

Subjective Function Difficulties at Older Age with Subjective Cognitive Decline: Their Chain Mediation by History of Depressive Disorder and Attention Deficit Levels

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Objectives: Older adults with subjective cognitive decline (SCD) and a history of depressive disorder may be particularly vulnerable to activities of daily living (ADL) difficulties as their attention levels are less consistent. Despite these expectable relationships, studies are yet to map the likely chain mediation of these variables among older adults. **Methods:** We explored the association between subjective decline in ADLs and SCD-functioning by a history of depressive disorder and attention deficit mediation. We used the 2019 wave of Behavioral Risk Factor Surveillance System dataset on 1946 older adults aged 65 to ≥ 80 with SCD. **Results:** Chain mediation analysis shows that ADLs directly affect SCD-functioning. History of depressive disorder and attention deficit serially mediated the relationship between ADL difficulties and SCD-functioning, with 13.7% mediating effect. Middle-old cohort (70-74 years) and males with SCD reported more subjective ADLs difficulties than younger old and older old adults or females. **Conclusion:** These findings extend the chronic stress theory predictions that affective reactivity to a daily activity difficulty may dysregulate the stress pathway with SCD. Long-term depression and attention deficits exacerbate daily functional limitations in older adults with SCD. Mindfulness interventions for older adults with SCD to self-monitor in ADL may be indicated to improve their quality of life.

Keywords/phrases: activities of daily living, attention deficit, chronic stress theory of aging, history of depressive disorder, subjective cognitive decline, stress pathway

Introduction

People at an older age may experience subjective difficulties in activities of daily living (B-ADL), also reporting subjective cognitive decline (SCD). Subjective cognitive decline (SCD) is when an individual expresses concerns about increasing needs for support in mental activities the person was capable of previously (Ahn et al., 2020). With a lower level of activities in daily living, SCD may be more prevalent (Reppermund et al., 2013; Stogmann et al., 2016). Moreover, subjective perception of decline in function may contribute to or be associated with depression symptoms from frequent irritations with lapses in daily function (Stogmann et al., 2016).

Depression symptoms often co-occur with attention deficit (American Psychological Association, 2013), adding to a sense of functional decline (Keller et al., 2019; Wang et al., 2020) and frequent mental irritations (Keller et al., 2019; Wang et al., 2020). Those with a history of depression may be particularly vulnerable to subjective functional difficulties, as a key symptom of depression is a sense of disconnectedness from routine daily activities (Santini et al., 2020). Yet, studies have not examined the role of depression and attention deficit level mediation of subjective difficulties in older adults with SCD.

However, findings would be important for interventions to improve their quality of life for older adults with subjective functional difficulties.

Activities of daily living difficulties in SCD

Having subjective difficulties in basic activities of daily living (ADL) may present as failures in significant life domains in older adults. Basic ADLs include activities such as bathing, toileting, eating, and grooming (Katz et al., 1970; Hall et al., 2011) and are presumed for instrumental activities of daily living (IADLs), which involve more advanced tasks like making a phone call, handling finances, or taking medication (Reppermund et al., 2013; Stogmann et al., 2016). Basic ADL deficits would impair IADLs in the absence of targeted interventions (Hiroko et al., 2005). For example, older adults with mild cognitive impairment reported being less capable in their instrumental activities of daily living (Jekel et al., 2015). Similar findings have been reported for older adults with SCD (Chen et al., 2017; Cornelis et al., 2017; McAlister et al., 2016; Reppermund et al., 2013; Roehr et al., 2019; Stogmann et al., 2016).

Moreover, impairments in daily living activities, in general, strongly predict the progression of dementia (Reppermund et al., 2013; Stogmann et al., 2016). However, there is often a cross-over effect between ADLs and IADLs (Reppermund et al., 2011; 2013), especially among those with age-related cognitive decline (Burton et al., 2018; Jekel et al., 2015; Reppermund et al., 2011; 2013; Roehr et al., 2019). In the present study, we examined daily living activity difficulties by combining the two subcategories in their relationship with SCD functioning and considering the role of history of depression and attention deficit.

History of depressive disorder co-occurring with attention deficits in older adults with SCD

The association between depressive disorders and cognitive decline is widely documented in the literature (Stogmann et al., 2013; Rovner et al., 2016). For instance, the experience of SCD, if less well managed, may trigger depressive symptoms, which often co-occur with attention deficits (Keller et al., 2019). Attention is the entry point for a wide variety of sensory information accessing one's consciousness (Keller et al., 2019). A good attention capability is critical for various cognitive tasks (Zuckerman et al., 2018). Older adults with SCD may experience attention issues, like difficulties concentrating, remembering, or making decisions (Cotrena et al., 2016; Fehnel et al., 2016), which may be a result of depressive symptoms or cognitive impairment (Keller et al., 2019).

