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A Link between Subjective Perceptions of Memory and Physical Function: Implications for Subjective Cognitive Decline

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Abstract

Subjective impairment in memory is a frequently defining feature of subjective cognitive decline (SCD), a state hypothesized to precede objectively apparent cognitive symptoms of Alzheimer's disease (AD) and to hold promise as a non-invasive, inexpensive, preclinical indicator of AD. However, a full model of the factors that contribute to subjective memory (SM), and therefore to SCD, has yet to be articulated. While SM impairment is widely known to be associated with negative affect, the extent to which SM functioning may also reflect other factors, particularly subjective beliefs or perceptions about one's health, is not known. To examine the extent to which SM is associated with subjective perceptions of health more broadly, the current study investigated the link between SM and subjective physical functioning (independent of depressive affect, and objective cognitive and physical function) in an ethnically diverse sample of 471 older adults enrolled in the population-based Northern Manhattan Aging Project. 199 (42%) participants endorsed no difficulty on a 5-point SM index while 272 (58%) endorsed some degree of difficulty. As hypothesized, SM correlated with both depression and subjective physical function, but not with age, education, global cognition, or objective physical function. When objective and subjective physical function were entered in two separate, adjusted linear regressions predicting SM, only subjective physical function and depressive affect independently predicted SM. Subjective perceptions of memory appear to reflect individuals' broader health perceptions in part. Articulating the various correlates of SM will improve identification of SCD specific to preclinical AD.

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Keywords

Memory complaints; preclinical Alzheimer's disease; subjective cognition; subjective cognitive decline; subjective memory

INTRODUCTION

Subjective cognitive decline (SCD), per recent consensus guidelines, is a state defined by the subjective perception of cognitive decline in the context of normal age-, gender-, and education- adjusted performance on standardized cognitive tests that are used to make a diagnosis of mild cognitive impairment (MCI) or dementia [1]. As defined, SCD may encompass complaints about subjectively perceived decline in memory or non-memory domains. Subjective memory (SM) or other cognitive impairment in the context of cognitive functioning deemed within normal limits on objective assessment has been considered a potentially early marker of dementia for over 20 years [1–18]. Reisberg and colleagues estimated that subjective perceptions of decline can occur approximately 15 years prior to the onset of clinically apparent cognitive symptoms (i.e., MCI) [19], and the recent development of new imaging technologies and disease biomarkers has reinforced the idea that SCD could indicate the early presence of Alzheimer's disease (AD) pathology [20–22].

However, subjective cognition is a complex construct that remains incompletely understood. The utility of SCD as a marker for prodromal AD presumes that SCD reflects subtle, disease-based cognitive decline. However, it has been established that an individual's subjective perception and/or report of cognitive decline reflects not only disease-driven cognitive symptoms, but a host of characteristics specific to the individual, including but not limited to acute affective states such as depression or anxiety as well as more stable personality traits such as neuroticism [16, 23–27]. Indeed, the link between depressive symptoms and subjective impairment has been shown to contribute to the misdiagnosis of MCI [28]. Thus, Jessen and colleagues clearly identify psychiatric comorbidities, subthreshold psychiatric symptoms, and personality traits as factors that must be assessed and considered when researching SCD [1].

However, the full range of factors that may contribute to subjective cognitive states, and which should therefore be considered when assessing SCD, is unclear. There is reason to believe that an individual's subjective belief systems including but not limited to beliefs about perceived control [29], subjective age, or age essentialism (i.e., the degree to which aging is believed to be an immutable process) have the potential to shape the perception of cognition in later life [30–32]. For example, Luszcz and colleagues (2015) recently examined older adults' subjective belief systems related to various health domains [29]. The authors found a strong correlation between locus of control (internal versus external) for memory and locus of control for physical health ($r = 0.69$), suggesting that subjective belief systems may transcend specific health domains. However, the authors did not directly examine whether participants had complaints about memory or whether negative affect mediated beliefs about memory and physical functioning. Indeed, negative affect is known to be associated with reduced perceptions of both physical [33, 34] and cognitive

functioning [23, 27]. Finally, the extent to which beliefs about cognitive and physical functioning may be linked at the level of objective decline in these domains versus linked at the level of self-perception only, is not clear.

