates. All continuous covariates were grand mean centered, and for each categorical variable, we selected an appropriate reference category (Table 1).

Results

Descriptive Statistics

Participant characteristics are provided in Table 1 and inter-correlations among key study variables are shown in Table 2.

Substantive Analyses

First, two models predicted individuals' current depressive symptoms based on their concurrent reported frequency of memory problems and perceived memory decline (see Table 3: models 1 and 2). At times when individuals reported more frequent memory problems, they tended to report more depressive symptoms ($b = -0.094$; SE= 0.016; $p < 0.001$). Also, at times when individuals reported that their memory declined over the past 10 years, they tended to report more depressive symptoms ($b = -0.139$; SE= 0.021; $p < 0.001$). Similarly, when predicting individuals' current reported frequency of memory problems and perceived memory decline based on their concurrent depressive symptoms (see Table 4: models 1 and 2), results showed that at times when individuals reported more depressive symptoms, they tended to report more frequent memory problems ($b = -0.031$; SE= 0.005; $p < 0.001$) and perceived greater memory decline ($b = -0.027$; SE= 0.004; $p < 0.001$).

In the next set of models, the lagged variables were added to test whether individuals' reports of memory problems predict future depressive symptoms (see Table 5: models 1 and 2) and vice versa (see Table 6: models 1 and 2). Participant ratings of frequency of memory problems did not predict depressive symptoms the following year ($b = -0.021$; SE = 0.018; p =0.238). However, when individuals reported that their memory declined over the past 10 years, they tended to report more depressive symptoms the following year ($b = -0.064$; SE= 0.024; $p < 0.01$). When examining the reciprocal relationship with depressive symptoms predicting future self-reported memory problems, depressive symptoms did not predict individuals' ratings on the frequency of memory problems the following year ($b = -0.004$; SE = 0.006; $p = 0.526$). Likewise, reporting more depressive symptoms did not predict the next year's self-reported perceived memory decline ($b = -0.009$; SE= 0.005; $p = 0.051$).

Discussion

This study investigated the temporal relationships between self-reported memory problems and depressive symptoms in cognitively normal older adults, with the goal of better understanding the complex associations between the two over time. Consistent with previous cross-sectional studies (Balash et al., 2013; Buckley et al., 2013; Zlatar, Muniz, Galasko, & Salmon, 2017), we found that self-reported memory problems and depressive symptoms were associated concurrently. That is, at times when older adults reported higher depressive symptoms, they also reported that their memory had declined over time and that they had more frequent memory problems, and vice versa. Whereas frequency of memory problems and depressive symptoms were concurrently related, no clear temporal association emerged between them. In contrast, there was a directional predictive relationship between perceived memory decline and depressive symptoms: self-reported memory decline predicted future depressive symptoms whereas depressive symptoms did not predict future reports of memory decline. In this sample, self-reported memory decline preceded depressive symptoms the following year.

We found that the two items assessing self-reported memory problems, frequency of memory problems and perceived memory decline, were differently associated with depressive symptoms when they were examined longitudinally. Self-reported frequency of memory problems may not be linked with future depressive symptoms as shown in our study. Frequency ratings are generally tied to perceptions of particular situations, and situation-specific beliefs tend to be relatively stable and stereotyped (Robinson & Clore, 2002). Thus, when a question about frequency of memory problems was asked, older adults could have referred to specific situations when they had trouble remembering things. Thinking of these specific experience of memory problems may result in the moment of stress and worry. However, some older adults may believe that it is normative to experience memory problems as they age as shown in a study conducted by Commissaris, Ponds, and Jolles (1998). Thus, there may be a disconnection between specific experience of memory problems and long-term negative emotions. This disconnection may have contributed to the unclear temporal relationship between self-reported frequency of memory problems and depressive symptoms that was found in this study. In contrast, our findings suggest that the item assessing perceived memory decline over 10 years may predict subsequent depressive symptoms. Older adults who perceive that their memory has declined over time may view

their future in a more pessimistic way, including fear of developing dementia or cognitive decline (Corner & Bond, 2004; Sneed & Whitbourne, 2003). According to Beck's cognitive theory of depression (Beck, 1967), these negative thought patterns about the self, the world, and the future can contribute to greater reporting of subsequent depressive symptoms. Therefore, the item assessing perception of memory decline may help predict future depressive symptoms.