The complex interaction between attention deficits and depression associated with daily functionality may contribute to deficits in cognitive domains (Keller et al., 2019). While increasing literature reported effects of depressive symptoms in ADL and SCD-functioning (Stogmann et al., 2016; Reppermund et al., 2013; Rovner et al., 2016; Wu et al., 2021), very few examined attention level fluctuation. Although attention is an important feature of depressive disorder (American Psychiatric Association, 2013), contributing to deficits in ADL (Keller et al., 2019), it is less understood, especially among older people with SCD. Moreover, while subjective difficulties in daily living may be higher with SCD, the likely serial mediation of the role of history of depression and attention deficit relationship is less known.

Theoretical presuppositions on subjective difficulties with SCD and depression and attention deficit

The chronic stress theory of aging proposes emotional wear and tear in personal well-being (Charles et al., 2013), suggesting that an individual's psychological reactivity toward

negative daily events in their lives may determine their mental well-being (Almeida et al., 2009). Seemingly minor daily events such as daily living activity difficulties may trigger affective responses associated with general affective distress (Charles et al., 2013; Hanh et al., 2014; Sin et al., 2020). In older adults with SCD, these long-term disruptive emotional states (Charles et al., 2013), if not intervened, might interfere with attention functions through the canonical stress pathway, leading to depression (Iwata et al., 2013). In theory, a history of depressive disorder and attention impairments jointly affect cognitive control, perception, and decision-making (Keller et al., 2019), exacerbating reduced functional performance in people with SCD.

Age-cohort and gender in subjective difficulties in ADLs with SCD

Subjective difficulties in ADLs in older adults with SCD may differ by age cohort and gender in ways less well explored. For instance, whereas there is evidence to suggest that younger old age cohort (55-69 years) were at higher risk for subjective functional difficulties irritations, particularly when the experience of SCD is accompanied by depressive symptoms (Brown et al., 2022; Masel & Peek, 2009; Reppermund et al., 2013; Wang et al., 2017), and the middle old age cohort (71-79) report more cognitive complaints (Dufouil et al., 2005), the changes were variable and mild among some middle old adults (Brown et al., 2022). Moreover, when the experience of SCD is associated with other psychological comorbidities, study found that younger old (55-59) and older old ≥ 80 cohorts showed the most substantial effects (Brown et al., 2022). By contrast a moderated mediation study assessing the relationship between healthcare access and SCD-functioning by psychological distress mediation showed that middle to older age cohorts (70-74 years old) experienced the most pronounced effect, compared to younger old (65-69) and older-old adults (75 - ≥ 80) (authors).

By gender, the subjective functional difficulties and SCD is underexplored in the presence of a history of depression. For instance, women carry a higher risk for depression the life span compared to men (Girgus et al., 2017), and yet seem to have greater overall daily functionality than men (Alleva et al., 2017). Men may be less resilient to everyday irritations, which may increase their sense of subjective functional difficulties (Wang et al., 2018), although there would be variations by their SCD and personal circumstances. Besides, experience of subjective functional difficulties would be higher on the socio-economic gradient (Gupta et al., 2021) and compounded at older age cohort. These relationships need to be studied in sufficiently powered studies as with national databases. Our study aimed to address this gap in the evidence.

The present study

Despite these expectable association, studies as previously reviewed, studies are yet to map the likely chain mediation of the history of depressive symptoms and attention levels on SCD and subjective functional difficulties among older adults. In the present study, we used a cross-sectional study design to examine the relationship between daily living activities and SCD-functional performance and the mediating role of a history of depressive disorder and attention deficits in that relationship. By convention, categorical sociodemographic variables are moderators, while experience continuum variables are mediators (Hayes & Andrew, 2014). Following our conceptual model (see Figure 1), we hypothesized that:

- Hypothesis 1: Higher subjective function decline in activities of daily living is associated with

higher subjective cognitive decline in males and middle-old to older-old age cohorts.

- Hypothesis 2: History of depressive symptoms mediates the relationship between a subjective functional decline in activities of daily living and subjective cognitive decline, increasing a sense of subjective cognitive decline.
- Hypothesis 3: Attention level fluctuations mediate the relationship between a subjective functional decline in activities of daily living and subjective cognitive decline, increasing a sense of subjective cognitive decline.
- Hypothesis 4: History of depressive symptoms and attention level fluctuations play a chain-mediating role between a subjective functional decline in activities of daily living and subjective cognitive decline, contributing to a lower subjective cognitive decline than either of the factors alone.

[Place Figure 1 about here]

Findings will clarify profiles of SCD-functional performances among older adults with a history of depressive disorder and attention deficits across gender and age cohorts, which is important to determine appropriate intervention to improve their daily quality of life.

Material and methods

Design and sample

This cross-sectional study utilized the 2019 Behavioral Risk Factor Surveillance Survey (BRFSS) data from the Center for Disease Prevention and Control (CDC, 2019), a large, nationally representative sample of 121,099 noninstitutionalized U.S. adults aged 18 years or older. For the present study, we analyzed data from 2035 cases of individuals aged ≥ 65 years old who reported having experienced subjective cognitive decline and limited daily performance in the past twelve months. We excluded multivariate outliers, leaving 1946 cases for analysis.