In a step toward more comprehensively characterizing the variables that contribute to SM in non-demented older adults, the current study examined the extent to which SM has selective associations with subjective physical health, above and beyond any association with depressive affect, or objective cognitive and physical health. Indicators of physical function included measures of gait and hearing, two abilities that frequently decline with age, have relevance for important health outcomes and quality of life [35–38], and have been shown to differ across subjective and objective assessment methods [39, 40]. In line with existing work, we hypothesized that SM would be associated with depressive affect. However, based on the idea that subjective belief systems may influence SM, we expected an association between SM and subjective physical function independent of objectively measured function in these areas, or depressive affect.

METHODS

Participants

Individuals in the study were drawn from a sample of community dwelling older adults enrolled in the North Manhattan Aging Project (NMAP), a longitudinal study (funded by the National Institutes of Health) conducted between 1990 and 1996, by a consortium at Columbia University, including what is now the Stroud Center for Study of Quality of Life in Health and Aging. Details of the NMAP have been published previously [41]. In brief, the NMAP included 1,773 Medicare beneficiaries aged 65 years and older, randomly selected from a geographic area encompassing 13 adjacent census tracts in North Manhattan. Face to face assessments were made mostly in the subject's home, at baseline in 1990 and every 18 months thereafter, for a total of three waves of interviews.

Measures

Trained research assistants administered a computer-assisted interview, the Comprehensive Assessment and Referral Interview (CARE), covering a wide range of functions across many areas of life including cognitive abilities, affective, social, and psychological status, selected medical and psychiatric conditions, as well as activities related to health care utilization [42, 43]. The CARE survey-assessment method consists of 22 scales (e.g., cognitive impairment, depression, subjective memory, ambulation, hearing) derived from a biometric approach to delineating clusters of items, whose concurrent and predictive validity has been demonstrated [44]. All of the measurements below represent items within the CARE.

Subjective memory

The CARE includes a ten-item scale of subjective memory complaints. Previous analyses yielded two equal clusters of five subjective memory items, one cluster assessing the presence of memory difficulty and another cluster assessing whether the memory difficulty is functionally restrictive or not [42, 45]. To be consistent with current conceptualizations of SM impairment as preceding the onset of functional restriction (in the context of SCD), the

current study included only the first cluster of subjective items querying the presence of memory complaints, producing an SM index ranging from zero to five, with higher scores indicating more complaints about SM (Table 1).

Physical function

Indicators of physical function were selected based on the availability of measures that assessed specific physical abilities both objectively (i.e., observed by examiner) and subjectively (i.e., reported by the participant). Two markers of physical function, hearing and gait, met this criterion. Hearing was rated objectively by the examiner based on hearing difficulty observed during the interview, and rated subjectively by the participant (i.e., “Do you have difficulty hearing?”). Gait was rated objectively by the examiner based on difficulty in walking observed during evaluation, and rated subjectively by the participant (i.e., “Do you have difficulty walking indoors?”). All variables were scored dichotomously. The two objective markers were summed, as were the two subjective markers, creating two separate index scores ranging from zero to two for objective physical function and subjective physical function (SPF). Higher scores indicated worse functioning.

Global cognition

Global cognition was measured with a 12-point scale embedded in the CARE, assessing elements of orientation, memory, semantic knowledge and basic comprehension, that has demonstrated good construct and predictive validity [44, 46]. Higher scores indicate worse cognition.

