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Prospective Associations Between Subjective Age and Fear of Falling in Older Adults

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Abstract

Objective: Subjective age has been implicated in a range of health outcomes but its associations with Fear of Falling (FoF) are unknown. The present study examined the relation between subjective age and FoF in large national sample.

Methods: Participants were drawn from the National Health and Aging Trends Study (NHATS, 2011-2017). 1,679 participants provided data on FoF, subjective age, demographic factors, depressive symptoms, prior falls, self-rated health and measures of the Short Physical Performance Battery. FoF was assessed again 7 years later.

Results: Regression analyses revealed that an older subjective age was related to a 24% higher likelihood to develop FoF 7 years later. This association was independent of age, sex, educational attainment, race and prior falls. In addition, depressive symptoms, self-rated health, and physical inactivity mediated the associations between subjective age and FoF.

Conclusions: The present study showed that an older subjective age is related to the development of FoF over time, and further identified psychological and functional pathways that may explain this association. These results confirm the role of subjective age on one of the markers of frailty in the aging population.

Keywords

Subjective age; Fear of Falling; Longitudinal

INTRODUCTION

Fear of falling, usually defined as a common factor relating to perception, feelings and subjective evaluation associated with personal fall risk, is considered as an important psychological factor associated with falls (Gomez et al., 2017). Regardless of falling status,

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FoF is related to several functional and health-related outcomes including reduced gait performance (e.g., Donoghue et al., 2013; Reelick et al., 2009; Rochat et al., 2010), poorer quality of life (Schoene et al., 2019), reduced social interactions and depression (Choi et al., in press; Scheffer et al., 2008), and mortality in older adults (Lee & Hong, in press). According to these consequences, identification of factors that predict the development of FoF represents an important issue in gerontology, and may improve fall prevention and functional independence for older adults. Although functional, behavioral, and health parameters have been previously associated with FoF (Curcio et al., 2020; Denking et al., 2015; Oh et al., 2017), several studies have identified the role of psychological factors in FoF, such as self-perceived health (Denking et al., 2015) or anxiety (Payette et al., 2016). However, little is known about whether FoF is predicted by individuals' subjective age, that is how old or young people feel relative to their chronological age.

Subjective age can be conceptualized as a biopsychosocial marker of aging (Stephan et al., 2018), which is associated with health-related outcomes in aging (Wurm et al., 2017). Indeed, a growing body of research support the relationship between the tendency to feel older than his chronological age and higher risk of cognitive impairment and dementia (Stephan et al., 2017), poorer physical performance (Stephan et al., 2013), higher risk of health conditions (Demakakos et al., 2007) and mortality (Rippon & Steptoe, 2015; Stephan et al., 2018). Although no study to date has tested the extent to which subjective age may be related to the incidence of FoF in advanced age, the relation between subjective age and a range of psychological, behavioral, and functional factors that have been found to contribute to FoF suggests that feeling older than his chronological age may increase the risk of developing FoF in old age. Indeed, an older subjective age is associated with psychological factors, such as higher depressive symptoms (Choi & Dinitto, 2014; Spuling et al., 2013) and worse self-rated health (Spuling et al., 2013), that have been related to higher risk of FoF (Denking et al., 2015). Furthermore, an older subjective age is associated with fewer psychological resources such as lower self-esteem (Mirucka et al., 2016), and more vulnerability to stress (Bellintier & Neupert, 2020; Shrira et al., 2016), which are related to increased FOF (Hajek et al., 2018). Lastly, an older subjective age is related to lower self-efficacy beliefs (Caudroit et al., 2012; Boehmer, 2007), which are components of FoF (Tinetti, 1990). In addition to psychological pathways, the relation between feeling older and several physical outcomes in old age also suggests that subjective age may be related to the development of FoF over time. For example, an older subjective age is associated with slower gait speed (Stephan et al., 2015) and worse muscular function as measured by grip strength (Stephan et al., 2013), which increases FoF (Donoghue et al., 2013; Kressig et al., 2001; Belka et al., 2019). Finally, behavioral patterns associated to an older subjective age may also increase the risk of being afraid of falling among older adults. Indeed, people who feel older than their chronological age tend to adopt a restrictive lifestyle (Montepare, 2020), or stay physically inactive (Wienert et al., 2015), which is related to the development of FoF (Denking et al., 2015; Mendes da Costa et al., 2012). However, despite these findings, no study has yet tested the association between subjective age and FoF.