Sociodemographic characteristics of the participants

The 1946 participants included in this study were older adults who experienced confusion or memory loss that was happening more often or was getting worse within the past year. They comprised of 1007 (51.7%) women and 939 (48.3%) men, with an age range from 65 to ≥ 80 years included 65-69 (22.3%), 70-74 (24.2%), 75-79 (20.5%), and ≥ 80 (33.1%). A comparable percentage of participants completed high school (658 or 33.8%) or college or technical school (614 or 31.6%). The remainder attended college or technical school (539 or 22.7%), did not complete high school (130 or 6.7%), or answered don't know/not sure/refused (5 or .3%). The income levels of the participants were as follows: 509 (26.7%) earned $\geq 50,000$, 360 (18.5%) earned 15,000 to $< 25,000$. ($SD \pm 9.40$), 290 (14.9%) earned 35,000 to $< 50,000$, 237 (12.2%) earned 25,000 to 35,000, and 396 (20.3%) answered don't know/not sure/refused to give an answer. The participants' characteristics are shown in Table 1.

[Place Table 1 about here]

Variables and measurement

Dependent variable. SCD was assessed based on self-report on three questions asking the impact of the confusion of memory loss that they have experienced within the past 12 months: 1) How often have you given up day-to-day household activities or chores that you used to do, such as cooking, cleaning, taking medications, driving, or paying bills? 2) How often has confusion or memory loss interfered with your ability to work, volunteer, or engage in social activities outside the home? 3) How often do you need assistance with these day-to-day activities? (CDC, 2019). A higher score indicates a higher level of SCD-functional performance. In the present study, the Cronbach alpha for scores from the SCD measure was moderately high (.735).

Predictors

Subjective functional difficulties in ADLs. Subjective functional decline in activities of daily living was assessed by self-report on three yes/no questions: 1) Do you have serious difficulty walking or climbing stairs? 2) Do you have difficulty dressing or bathing? 3) Because of a physical, mental, or emotional condition, do you have difficulties doing errands alone such as visiting a doctor's office or shopping? (CDC, 2019). Items were scored on a 5-point Likert scale ranging from 1 to 5 (e.g., 1-always, 2-usually, 3-sometimes, 4-rarely, 5-never). A higher score indicates a higher level of daily activities. In the present study, Cronbach alpha for the subjective functional difficulties in ADLs was satisfactory (.610).

Mediator variable 1. History of depressive disorder was assessed by self-report on whether a person had a depressive disorder, including depression, major depression, dysthymia, or minor depression (CDC, 2019). It is a yes or no question, where 'yes' is coded one and 'no' is coded 2.

Mediator variable 2. Attention deficits were assessed by self-report on whether a person has serious difficulty concentrating, remembering, or making decisions due to a physical, mental, or emotional condition. It is a yes or no question, where 'yes' is coded one and 'no' is coded two.

Covariates. For covariates, we included age cohort, gender and education level following previous studies (Lee et al., 2020; Taylor et al., 2018). We created categorical variables for age cohort (1-younger old, 65-69 years, 2, middle old, 70-79, and older old (80 years plus) and gender (males = 1, females = 0). Education level was categorized as did not graduate high school, graduated high school, attended college or technical school, or graduated college or technical school.

Ethical standards

This BRFSS dataset is open access by the CDC (CDC, 2019), which provides de-identified data for public utilization. Therefore, there is no requirement for Institutional Review Board approval by the author's institution or affiliation for secondary data analysis studies that utilize publicly accessible data.

Data analysis

Serial Multiple Mediation Analyses

Chain mediation analysis was conducted using the PROCESS V.4.0 macro for SPSS (Model 6, Hayes et al., 2018) to test mediation effects of the history of depressive disorder and attention levels in the relationship between ADL and SCD functioning. We also examine how a history of depressive disorder and attention level affect SCD functioning. The benefit of this procedure, as suggested by Van Jaarsveld et al. (2010), is that it enables isolation of each mediator's indirect effect: history of depressive disorder effects (Hypothesis 2) and attention deficits (Hypothesis 3). Furthermore, this approach also allows the investigation of 'the indirect effect passing through both of these mediators in a series' (Van Jaarsvel et al., 2010, p. 1496) (Hypothesis 4). We utilized multiple regression and the bias-corrected percentile Bootstrap method for the study. The theoretical model was tested by estimating the 95% CI for serial mediation effects with 5000 bootstrap samples. The statistics were

considered statistically significant if the 95% CI did not include 0 (Hayes 2018). We controlled education in this study. All analyses were performed using IBM SPSS Statistics 28.