Depressive affect

Symptoms of depression were measured with a 32-point scale embedded in the CARE including both affective and somatic symptoms as well as several items regarding general worry and anxiety. The psychometric properties of this scale have been well established, including high internal consistency, interrater reliability, as well as convergent and predictive validity with clinical diagnosis of depression [42–44, 46–49]. Higher scores indicate more symptoms.

Procedures

All procedures in this study complied with APA ethical standards and guidelines on human experimentation, and were IRB approved. Interviews were conducted in either English or Spanish. As part of their participation in the study, 859 participants underwent a formal dementia diagnostic evaluation previously described in detail [50]. An independent diagnosis of dementia was made, blind to the CARE survey findings, by a multidisciplinary team conducting an extensive clinical and psychological examination. Specifically, the dementia evaluation consisted of two independent components: neuropsychological testing and examination by a physician including a semi-structured medical and psychiatric history, a physical and neurological examination, as well as measures of activities of daily living. Information gathered from each evaluation was integrated to form a clinical judgment of cognitively normal, cognitively impaired, or dementia.

Of those evaluated for dementia, 615 participants were diagnosed as non-demented, 605 of whom had available data for the SM index. To maintain consistency with the idea that SM impairment occurs as part of a subjective state preceding observable deficits in cognition or function (SCD), the study sample excluded 119 individuals who endorsed being functionally restricted by SM difficulty on any of the 5 items assessing the impact of SM problems (*Do problems with your memory make it difficult for you to take care of personal business*). The sample also excluded 15 individuals with missing data for physical function. The final sample ($n = 471$) included individuals who endorsed no SM difficulty ($n = 199$; 42.3%) or some degree of SM difficulty without restricted functioning ($n = 272$; 57.7%).

Data analysis

Descriptive analyses were conducted to determine the rate of endorsement for each of the five items in the SM index (Table 1) and the mean level of SM and other variables of interest. Bivariate correlations adjusted for multiple comparisons and between group analyses were planned to identify the demographic and clinical covariates of SM as well as the associations between objectively measured and subjectively perceived cognitive and physical function indices. Item level analyses were conducted using ANOVA and chi-square tests to determine the extent to which certain items in the SM index may have differential associations with the constructs of interest. Finally, objective and subjective physical function variables ($r = 0.48$) were entered into two adjusted linear regression models to examine the extent to which subjective and objective physical functioning each predicted SM independently of depressive affect. SPSS 23 was used for all analyses.

RESULTS

Nearly half of the sample endorsed no SM difficulty while 57.7% endorsed difficulty in at least one SM item. 12.5% endorsed only 1 item, 20.2% endorsed 2 items, 15.1% endorsed 3 items, and 7.4% and 2.5% endorsed 4 and 5 items respectively. The item endorsed most frequently was *more difficulty remembering things than it used to be* (37.6%) and the item endorsed least frequently was *difficulty remembering the names of people in your family or close friends* (11.7%). Table 1 presents frequency data for each individual SM item. Tables 2 and 3 present frequency data for each item included in the subjective physical function index as well as the examiner rated physical function index. Whether subjectively reported or examiner rated, the vast majority of participants were characterized as having neither walking nor hearing difficulties. Given that the SM and physical function variables were not normally distributed, non-parametric analyses were used to examine associations between the variables of interest.

Table 4 presents mean SM score as well as descriptive information for all measured demographic, cognitive, and physical function variables. On average, participants endorsed fewer than one of the physical symptoms (gait or hearing difficulty) and demonstrated fewer than one of these difficulties upon evaluation by the examiner. 20% of the sample ($n = 94$) scored above a previously published cut-off for depression, and 7% ($n = 35$) scored above the cut-off for cognitive impairment [44].

With regard to the analyses of SM in relation to demographic, cognitive, and physical function variables, Kruskal-Wallis tests revealed no association between SM and gender ($p > 0.05$) or self-identified race ($p > 0.05$). Spearman correlations revealed associations between SM and depressive affect as well as subjective physical function. SM was not associated with demographic variables including age and education, or with objective measures of cognition or physical function (Table 5). As expected, objective cognition was associated with depressive affect, age, and education, and it was also associated with objective physical function. Subjective physical function was associated with depressive affect, age, and objective physical function. Finally, objective physical function was also related to depressive affect and age. All bivariate associations are presented in Table 5.