Using data from a large national sample of older adults, this study examined the link between subjective age and FoF. Based upon existing research (Choi et al., 2014; Stephan et al., 2012; 2015), it was hypothesized that an older subjective age is related to a higher

concurrent FOF and higher risk of developing FOF over time. This association was tested controlling sociodemographic variables and falls history. Given that depressive symptoms, self-rated health and physical performances are important predictors of FoF (Curcio et al., 2020; Denkinger et al., 2015; Oh et al., 2017), additional analysis tested whether these factors accounted for the association between subjective age and FoF.

METHOD

Participants

The present study used data from The National Health and Aging Trends Study (NHATS). NHATS was designed to follow successive nationally representative cohorts of US adults aged 65 and older enrolled in Medicare (Montaquila et al., 2012). NHATS is sponsored by the National Institute on Aging (grant number NIA U01AG032947) through a cooperative agreement with the Johns Hopkins Bloomberg School of Public Health. For this study, data were available for 2011 (Wave 1) to 2017 (Wave 7). The cross-sectional analysis was conducted with a total of 2,172 participants who provided complete data at baseline (2011) on sociodemographic, physical, and psychological variables, as well as FoF, subjective age, prior falls and on FoF at follow-up (2017). In addition, among these 2,172 participants, 1,679 individuals (77.3%) had no FoF at baseline. This sample of 1,679 participants was used for longitudinal analysis.

Measures

Fear of falling.—In the NHATS, participants were asked “in the last month, did you worry about falling?”. A yes/no answer format was used.

Subjective age.—Participants were asked to report their felt age using the following question: « Sometimes people feel older or younger than their age. During the last month, what age did you feel most of the time? ». Proportional discrepancy scores were calculated by subtracting chronological age from felt age, divided by chronological age (Rubin & Berntsen, 2006). A positive score indicates an older subjective age and negative score indicates a younger subjective age. Responses three standard deviations above or below the mean were considered outliers and were excluded (Stephan et al., 2015). Based on these criteria, 103 participants were excluded.

Mediators.—*Self-rated health* was measured with one single item: “Would you say that in general your health is excellent, very good, good, fair, or poor?” Values were reversely recoded, and higher scores represent better self-rated health.

Depressive symptoms were measured using the Patient Health Questionnaire-2 (PHQ-2). The participants were asked to report how often they had little interest or pleasure in doing things, and how often they felt down and depressed or hopeless during the last month, using a scale from 1 “not at all” to 4 “nearly every day”.

Physical performance was assessed with the SPPB, which is a summary score that combines performance on three standing balance tests (side by side, semi-tandem, and full-tandem),

repeat chair stands (5 times) and walking speed on a 3-m course, allowing walking aids but not wheelchair or scooter. Scores range from 0 (not attempted) to 12 (best).

Covariates.—The sociodemographic characteristics of participants included age (in years), sex (coded as 1 for men and 0 for women), race (coded as 1 for white and 0 for other), and education (using a scale from 1 “No schooling completed” to 9 “Master’s, professional or doctoral degree”). Prior falls at baseline was also included as covariate. Participants were asked if they had fallen in the past 12 months using a yes/no answer format.