Prior to the regression analysis, we checked for the variance inflation factor values following the procedure by Mahalanobis. We observed values of 1.045–1.053 and tolerance values of .934–.957, indicating no multicollinearity and residual problem. As a result, all assumptions were met per Field's (2016) suggestions.

We computed a two-way ANOVA test to compare SCD functioning levels across gender and age cohorts (65-69, 70-74, 75-79, and ≥ 80 years old). *Post hoc* tests were performed using Fisher's Least Significance Difference to correct for multiple comparisons.

Results

Descriptive statistics. Descriptive statistics, correlations, and reliabilities for the study variables are displayed in Table 2. As expected, ADLs was positively associated with subjective cognitive decline ($r = .453, p < .001$), history of depressive disorder ($r = .220, p < .001$), difficulty concentrating ($r = .361, p < .001$), and education ($r = .190, p < .001$). ADLs were positively associated with a history of depressive disorder ($r = .207, p < .001$) and difficulty concentrating or remembering ($r = .267, p < .001$). History of depressive disorder was positively associated with attention levels ($r = .235, p < .001$).

[Place Table 2 about here]

Relationship between ADL and subjective functional decline in activities of daily living and subjective cognitive decline

Confirming Hypothesis 1, the study found a positive direct effect of ADLs on SCD-daily performance (total effect; $B = 1.41, p < .001$). When the mediators were included in the analysis, this coefficient was reduced but was still statistically significant (direct effect, $B = 1.21, p < .001$). ADL was also found to be a positive predictor of history of depressive disorder ($B = .105, p < .001$) and difficulty concentrating or remembering ($B = .111, p < .001$), see Table 3.

A two-way ANOVA was performed to analyze the effect of gender and age cohort on SCD-functional performance. A two-way ANOVA revealed that there was a statistically significant interaction between the effects of gender and age cohort, $F(1, 1938) = 3.03, p < .03$, although very small ($\eta_p^2 = .004$). Simple main effects analysis showed that age cohorts ($\eta_p^2 = .006, p = .008$) and gender ($\eta_p^2 = .004, p = .009$), respectively, has a very small effect size on SCD-functional performance. *Post hoc* testing revealed significant group differences in SCD-functional performance for pairwise group comparisons, with males having higher SCD-functional performance ($M = 12.86, p = .009$) than females ($M = 12.52, p = .009$), see table 3. Using alpha level $< .001$ (to counter for violence of homogeneity tests), pairwise group comparisons showed significant group differences only in age cohort 70-74 ($F(1, 1938) = 13.04, p < .001; \eta_p^2 = .006$), with males ($M = 13.37, 95\%CI 13.08, 13.66$) having higher SCD-functional performance than the females ($M = 12.44, 95\%CI 12.03, 12.85$), see Figure 2.

[Place Figure 2 about here]

[Place Table 3 about here]

History of depressive disorder and attention level fluctuation mediation of subjective functional decline in activities of daily living and subjective cognitive decline

We observed a significant indirect effect of ADLs on SCD-functional performance via history of depressive disorder ($B=.047$, $SE=.014$, 95% CI=[.021, .076]). The mediating effect value was .033, and the 95% CI was (.021 to .076), which accounted for 3% of the total effect. This value showed that history of a depressive disorder mediated the relationship between ADL and SCD-functional performance, confirming Hypothesis 2 (History of depressive symptoms mediates the relationship between a subjective functional decline in activities of daily living and subjective cognitive decline, increasing a sense of subjective cognitive decline). In addition, the indirect effect of ADLs on SCD-functional performance via attention level was also significant ($B=.123$, $SE=.019$, 95% CI=[.088, .164]). The mediating effect value was .09, and the 95% CI was (.088 to .164), which accounted for 9% of the total effect. This value showed that attention level mediated the relationship between ADL and SCD-functional performance, confirming Hypothesis 3 (see Table 4).

History of depressive symptoms and attention level chain mediation of subjective functional decline in activities of daily living and subjective cognitive decline

Finally, the study tested the indirect effect of B-ADLs on SCD-daily performance via history of depressive disorder and attention deficit. The relationship was significant with a point estimate of .022 (testing serial multiple mediation; $SE = .005$, 95% CI = .014, .032). The mediating effect value was .014, and the 95% CI was (.014 to .032), which accounted for 1.4% of the total effect. This value showed that history of depressive disorder and attention level serially mediated the relationship between ADL and SCD-functional performance. Therefore, Hypothesis 4 was also confirmed (see Table 4). In line with the study findings, the total mediating effect value of the overall model was .193, and the 95% CI was (.147 to .243), which accounted for 13.7% of the total effect.

[Place Table 4 about here]

The study showed an indirect relationship between higher ADL and higher SCD-daily performance. This association was partially mediated by lower levels of history of depressive disorder and attention difficulty, with attention difficulty having the strongest mediation effect. Results of the serial mediation analyses are presented in Figure 1.