Item level analyses were conducted with each of the five items comprising the SM index, in relation to objective physical function, subjective physical function, and depression. Adjusting for multiple comparisons, results were considered significant at $p < 0.003$. Item 1, *difficulty with memory*, was associated with both SPF ($\chi^2 = 11.44$, $p = 0.003$) and depression ($F(1,469) = 37.89$, $p < 0.001$). Item 2, *difficulty remembering things just read or heard*, was associated only with depression ($F(1,469) = 22.34$, $p < 0.001$). Item 3, *difficulty remembering names of family or close friends*, was not associated with any of the three constructs. Item 4, *difficulty finding the right word*, was associated only with depression ($F(1,469) = 40.40$, $p < 0.001$). Finally, Item 5, *more difficulty remembering things than it used to be*, was associated with both SPF ($\chi^2 = 14.89$, $p = 0.001$) and depression ($F(1,469) = 61.75$, $p < 0.001$). None of the individual SM items was associated with objective physical function.

Objective and subjective physical function were each entered separately as predictors of SM in two linear regression models adjusted for depressive affect, global cognition, and age. Both overall models were significant, but only depressive affect and subjective physical function had independent associations with SM (Table 6). Results were maintained when SM was log transformed to reduce positive skew (data not shown). Also not shown, when subjective and objective physical function were entered as predictors of SM in a single model, subjective physical function and depressive affect maintained an association with SM in the expected direction, however, a negative association emerged between objective physical function (i.e., more SM difficulty was associated with better objective physical function). As a high correlation between the two physical function measures ($r = 0.48$) may have led to this result, only results from the two separate adjusted models are discussed.

DISCUSSION

SCD is receiving increasing attention as a potentially early indicator of AD, one that could easily serve as a means of enriching secondary prevention trials with individuals who may be more likely to show AD biomarker positivity [51]. Indeed, rapidly emerging work has linked SCD to the presence of brain amyloid [20, 21, 52, 53] and other AD biomarkers such as medial temporal lobe volume [17], cerebrospinal fluid profile [22], and patterns of grey matter atrophy [14]. Most recently, SCD was shown to have an independent association, above and beyond objectively measured memory, with both amyloid beta and neurodegeneration in cognitively normal individuals [21].

Although SCD holds promise as a preclinical marker of AD and other dementias, the basis of SCD in non-demented older adults is certain to be multifactorial. As such, a number of older adults who experience SCD will not progress to develop dementia over time. For both physicians and patients, it is therefore important to comprehensively determine the factors that influence the subjective perception and report of memory and other cognitive changes when individuals are ostensibly cognitively healthy. The contribution of affective functioning to SCD has been well established, with many studies documenting increased cognitive complaints in individuals with negative affect including depression and anxiety. Little is known, however, about whether subjective cognition also reflects an individual's beliefs, concerns, or perceptions about his or her health and functioning more broadly. The current study examined this issue by investigating the extent to which SM impairment, a common feature of SCD, and subjective physical functioning were selectively associated.

Summary of main results

In the current study, bivariate analyses revealed no associations between SM and age, education, race, gender, global cognition, or objective physical function. Rather, SM showed the strongest association with depressive symptoms, but as predicted, was also selectively associated with subjective impairment in physical functioning related to hearing and gait. When subjective and objective physical health were entered into two separate adjusted models as predictors of SM, only depressive affect and subjective physical function had independent associations with SM. Finally, examination of individual items from the SM index revealed that subjective physical function was linked only with general memory complaints (e.g., *I have difficulty with my memory*). In contrast, depressive affect was related to both general and specific memory complaints (e.g., *I have difficulty remembering things that I have just read or heard*). The current results support longstanding evidence that SM is associated with affective functioning, and also provide novel information to suggest that SM (and perhaps certain forms SM) in part reflect perceptions of health more broadly.