Data analysis

Logistic regression analysis was conducted to test the cross-sectional association between subjective age and FoF, controlling for age, sex, education, race, and prior falls. Moreover, logistic regressions were conducted excluding participants who had FoF at baseline in order to test the relation between subjective age and the development of FoF 7 years later, controlling for demographic covariates and prior falls. In addition, in order to test to what extent psychological, functional and health-related pathways may explain the relation between subjective age and FoF, depressive symptoms, SPPB scores and self-rated health were tested as mediators using the PROCESS macro with 5000 bootstrapped samples (Hayes, 2013). These mediators were included simultaneously in the analysis. Subjective age, education, depression, SPPB and self-rated health scores were converted to z-scores in each analysis. Lastly, in order to test the association between subjective age and FoF at each of the annual assessment over the 7 years of follow-up, a complementary analysis was conducted using a logistic generalized estimating equation (GEE; Zeger et al., 1988). The GEE model enables analysis of cumulative longitudinal data controlling for repeated observations and follow-up years within participants (Ballinger et al., 2004).

RESULTS

Descriptive statistics for the sample who had complete data at baseline and follow-up (2017) are presented in Table 1. In the total sample ($N = 2,172$), 25.2% participants reported FoF on baseline. The proportional discrepancy scores between chronological age and subjective age indicated that participants with or without FoF at baseline felt on average 10 and 13.5 years younger, respectively. Results of cross-sectional analysis revealed that subjective age was related to higher likelihood of FoF at baseline controlling for demographic factors and falls (Table 2, Model 1). More precisely, results suggested that a 1 SD older subjective age was related to a 31% higher risk of FoF.

The longitudinal analyses revealed that subjective age was also associated with the development of FoF at follow-up with a sample of people who had no FoF at baseline, controlling for demographic factors and baseline history of falls (Table 2, Model 2). Results suggested that a 1 SD older subjective age at baseline was related to a 24% higher risk of FoF 7 years later. Table 3 has the results of the mediation analyses. For both cross-sectional and longitudinal models (Table 3, Model 1 and 2), examination of the indirect effects for each mediator revealed that an older subjective age has a significant indirect association with FoF through more depressive symptom, poor self-rated health, and lower physical performance. When all mediators were in the fully adjusted model, the direct effect of

subjective age on falls became nonsignificant for both models (for cross-sectional model: $\beta = 0.08$; $p = 0.21$; 95% Confidence Interval [CI] = $-0.04 - 0.22$; for longitudinal model: $\beta = 0.11$; $p = 0.11$; 95% CI = $-0.2 - 0.25$).

Lastly, GEE analysis was used on the population with complete data on baseline and without FoF on baseline. A total of 1,679 participants and 10,061 observations were included in the final analysis. The results of the adjusted GEE model revealed that subjective age was significantly associated with FoF across the six consecutive follow-ups (OR = 1.31, $p < 0.001$; Table 4).

DISCUSSION

The current study examined whether subjective age is related to FoF in older adults. As hypothesized, the results indicated that individuals who feel older are higher likely to fear falling concurrently and 7 years later. This association was independent of demographic factors and prior falls.

Psychological factors associated with subjective age explain partly why individuals who feel older are at risk of concurrent and incident FoF in old age. These findings suggested that individuals who feel older are more likely to fear of falling because they are more depressed and because they perceive their health less favorably. This is consistent with existing research having found that an older subjective age was related to higher depressive symptoms (Keyes & Westerhof, 2012) and poor self-rated health (Spuling et al., 2013), which in turn are associated with higher FoF among older adults (Hajek et al., 2018; Kim et al., 2013; Kumar et al., 2014, Curcio et al., 2020). Other psychological factors not tested in the present study may also explain the relation between subjective age and FoF. Indeed, an older subjective age is associated with higher levels of stress (Shrira et al., 2016; Terracciano et al., in press), lower life satisfaction (Westerhof, & Barrett, 2005), higher level of anxiety (Shrira et al., 2014), lower self-esteem (Mirucka et al., 2016) and self-efficacy (Boehmer, 2007). Given these results, it is likely that people who are feeling older have less psychological resources to cope with the physical changes associated with aging, and therefore are more likely to develop FoF (Adamczewska & Nyman, 2018).