Discussion

This study investigated the relationships between subjective ADL deficits, history of mental disorders, attention level, and SCD-functional performance. The findings indicated that history of depression and attention level mediated the relationship between subjective ADL deficits and SCD, exacerbating SCD. The SCD effect was stronger in males and the middle-old age cohort. Findings are consistent with previous studies that reported greater ADL difficulties with SCD (Roehr et al., 2019; Stogmann et al., 2016). In a previous study, the middle-old cohort (70-74 years old) had higher SCD in activities of daily living (authors), which was perhaps explained by the fact that they may have a recent history of work retirement they find frustrating to daily routine having been preoccupied with various work roles over decades. For instance, one of the assumptions is that younger-old adults in employment or voluntary community work might have greater daily function competencies and cope with limited

functional performance due to SCD (Li et al., 2021). Our study further adds to the evidence that difficulties in ADL may predict lower functional performance in older people with SCD in males and middle old adults.

A history of depressive disorders mediated the relationship between subjective difficulties in ADLs and SCD. One possible explanation for the association of depressive symptoms with cognitive and functional performance is global impairment (de Paula et al., 2016), triggering overlapping symptoms of cognitive decline and depressive symptoms, including apathy, loss of interests and hobbies, trouble concentrating, impaired thinking, and social withdrawal (Alzheimer's Association, n.d.). Pathological changes in neuromodulators associated with the depressive disorder may lead to attention impairments with a subsequent negative impact on daily performance (Bennet & Thomas, 2014; Keller et al., 2018).

Attention deficits mediated the relationship between ADLs and SCD, exacerbating SCD. A possible explanation is that both dysfunctions in attention and cognitive decline may include several sub-domains, from increased distractibility to an inability to sustain focus (Keller et al., 2019), leading to a lower level of functional performance in people with SCD. In the neurocognitive literature, cognitive functions are also known as aspects of executive function, which often require attentional processes (e.g., re-allocation of attention toward goal-relevant information upon encountering feedback of a performance error) (National Institute of Mental Health, 2019).

The chain or serial mediation of the history of depressive disorders and attention level in the relationship between subjective difficulties in ADL and SCD-functioning added to a higher sense of SCD than with either history of depression symptoms or attention deficits alone. Previous findings have shown that adverse factors like lower healthcare access magnify the frequency of daily distress, measured on mentally unhealthy days, and disrupt functional performance (authors). Chronic stress theory (Almeida et al., 2005, 2009; Sin et al., 2020) suggests that older adults experience a negative affect in responding to increased disruptions in day-to-day activities. Our study extends those of previous studies determining the effects of psychological distress associated with daily living activities contributing to SCD functioning in older adults with SCD. In older people with SCD, the history of depressive disorder may increase deficits in attention as it triggers more frequent psychological distress by repeatedly adjusting to stressors (Almeida et al., 2005; Keller et al., 2019; Sin et al., 2015).

This stress pathology interferes with the frontoparietal attention network through the stress pathway involving the hypothalamus-pituitary-adrenal axis (Iwata et al., 2013), impairing attention (Keller et al., 2019) and leading to a higher sense of SCD. A possible mechanism is these disruptions cause neuronal atrophy in the hippocampus and medial prefrontal cortex (Sapolsky, 2010), which play regulatory roles in various cognitive performances (Hyman et al., 2010; Jobson et al., 2021). Impairment in these areas potentially deteriorates various cognitive functions involving attention, such as memory, cognition, decision-making, and social behaviors (Hyman et al., 2010), causing changes in functional performance among older adults with SCD,

as indicated in this study. Therefore, we speculate that affective reactivity to a daily stressor, i.e., ADL limitations, combined with attention deficits, exacerbate cognitive disruptions in older adults with SCD.

Implications for well-being support practice with older adults with subjective difficulties in ADL and SCD

The findings of this study contribute to a better understanding of the influence of emotional reactivity to daily stressors like functional difficulties on determining levels of functioning in people with SCD. Person-centric intervention for older adults with SCD to self-monitor in ADL may be indicated to improve their quality of life. Mindfulness training is one of the feasible early interventions effective for people with SCD to reduce cognitive complaints (Smart et al., 2016). Mindfulness is a type of meditation with a strong emphasis on heightened awareness of the present moment (Jha et al., 2007) through a complete connection between the body and the mind (Farb et al., 2012). Using eco-psychosocial concepts, mindfulness assumes that various biological risk factors are at play years before the onset of a disease clinically evident, which is relevant to the dementia process where symptoms can start years before a diagnosis can be established (Crimmins and Seeman, 2004), reducing progression to dementia or Alzheimer's disease. A variety of meditation programs showed significant benefits for cognitive functioning by increasing neuroplasticity (Davidson & Kaszniak, 2015) and enhancing brain function and cognitive domains, i.e., attention, memory, executive function, processing speed, and general cognition (Gard et al., 2014). An example of a meditation program is Kirtan Kriya yoga meditation involving a short breathing relaxation and the visualization of light while listening to instrumental music. When compared to relaxation alone, eight weeks of Kirtan Kriya improved mental health and cognition in older dementia caregivers (Lavretsky et al., (2013).