This study emphasizes the importance of carefully selecting self-reported memory items when examining the relationship between self-reported memory problems and depressive symptoms, particularly in a longitudinal study. Despite concurrent associations between both self-reported memory items and depressive symptoms, we found that only perceived memory decline predicted future depressive symptoms, not self-reported frequency of memory problems. These varying associations may signify that the two items are assessing different aspects of self-reported memory. This is an important point to make as often a single-item is used to assess self-reported memory to dichotomously determine whether individuals report memory problems or not (Abdulrab & Heun, 2008). Yet, different subgroups of older adults may be distinguished by different self-reported memory items. For instance, Tobiansky, Blizard, Livingston, and Mann (1995) found that out of nine self-reported memory items, one was associated with future development of depression (being embarrassed by their perceived memory problem), and two items were associated with future dementia (forgetting what they have read or heard and claiming that their memory posed a significant problem for them). Therefore, a single self-reported memory item may limit predictive utility. Future studies should focus on the development of a standardized assessment of self-reported memory problems that adequately separates different aspects of memory self-report.

An educational intervention improving older adults' perception of memory decline may help address future depressive symptoms. Perceiving cognitive decline over time can be distressing and can restrict social functioning, negatively impacting the quality of life (Pusswald et al., 2016). This is especially applicable to older adults who report both memory problems and depressive symptoms. For instance, Pusswald et al. (2016) found that older adults who reported memory problems and depressive symptoms showed reduced physical and mental health-related quality of life compared to the control group without both symptoms. The combined effects of perception of one's memory decline and depressive symptoms significantly permeate everyday living of older adults, negatively impacting their quality of life. Therefore, improving older adults' perception of memory decline may help prevent subsequent depressive symptoms.

One of the main limitations of this study is the measurement of self-reported memory problems. Only two items (frequency of memory problems and perceived memory decline) were used to assess participants' self-reported memory and these items may be particularly sensitive to some types of response bias (Hill et al., 2018). For instance, the item assessing perceived memory decline yearly (i.e., compared to 10 years ago, how would you rate your memory?) can introduce a recall bias, and result in an inaccurate self-assessment of perceived memory decline (Robinson & Clore, 2002). A wide timeframe to recall an event, such as 10 years ago, requires older adults to estimate relevant events and answer the item

based on their generalized beliefs or emotions rather than specific events, and this can contribute to response bias (Cavanangh, Feldman, & Hertzog, 1998; Robinson & Clore, 2002). Additionally, annual assessments of depressive symptoms and memory problems may not fully capture the variation in daily memory lapses and emotional experiences. Another limitation is due to the recruitment of older adults to engage in an intensive annual assessment like that in the current protocol. However, the sample was very racially diverse with about 32% of the sample identifying as Black. This diversity enhances generalizability of the findings beyond White older adults (the group most typically represented in previous investigations of similar relationships). The findings of this study can be generalized to community dwelling African American and White older adults without MCI and dementia

Conclusion

Understanding the temporal associations between self-reported memory problems and depressive symptoms is crucial for future examinations of their predictive utility for cognitive decline and AD. Findings of the current study suggest that perceived memory decline may result in future depressive symptoms. No detectable temporal association between frequency of memory problems and depressive symptoms was found. This study highlights how different self-reported memory items are linked to different experiences of memory problems and therefore, differentially related to outcomes of interest such as depressive symptoms. Moreover, this study reinforces the temporal complexity of the relationship between self-reported memory problems and depressive symptoms.

Acknowledgements

This work is supported by National Institute on Aging under Grant [R01AG055398] to N.H; [R01AG022018] to L.L.B; and [R01AG017917] to D.A.B.

The authors thank the Minority Aging Research Study (MARS) and the Rush Memory and Aging Project (MAP) research teams and the participants for their contributions to the two studies.

Data Availability Statement

The data that support the findings of this study are available from Rush Alzheimer's Disease Research Center (RADC). Any request to produce the data on which this manuscript is based for examination should be directed to the RADC (https://www.radc.rush.edu/). I am unable to personally attest to the provision of data, but would assist the editor or other researchers with any information needed if data were to be requested from RADC.

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Table 1.

Participant characteristics (n=1724)

Characteristic	
Age, years, mean ± SD	77.03 ± 7.54
Sex, n (%) (ref = Male)	
Female	1324 (76.80)
Male	400 (23.20)
Race*, n (%) (ref = White)	
White	1159 (67.74)
Black	552 (32.26)
Education, years, mean ± SD	14.70 ± 3.39
Income level, n (%) (ref =$20,000-$49,999)	
$0-$19,999	481 (27.90)
$20,000-$49,999	717 (41.59)
>$50,000	526 (30.51)
MMSE score, mean ± SD	28.38 ± 1.61
CES-D, mean ± SD	1.15 ± 1.65
Frequency of memory problems, mean ± SD	2.78 ± 0.91
Perceived memory decline, mean ± SD	2.16 ± 0.62

Note. MMSE = Mini-Mental State Examination; CES-D = Center for Epidemiologic Studies Depression Scale;

*Data were missing for 13 participants

Table 2.