At the behavioral level, an older subjective age is associated with less physical activity (Stephan et al., 2019), lower engagement in daily behaviors, and other behaviors such as cessation of driving (Montepare, 2020; Pachana et al., 2017). In addition, self-efficacy beliefs which are components of FoF could also explain the behavioral mechanism. Feeling older is related to lower self-efficacy beliefs (Boehmer, 2007) which have been demonstrated to influence health-protective behaviors such as higher physical activity (Caudroit et al., 2012; McAuley et al., 2011). Even if the association between FoF and activities limitation is complex (Allison et al., 2013; Litwin et al., 2018), it is likely that people who feel older than their chronological age develop mobility limitations and a restrictive lifestyle, which could lead to the development of FoF over time. Indeed, SPPB was a significant mediator of the relationship between subjective age and FoF, which suggest that poor physical performance account for part of the association between subjective age and FoF. This finding is also consistent with evidence that an older subjective age is related to walking speed (Stephan et

al., 2015) and handgrip strength (Stephan et al., 2013), which in turn increase the risk of FoF in old age (Donoghue et al., 2013; Kressig et al., 2001; Belka et al., 2019).

In addition, health-related outcomes may potentially explain the current findings. Indeed, previous studies showed that the age individuals feel is a marker of health status and chronic health conditions (e.g., Stephan et al., 2016; Thyagarajan et al., 2019). For example, an older subjective age is associated with several chronic conditions, such as obesity or hypertension (Demakakos et al., 2007; Stephan et al., 2019). And such chronic conditions are associated with the risk of FoF in old age (Neri et al., 2017; Reyes-Ortiz et al., 2006). Therefore, it is probable that individual who felt older develop more chronic disease, which in turn increased the risk of being afraid of falling.

From a clinical perspective, the findings support considering subjective age when evaluating the risk of falling. Indeed, subjective age is related to both FoF and walking speed (Stephan et al., 2015), which are key factors (i.e., FoF) in the risk of falling assessment (Moncada, & Mire, 2017). Furthermore, it has been shown that psychological factors like subjective age are potentially modifiable (Eibach et al., 2010; Hughes et al., 2013). For example, studies have used the strategy of positive social comparison to make older adults feel younger, and thereby improved physical and memory functioning (Shao et al., 2020; Stephan et al., 2013). Given the limited efficacy of exercise programs for decreasing FoF in community-dwelling older people (Kumar et al., 2016), interventions that combine physical exercise and subjective age manipulation could optimized the benefits of such programs.

The strengths of this study include the use of a large national longitudinal sample, the inclusion of demographic, physical, and psychological covariates, and the prospective data with a 7-year follow-up. Furthermore, consistency of results across analytic models supports the robustness of the findings. Indeed, GEE analyses show similar pattern of results than logistic regression analyses. But despite these strengths, this study presents several limitations that should be considered when interpreting the results. First, the study design precludes us from drawing inferences of causal relationships between subjective age and FoF. Indeed, this study focused only on the predictive role of subjective age on FoF. Further research is needed to identify the reciprocal relations between subjective age and FoF over time. Indeed, individual with Fof may restrict physical activities, which may lead to feeling older. The second limitation concerns FoF evaluation. The use of a dichotomized question for assessing FoF is reliable and simple to use in research and clinical practice (Jørstad et al., 2005), but future studies should incorporate a more detailed assessment of FoF (e.g., FES-I scale). Finally, the sample in the present study is from the USA. According to the social and cultural differences in subjective age (e.g., Westerhof et al., 2003), future research should examine whether similar patterns are found in other cultures.

To our knowledge, this study is the first investigation of the contribution of subjective age on concurrent and incident FoF in older age. It confirms that feeling older is associated with negative outcomes in aging, and provides information for the design of tailored intervention programs to prevent falls and its determinants.