Moreover, the negative affect associated with daily living difficulties and self-perceived cognitive difficulties can lead to worry and anxiety out of fear of dementia (Smart et al., 2016). As a non-pharmacological model, mindfulness can help people with SCD to recognize and counter negative affect associated with difficulties performing daily living activities, helping them to accept cognitive failures (Marchant et al., 2021). Given that SCD is a precursor for mild cognitive impairment and Alzheimer's Disease (Jessen et al., 2014; Taylor et al., 2018; Stogmann et al., 2016), people with SCD may benefit from mindfulness interventions improving psychological wellbeing, thus reducing the risk of dementia.

Limitations of the study and suggestions for further research

The present study was self-report and correlational. Future studies could research variables through different methods to overcome the correlational nature of the study findings. For example, daily living activities can be measured on recorded tasks (i.e. making a phone call, preparing a pillbox in a specific order within 15 minutes) and observed on an actigraphy (Yakhia et al., 2014). The use of cross-sectional data collection is a limitation, although carried out among a relatively large sample. More valid findings would be generated by testing the associations reported here utilizing a longitudinal research design. Although this study has a partial mediating effect on the mentally unhealthy days on the relationship between healthcare access and SCD-IADLs in older adults with SCD, there would be other mediating variables in this relationship for future study. The significant SCD-functional performance effects observed

across gender and age cohort were weak, suggesting a need for further aging health and function studies utilizing similar data sets as the BRFSS.

The mediating effect of attention deficit alone in the relationship between ADL and SCD-functioning is slightly stronger than the mediating effect of a history of depressive disorder independently or serially combined with attention deficit. Given possible overlapping clinical symptoms of depression and attention deficit (Keller et al., 2019), this finding warrants further investigation into sub-domains of impaired attention, like sustained or divided attention (Cotrena et al., 2019). For example, previous structural equation modelling indicated that impaired switching attention prospectively predicted higher depressive symptoms and that higher depressive symptoms predicted worse selective and switching attention (Mac Giollabhui et al., 2019). Practitioners working with the clinical population must be careful when applying this finding, given our non-clinical samples. As person-centric interventions are needed, it is becoming increasingly important to understand the role of depressive symptoms and attention level in mediating the relationship between ADL and functional performance in older adults with SCD. Knowledge of attention deficits co-occurring with depressive symptoms contributing to SCD can determine which individuals would most likely benefit from treatments targeting subjective cognitive symptoms like attention deficits.

Conclusion

Our study has examined the association between daily living difficulties and subjective cognitive decline-functioning and the potential mechanism underlying this relationship in a national U.S. sample of older adults with SCD. Our hypotheses were fully supported such that higher activities of daily living is associated with higher subjective cognitive decline in males and middle old to older old age cohorts (70-74 years old). Using the chain mediation model, we found that history of depressive symptoms and attention level fluctuations mediate the relationship between the subjective functional decline in activities of daily living and subjective cognitive decline, contributing to a lower subjective cognitive decline than either of the factors alone. These findings extend the previous predictions of chronic stress aging, confirming the potential effect of daily living activity difficulties contributing to a higher sense of SCD through dysregulation of the canonical stress pathway. Targeted person-centric mindfulness interventions through self-monitoring in ADL may slow SCD progression to a less severe level in older adults with psychological distress.

Acknowledgement: This study is a secondary analysis of publicly available data from the Behavioral Risk Factor Surveillance Survey (BRFSS) from the Center for Disease Prevention and Control. The data analytic modelling utilized model 6 in PROCESS Version. 4.0 macro in SPSS (Hayes et al., 2018), a widely accessible program to researchers. We did not pre-register the study for our scientific writing, perceiving no conflict of interest or consent for publication.

Declaration of Interest: The authors declare no competing interests to declare.

Data Availability Statement: This BRFSS dataset is open access by the CDC (CDC, 2019), which provides de-identified data for public utilization.

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Table 1 Participants' characteristics

Variable	Frequency (<i>n</i>)	%
Gender		
Male	939	48.3
Female	1007	51.7
Age cohorts		
65 – 69 years old	433	22.3
70 – 74 years old	470	24.2
75 – 79 years old	398	20.5
≥ 80 years old	645	33.1
Education status		
Did not graduate high school	130	6.7
Graduated high school	658	33.6
Attended college or technical school	539	27.7
Graduated from college or technical school	614	31.6
Don't know/Not sure/Refused	5	.3
Income level		
< 15,000	154	7.9
15,000 - < 25,000	360	18.5
25,000 - < 35,000	237	12.2
35,000 - < 50,000	290	14.9
≥ 50,000	509	26.2
Don't know/Not sure/Refused	396	20.3
Marital status		
Married	919	47.2
Divorced	276	14.2
Widowed	623	32.0
Separated	16	.8
Never married	96	4.8
A member of an unmarried couple	10	.5
Refused	8	.4
Race		
White	1799	92.4
Black or African American	94	4.8
American Indian or Alaskan Native	25	4.8
Asian	3	.2
Don't know/Not sure/Refused	26	1.3
Healthcare access		
Yes	774	39.8
No	1154	59.3
Don't know/Not sure/Refused	18	.9