Nature of subjective memory complaints

Participants endorsed an average of 1.4 of five SM symptoms, with over half of the sample (58%) endorsing at least one symptom. Based on the applied inclusion and exclusion criteria, this finding under-represents the total number of non-demented individuals in the overall study who endorsed SM difficulty ($n = 391$; 66%), as those participants who reported being restricted by their SM difficulty ($n = 119$) were excluded. Of the five specific memory complaints that comprised the SM index, participants were most likely to report that it is more difficult to remember things *than it used to be*, a finding that is not surprising given the well-established age-related changes in cognition that occur over time. Indeed, previous work from our lab demonstrated that cognitively healthy older adults were much more likely to say that their mind is not as clear *as it used to be* (47%) than to endorse other types of cognitive deficits that were not framed in reference to previous levels of performance [54]. Not surprisingly, individuals in the current study were least likely to endorse having difficulty remembering the names of family members or close friends, a symptom that is more characteristic of AD than healthy aging.

The relatively high rate of any type of SM difficulty in this study (66% including those that are perceived to be functionally restrictive) is relatively consistent with rates from previous studies of non-demented individuals who endorsed memory difficulties when asked about their memory in general [54], or in reference to previous levels of memory functioning [8, 55]. Of note, in previous work, we showed that dramatically fewer individuals (3%) endorsed difficulties when asked if their memory was worse than others their age (i.e., age-anchored SM), and that age-anchored SM was most highly associated with objective performance on a memory task [54]. Taken together, results across studies suggest that cognitive complaints can be quite common when older adults evaluate their abilities in general rather than in direct comparison to peers, and that age-anchoring (or another form of anchoring judgments to an expected level of performance) may thus be important when querying individuals about SCD.

In the current study, in which SM was not age-anchored, it is thus not surprising that rates of SM complaints were relatively high and that level of SM was unrelated to objectively measured global cognition. It is quite conceivable that a global cognitive screening measure would not detect subtle cognitive changes experienced by non-demented individuals, and that SM may have been associated with objective cognition if compared against a more challenging measure of episodic memory, for example. However, the purpose of the current study was not to establish an association (or lack thereof) between SM and cognition. Rather, the intent was to determine the extent to which SM may be associated with subjective perceptions or beliefs about health that are not specific to cognition. To our knowledge, this was the first study to have the explicit goal of understanding whether or not subjective perceptions of cognitive and physical health are related, and whether this association exists apart from measured function in these areas or depressive affect.

Depressive affect

As many previous studies have indicated [23, 27], the current study found that SM difficulty was most strongly related to depressive affect. Interestingly, analysis of the SM items in the current study revealed that depressive affect was linked not only to general memory complaints (*I have difficulty with my memory*), but to specific memory complaints as well, such as difficulty remembering information that was just read, or difficulty remembering the right word. The basis of the association between memory complaints and depressive affect is not entirely clear and there are several potential, not mutually exclusive, explanations for this association. First, Dux and colleagues have posited an extension of the symptom perception hypothesis as a potential basis for the link between depression and memory complaints [24]. The symptom perception hypothesis suggests that individuals with negative affect vary in the manner in which they experience, respond to, and report bodily sensations with high levels of negative affect leading to increased attention to and complaints about somatic symptoms [33, 34]. This may be extended to include cognitive symptoms according to Dux and colleagues. A second possibility is that cognitive functioning is truly compromised in the context of mood disturbance, and thus accurately reported as such; indeed, individuals experiencing negative affect demonstrate cognitive difficulties which may reflect symptoms of depression such as inattention and poor concentration [56, 57]. A third possibility is that symptoms of memory loss and negative affect jointly reflect an underlying degenerative

process [58, 59]. Indeed, despite the field's efforts to tease apart changes in subjective and objective cognition that stem from negative affect versus a neurodegenerative process, there is recent evidence that depression and certain personality styles such as neuroticism place individuals at increased risk for AD [60, 61]. Additional work on the longitudinal course of these various phenotypes is therefore needed to more fully understand the basis of the association between SM difficulty and depressive affect.