Inter-correlations among key study variables at baseline

	1	2	3	4	5
1. Age	-				
2. Education	−0.040***	-			
3. CES-D	0.060*	−0.164***	-		
4. Frequency of memory problems	−0.040	0.027***	−0.208***	-	
5. Perceived memory decline	−0.029	−0.013*	−0.163***	0.613***	-
6. MMSE	−0.288***	0.168***	−0.166***	0.120***	0.017

Note. CES-D = Center for Epidemiologic Studies Depression Scale; Frequency of memory problems = How often do you have trouble remembering things?; Perceived memory decline = Compared to 10 years ago, how would you you're your memory?; MMSE = Mini-Mental State;

*** $p < .001$.

** $p < .01$.

* $p < .05$.

Table 3.

Results for the multilevel models examining self-reported memory problems predicting depression

	Depression	
Variables	**Model 1 b (SE)**	**Model 2 b (SE)**
Within person frequency of memory problems	−0.094 (0.016)***	-
Within person perceived memory decline	-	−0.139 (0.021)***
Age	0.013 (0.004)***	0.013 (0.004)**
Income (ref =$20,000-$49,999)	−0.325 (0.038)***	−0.327 (0.038)***
Sex (ref = Male)	−0.068 (0.032)*	−0.068 (0.032)*
Race (ref = White)	−0.053 (0.033)	−0.053 (0.033)
Education	−0.057 (0.009)***	−0.057 (0.009)***
Follow up year	0.021 (0.004)***	0.021 (0.004)***

Note: Frequency of memory problems = How often do you have trouble remembering things?; Perceived memory decline = Compared to 10 years ago, how would you you're your memory?;

*** p<.001.

** p<0.01.

* p<0.05

Table 4.

Results for the multilevel models examining depression predicting self-reported memory problems

	Frequency of Memory Problems	Perceived Memory Decline
Variables	**Model 1 b (SE)**	**Model 2 b (SE)**
Within person CES-D	−0.031 (0.005)***	−0.027 (0.004)***
Age	−0.010 (0.002)***	−0.007 (0.001)***
Income (ref =$20,000-$49,999)	0.066 (0.020)**	0.002 (0.014)
Sex (ref = Male)	0.012 (0.017)	0.047 (0.012)***
Race (ref = White)	0.047 (0.017)**	0.016 (0.012)
Education	−0.002 (0.005)	−0.009 (0.003)**
Follow up year	−0.017 (0.002)***	−0.012 (0.002)***

Note: CES-D = Center for Epidemiologic Studies Depression Scale; Frequency of memory problems = How often do you have trouble remembering things?; Perceived memory decline = Compared to 10 years ago, how would you you're your memory?;

*** $p<.001$.

** $p<0.01$.

* $p<0.05$

Table 5.

Results for the multilevel models examining lagged self-reported memory problems predicting depression

	Depression	
Variables	**Model 1 b (SE)**	**Model 2 b (SE)**
Lagged frequency of memory problems	−0.021 (0.018)	-
Within person frequency of memory problems	−0.085 (0.018)***	-
Lagged perceived memory decline	-	−0.064 (0.024)**
Within person perceived memory decline	-	−0.137 (0.023)***
Age	0.018 (0.004)***	0.018 (0.004)***
Income (ref =$20,000-$49,999)	−0.306 (0.042)***	−0.301 (0.042)***
Race (ref = White)	−0.040 (0.035)	−0.045 (0.035)
Sex (ref = Male)	−0.075 (0.035)*	−0.080 (0.035)*
Education	−0.060 (0.010)***	−0.061 (0.010)***
Follow up year	0.022 (0.004)***	0.022 (0.004)***

Note: CES-D = Center for Epidemiologic Studies Depression Scale; Frequency of memory problems = How often do you have trouble remembering things?; Perceived memory decline = Compared to 10 years ago, how would you you're your memory?;

*** $p<.001$.

** $p<0.01$.

* $p<0.05$

Table 6.

Results for the multilevel models examining lagged depression predicting self-reported memory problems

	Frequency of Memory Problems	Perceived Memory Decline
Variables	**Model 1 b (SE)**	**Model 2 b (SE)**
Lagged CES-D	−0.004 (0.006)	−0.009 (0.005)
Within person CES-D	−0.027 (0.006)***	−0.027 (0.005)***
Age	−0.012 (0.002)***	−0.007 (0.002)***
Income (ref =$20,000-$49,999)	0.066 (0.022)**	0.004 (0.016)
Race (ref = White)	0.062 (0.018)***	0.063 (0.014)
Sex (ref = Male)	0.012 (0.018)	0.044 (0.013)**
Education	−0.003 (0.005)	−0.007 (0.004)
Follow up year	−0.020 (0.003)***	−0.012 (0.002)***

Note: CES-D = Center for Epidemiologic Studies Depression Scale; Frequency of memory problems = How often do you have trouble remembering things?; Perceived memory decline = Compared to 10 years ago, how would you you're your memory?;

*** $p<.001$.

** $p<0.01$.

* $p<0.05$