Table 2 Descriptive statistics and correlations among study variables ($N = 1946$)

Variable	1	2	3	4	5	M	$M_{(25,75)}$	SD	Skewn ess	Kurt osis
1. SCD-daily performance	1					12.65		2.81	-1.26	.981
2. B-ADLs	.453*	1				5.23		.95	-1.01	-.035
3. History of depressive disorder	.220*	.207*	1			6.39	2(1,2)		-.210	.061
4. Attention deficits	.361*	.267*	.235**	1		2.84	2(1,2)		-.210	-.995
5. Education level	.190*	.195*	.050**	.159*	1	2.72	3(2,4)		.958	-.195

* $p < .001$

$M \pm SD$: mean $\pm$ Standard Deviation; $M \pm (P_{25,27})$: median (quartile, quartile)

1,2 follows a normal distribution and is described as $M \pm SD$

3-5 does not follow a normal distribution and is described as $M \pm (P_{25,27})$

Table 3 Pairwise group comparison across gender and age cohort in SCD functioning in the U.S. sample.

	Males		Females	
	Mean	95% SD	Mean	95% SD
Age cohort				
65 - 69	12.62	12.24-13.00	12.63	12.26-12.99
70 - 74	13.37	13.02-13.73	12.44	12.08-12.80
75 -79	12.82	12.42-13.21	12.87	12.48-13.25
≥ 80	12.61	12.30-12.93	12.15	11.85-12.44

SD (Standard deviation)

Table 4 Indirect effect of ADLs on SCD-daily performance via history of depressive disorder and difficulty

Path	Coefficient	95% CI	
		LL	UL
Indirect 1 B-ADLs $\rightarrow$ History of depressive disorder $\rightarrow$ SCD-functioning	.047	.021	.076
Indirect 2 B-ADLs $\rightarrow$ Attention levels $\rightarrow$ SCD-functioning	.123	.088	.164

Indirect 3 B-ADLs → History of depressive disorder → Attention levels → SCD-IADLs	.022	.014	.032
Total effect	1.41	1.29	1.52
Direct effect	1.21	1.10	1.33
Total indirect effect	.193	.147	.243