Subjective physical functioning

We hypothesized that SM would be associated with subjective physical functioning, independent of depressive affect or objective physical functioning. While several studies of SM have linked it to physical functioning, they have not examined the extent to which this association arises because of changes in both cognition and physical function, or whether it exists at the level of self-perception [23, 62, 63]. The current study therefore carefully matched subjective and objective measures of physical function to disentangle this issue. Based on previous work, we expected to find some dissociation in subjectively versus objectively measured physical functions examined in this study (i.e., gait and hearing).

Gait is an important functional marker predictive of a variety of key outcomes in older adults including disability [64] and mortality [37]. There is evidence that objectively and subjectively rated gait are not entirely overlapping. For example, meaningful differences in objectively measured long-distance corridor walking (400 meters) were demonstrated among 3,075 older adults able to walk without the assistance of a device, and who all *reported no difficulty* walking a quarter of a mile, climbing one flight of stairs without resting, or performing basic activities of daily living [40]. Approximately 12% of these individuals were unable to complete the objective walking evaluation, and of those who finished, completion times ranged from 3.35 minutes to 15.7 minutes. Thus, significant variability in objective performance was observed among individuals with similar subjective ratings of gait. Similarly, ratings of hearing impairment, a frequent disability among older adults that has been linked to depression [36] and poor quality of life [35], have been shown to diverge across objective versus subjective measurements. Choi and colleagues (2016) suggest that differences in the correlates of hearing ability across studies may reflect variability in the use of these different types of assessment methods [39]. Their group demonstrated a 69% agreement rate between objective audiometric and subjectively rated hearing impairment in a sample of 1,669 older adults in the nationally representative National Health and Nutrition Examination Survey (NHANES), with the majority of misclassifications attributable to subjective over-estimation of hearing ability.

In the current study, 23% of participants endorsed having difficulty in at least one of the measured physical functions (gait or hearing), and 20% were rated by the examiner to have difficulty in at least one. While the subjective and objective indices of physical function were correlated, as hypothesized, only the subjective physical function index was associated with SM. Moreover, this association was independent of depressive affect, suggesting that perceptions of cognition may in part reflect perceptions of health more broadly. While the current study did not directly examine subjective belief systems, this was the first study to demonstrate an independent link between cognitive and physical subjective experiences, and

current findings might be interpreted in the context of various types of subjective belief systems. For example, there is evidence from a community sample that in comparison to those without SM difficulty, individuals aged 60–64 years who complain about their memory have lower general levels of mastery, or sense of control over one's life [23]. However, the contribution of this belief system, or psychological phenomenon, did not remain significant when entered simultaneously along with other variables such as gender, self-reported physical health, cognition, history of head injury, ruminative personality style, and self-reported mental health, perhaps due to the overlapping nature of some of these predictors. More recently, Luszcz and colleagues (2015) demonstrated an association between control beliefs regarding memory and control beliefs regarding health, describing the result as “a hitherto unreported cross-fertilization of health and memory beliefs.” The authors argued that the association between different types of health beliefs may have relevance for understanding the basis of SM complaints in some individuals. It is also possible that individuals hold subjective beliefs surrounding their health in particular, but which transcend different domains of functioning. For example, when Choi and colleagues examined the associations between hearing and other aspects of physical health using both subjective and objective methods, the associations of the greatest magnitude were those between self-rated hearing and self-rated physical health [39]. The authors interpreted the strong connections between subjective perceptions as potentially reflective of *health pessimism*, or the tendency to endorse difficulties across multiple domains of health [65]. Other related but distinct constructs gaining attention for their potential role in the experience of aging such as subjective age, age identity, or age essentialism [30, 31] may also factor into an older adult's perception of their memory abilities. Such constructs, discussed widely in the fields of geropsychology and lifespan psychology but not typically considered in the cognitive diagnostic process, may offer important information as the field moves toward a more complete model of SCD.