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Table 1.Baseline Characteristics of the Sample ($N=2,172$)

Variables	Total ($N=2,172$)	FoF: yes ($N=493$)	FoF: no ($N=1,679$)
Sex (% Female)	58.9%	74.4%	54.3%
Age	75.24 (6.75)	76.75 (7.23)	74.80 (6.54)
Education	5.55 (2.27)	5.32 (2.16)	5.62 (2.30)
Race (% White)	74.3%	74.6%	74.2%
Depression	1.38 (0.60)	1.58 (0.67)	1.32 (0.56)
Subjective age	-0.17 (0.16)	-0.13 (0.16)	-0.18 (0.16)
SPPB	9.10 (2.89)	7.66 (3.23)	9.53 (2.63)
Falls ^a	20.9%	35.5%	16.7%
FoF	22.7%	100%	0%

Notes. Values are M (SD) or %. Subjective age was obtained in years and was subtracted from chronological age and then divided by chronological age.

^aPercentage of people who had fallen down in the past 12 months.

Table 2. Summary of Binary Logistic Regression Analysis Predicting FoF from Subjective Age

Variables	Model 1 (N=2,172)		Model 2 (N=1,679)	
	β	Odds Ratio (95% CI)	β	Odds Ratio (95% CI)
Age	0.28	1.32 (1.15-1.49) ***	0.32	1.38 (1.20-1.59) ***
Sex	-0.79	0.45 (0.35-0.58) ***	-0.20	0.82 (0.65-1.04)
Race	0.08	1.08 (0.84-1.39)	0.28	1.32 (1.00-1.73) *
Education	-0.06	0.94 (0.84-1.06)	0.08	1.09 (0.96-1.22)
Falls ^a (baseline)	0.93	2.52 (2.00-3.19) ***	0.32	1.37 (1.03-1.83) *
Subjective age ^b	0.27	1.31 (1.15-1.49) ***	0.21	1.24 (1.08-1.42) **

Notes.

^a Self-reported fall down in the past 12 months at baseline.

^b Subjective age: Higher value represents an older subjective age (felt age-chronological age/chronological age). β are standardized regression coefficients. Model 1 is the association between baseline FoF and baseline subjective age controlling for demographic factors and prior falls. Model 2 is the association between subjective age at baseline and FoF at follow up with a sample who had no FoF at baseline, controlling for demographic factors and prior falls.

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$

Table 3.

Summary of bootstrap analysis.

Variables	Model 1 (N=2,172)			Model 2 (N=1,679)		
	β	SE	95% CI	β	SE	95% CI
SPPB	0.0685	0.0140	0.0440 ; 0.0987	0.0317	0.0109	0.0129 ; 0.1386
Depression	0.0389	0.0105	0.0207 ; 0.0623	0.0214	0.0092	0.0059 ; 0.0414
Self-rated health	0.0761	0.0171	0.0444 ; 0.1125	0.0430	0.0163	0.0134 ; 0.0768

Notes: SE = Standard Error. Bootstrap estimates and 95% bias-corrected confidence interval for indirect effects of subjective age on FoF, through SPPB, self-rated health, and depressive symptoms controlling for age, sex, education, race and prior falls.

Model 1 is the association between baseline FoF and baseline subjective age controlling for demographic factors and prior falls. Model 2 is the association between subjective age at baseline and FoF at follow up with a sample who had no FoF at baseline, controlling for demographic factors and prior fall

Table 4: Generalized Estimating Equation Predicting FoF Over a Seven Years Follow-up (N=1,679 participants).

Variables	β	SE ^c	Odds Ratio (95% CI)
Time	0.16	0.01	1.18 (1.14-1.22) ***
Age	0.41	0.05	1.51 (1.36-1.67) ***
Sex	-0.24	0.09	0.79 (0.66-0.94) **
Race	0.23	0.10	1.26 (1.03-1.53) *
Education	0.01	0.04	1.01 (0.93-1.10)
Falls ^a (baseline)	0.47	0.10	1.60 (1.32-1.97) ***
Subjective age ^b	0.27	0.05	1.31 (1.36-1.67) ***

Notes: β are standardized regression coefficients.

^a Self-reported fall down in the past 12 months at baseline.

^b Subjective age: Higher value represents an older subjective age (felt age-chronological age/chronological age).

^c Standard Error

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$