Notes: *CI* confidence interval, *LL* lower limit, *UL*
upper limit

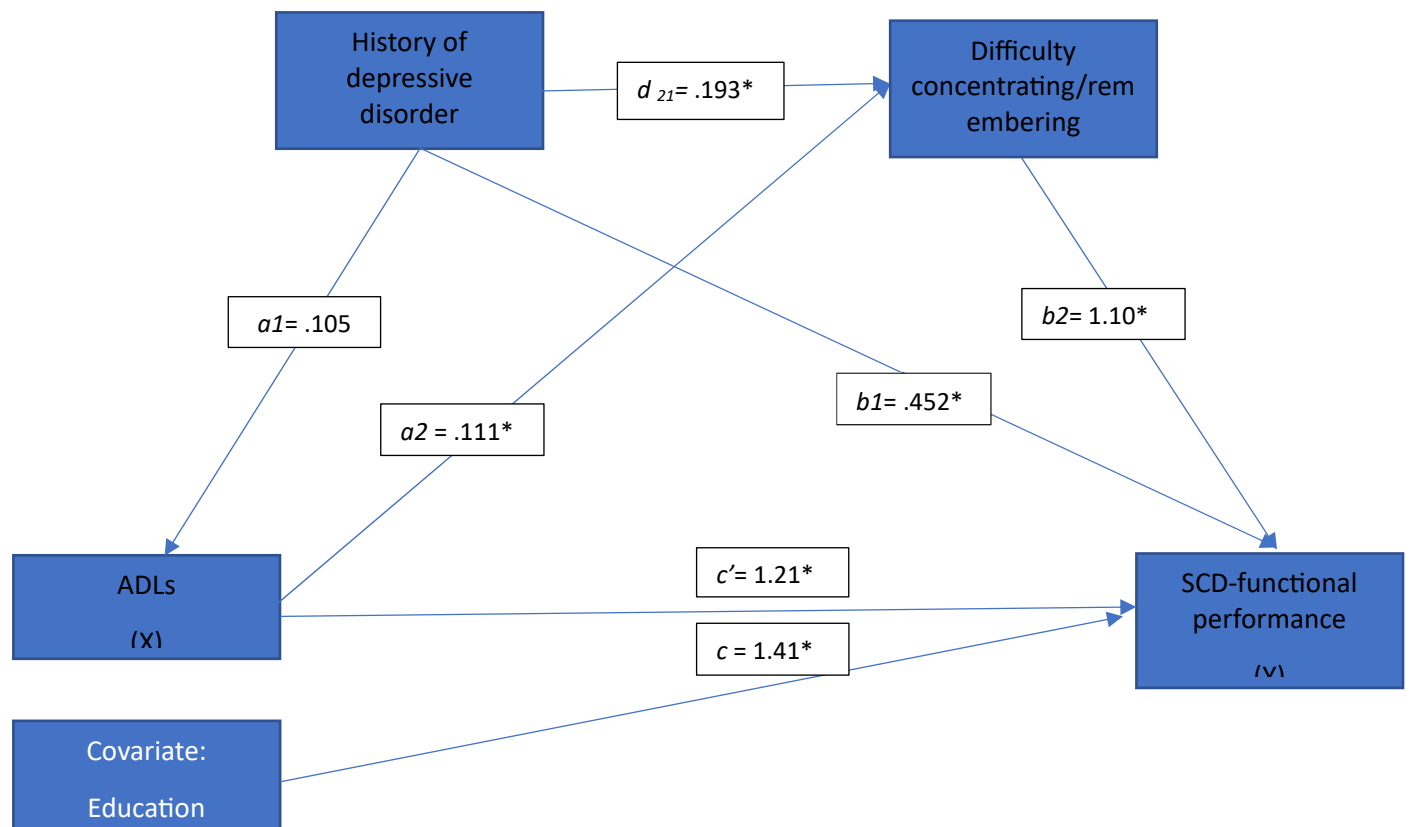


Figure 1

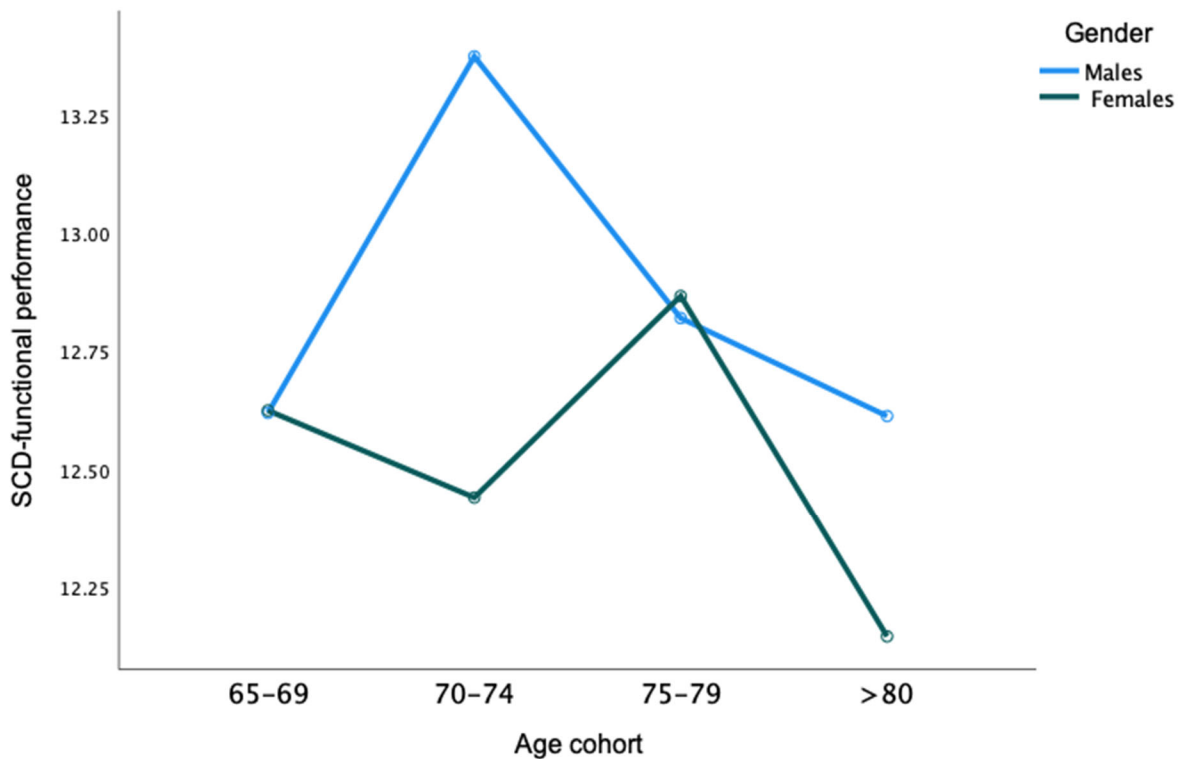


Figure 2

Figure lists

Figure 1 presents the result of serial multiple mediational models, $*p < .005$, $**p < .001$. ADL (activities of daily living); SCD (subjective cognitive decline). The values shown are unstandardized coefficients.

Figure 2 SCD-functional performance across age cohort and gender. SCD (Subjective cognitive decline).