Examination of memory complaints at the item level has the potential to shed light on the various factors that contribute to SCD. Interestingly, analysis of the five individual SM items in the current study revealed that subjective physical function was associated only with items representing general memory complaints (difficulty with memory), and not with more specific memory complaints (i.e., difficulty remembering the right word, or information that was just read). As mentioned above, this selectivity in item level associations was not seen for depressive affect, a construct that was related to *both* general and specific memory complaints. The different pattern of associations between SM and SPF, versus SM and depression, highlights the heterogeneous nature of SM complaints. Moreover, while speculative, results from item level analyses suggest that the type of memory complaints endorsed by an individual has the potential to provide information about the etiology or context of the complaint. That is, complaints restricted to memory in a broad sense could in part reflect subjective belief systems (i.e., low health related perceived control), whereas complaints about difficulty remembering specific types of information may be more likely to arise with negative affect (either because such memory difficulties lead to negative affect, are caused by negative affect, or along with negative affect reflect a joint etiology such as AD). Ultimately, future work employing techniques such as structural equation modeling

will be critical for determining more directly the latent constructs underlying various forms of subjective cognition, subjective physical health, and mood.

Taken together, the current data suggest that assessment of SM, and the more formally defined construct of SCD, may be fine-tuned by consideration of an individual's health and health perceptions more broadly, to determine the extent to which cognitive concerns are isolated, or linked to other health-based concerns. Understanding the various contributors to SCD will enhance the field's ability to determine the circumstances under which SCD signals preclinical AD. While the field is cognizant of the co-occurrence of SCD and depression, greater attention needs to be paid to health more broadly, as well as relatively stable perspectives and beliefs that may serve to increase SCD in the absence of depression. Longitudinal studies assessing mood, subjective cognition, and health more broadly, in addition to sensitive, objective gold standards of cognitive and physical health, are needed to disentangle the complicated associations between these various constructs and their relevance for pathologic cognitive aging.

While the immediate goal of the current paper was to better understand the factors which contribute to SCD, this work also aims to inform our understanding of how we may improve perceived weaknesses in memory among older adults in the interest of enhancing overall quality of life (QOL). The finding that subjectively rated memory and health are associated, independently of depression or objective levels of functioning in these areas, provides some insight into the potential effects of an individual's belief systems on their subjective health and identifies a potential means of intervening to improve QOL. Ongoing work by our group is dedicated not only to improving the specificity of SCD as a marker of preclinical AD, but to disentangling the various causes of cognitive concerns among community dwelling older adults (e.g., mood, typical aging, degenerative disease, belief systems), the effects of cognitive concerns on important patient-centered outcomes (e.g., QOL, well-being), and considering the various pathways by which subjectively perceived cognitive changes may be best managed.

There are several limitations to the current study. First, our physical function index consisted of only two items. Ideally, we would have had access to a more comprehensive assessment of physical function. However, our priority in this retrospective analysis was to obtain performance indicators available through both objective and subjective assessment in order to isolate differences across these aspects of health that were linked specifically to the manner of rating, and not the functions that were being assessed. Future work should prospectively equate more comprehensive measures of subjective and objective health. Second, we did not explicitly measure specific subjective beliefs such as self-mastery, health-related perceived control, health pessimism, or other such beliefs to enable direct examination of their association with subjective memory complaints. Third, the degree to which SM mapped onto objective cognition was only examined at a cursory level given the fact that cognition was represented by performance on a global cognitive screening instrument in this sample of non-demented older adults. For this same reason, we are unable to characterize MCI in the current study, and therefore cannot directly speak to whether current results differ across individuals who are cognitively healthy versus those with MCI. Future work will benefit from characterizing objective cognition comprehensively and

rigorously, as well as considering how subjective cognition maps onto sensitive indicators of prodromal AD such as short-term memory binding [66] or face name learning [67], for example. Similarly, future work aimed at disentangling the association between subjectively perceived cognition and physical functioning will benefit from more rigorous and objective markers of physical functioning (i.e., gait speed, audiometric testing) that examine the same functional or health constructs from both subjective and objective perspectives.

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Table 1

Frequency of Subjective Memory Item Endorsement

Subjective Memory Items	Rate
Do you have any difficulty with your memory?	34.6%
Do you have difficulty in remembering things you have just read or heard?	27.8%
Do you have difficulty remembering the names of people in your family or close friends?	11.7%
Do you often stop in the middle of saying something because you have difficulty or problems remembering the right word?	28.9%
Is it more difficult for you to remember things than it used to be?	37.6%

Table 2

Subjective Physical Function Item Endorsement

		<u>Do you have difficulty hearing?</u>	
		Yes	No
Do you have difficulty walking indoors?	Yes	3.8% (18)	6.6% (31)
	No	22.5% (106)	67.1% (316)

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Table 3

Objective (Examiner Rated) Physical Function

		Difficulty Hearing	
		Yes	No
Difficulty Walking	Yes	3.2% (15)	11% (52)
	No	6.2% (29)	79.6% (375)

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Table 4

Demographic, Cognitive and Physical Function Data

	Mean (SD)/Frequency	Range
Age	72.80 (5.99)	65–94
Education	8.38 (4.51)	0–17
% Female	67.3%	NA
% Caucasian	19.3%	NA
% African American	34.6%	NA
% Hispanic	46.1%	NA
Global Cognition	1.93 (1.67)	0–9
Subjective Memory	1.41 (1.46)	0–5
Objective Physical Function	0.24 (0.49)	0–2
Subjective Physical Function	0.38 (0.56)	0–2
Depressive Affect	4.88 (3.28)	0–19

Table 5

Correlates of Objective and Subjective Function $r(p)$

	SM	OC	SPF	OPF
Depressive Affect	0.371 (<0.001) [*]	0.105 (0.022)	0.151 (0.001) [*]	0.157 (0.001) [*]
Age	0.087 (0.058)	0.204 (<0.001) [*]	0.165 (<0.001) [*]	0.208 (<0.001) [*]
Education	−0.010 (0.836)	−0.291 (<0.001) [*]	0.062 (0.179)	0.038 (0.411)
Subjective Memory				
Objective Cognition	0.014 (0.761)			
Subjective Physical Function	0.161 (<0.000) [*]	0.062 (0.176)		
Objective Physical Function	0.014 (0.755)	0.098 (0.033)	0.475 (<0.001) [*]	

SM, Subjective memory; OC, objective cognition; SPF, subjective physical function; OPF, objective physical function.

^{*} Significant when controlling for multiple comparisons ($p < 0.003$).

Table 6

Predictors of SM in adjusted linear regression models

Model	B (SE)	R ²	F	p
OPF				
Overall Model	NA	0.143	19.450	<0.001
Depression	0.375 (0.018)	NA		<0.001
Objective Physical Function	−0.062 (0.133)			0.172
Objective Cognition	−0.013 (0.038)			0.682
Age	0.083 (0.011)			0.067
SPF				
Overall Model	NA	0.147	20.138	<0.001
Depression	0.352 (0.018)	NA		<0.001
Subjective Physical Function	0.091 (0.116)			0.040
Objective Cognition	−0.018 (0.038)			0.689
Age	0.052 (0.011)			0.240

OPF, objective physical function; SPF, subjective physical function; β , standardized beta.