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Negative aging perceptions and cognitive and functional decline: Are you as old as you feel?

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Abstract

Background: Research has shown the associations between negative aging perceptions and cognitive and physical decline may be mediated through behavioral and psychological pathways, but they are rarely examined simultaneously. We aimed at assessing the difference in the probability of following a high-, mid-, or low-performing cognitive trajectory, and a high- or low-performing physical function trajectory by negative aging perceptions. We sought to test two competing pathway mechanisms for the associations.

Methods: This longitudinal study used data from the Irish Longitudinal Study on Ageing (TILDA), a nationally representative study of community-dwelling adults in Ireland. Adults aged ≥ 50 years who participated in two or more waves of TILDA ($n = 6121$) were included. An analysis of the population aged 65 years and above was also conducted ($n = 2359$). We identified latent class trajectories of Mini-Mental State Examination (MMSE), Instrumental Activities of Daily Living (IADL), ADL, and Timed-Up-and-Go (TUG) performance using Latent Growth Class Analysis (LGCA) on data collected every 2 years over 5 waves. Multinomial logistic regression was used to estimate the likelihood of membership to each trajectory class by negative aging perceptions (APQ). Finally, we tested possible behavioral, psychological, and social mechanisms.

Results: LGCA identified three trajectory classes in cognitive and two in each physical function measure. People with the highest tertile of negative APQ were more likely to be in the declining MMSE class and the increasing IADL, ADL, and TUG classes. These associations for cognitive function were partially mediated by psychosocial pathways and for physical function were fully mediated by both psychosocial and health behavior pathways.

Conclusions: Negative aging perceptions were associated with cognitive and physical function declines. Poor self-rated health, depressive symptoms, loneliness, and low exercise seem to explain the relationships; however, the possibility of reverse causation remains.

KEYWORDS

cognitive function, depression, functional decline, loneliness, longitudinal, mediation, negative aging perceptions, poor self-rated health, Timed Up and Go

INTRODUCTION

As people age, cognitive and physical function often declines, bringing with it many adverse health outcomes.¹ With increasing longevity, the importance of maintaining physical and cognitive function increases to ensure added years of life are as healthy as possible. Although chronological age is a primary factor in explaining late-life health outcomes, aging is also a subjective experience. Consequently, an individual's subjective age, how old they feel, can influence their cognitive, physical, and self-rated health, and aging perceptions.^{2,3} Furthermore, aging perceptions or attitudes to aging affect individuals' expectations and experience of the aging process.^{3,4}

A growing body of research has documented the association between negative aging perceptions and health outcomes such as physical health and function^{5,6} and mental health.⁷ Older adults who have negative perceptions of aging have lower life satisfaction⁸ and worse self-rated health.^{3,8} Prospective data collection in longitudinal studies allows the examination of temporal changes in health outcomes, following baseline measurement of aging perceptions, reducing some of the possibility of reverse causation. Longitudinal studies find that older adults with negative self-perceptions of aging have greater levels of disability,⁹ worse physical function,^{5,10} and lower mood⁷ than older adults with positive self-perceptions of aging. Systematic reviews consistently support the association of more negative aging perceptions and worse health outcomes and behaviors.^{3,11,12}

The stereotype embodiment theory suggests that beliefs and attitudes towards aging are shaped by both personal experiences and societal attitudes.⁴ These attitudes are hypothesized to influence health outcomes through a mixture of psychological, behavioral, and physiological pathways. Furthermore, age stereotypes may generate expectations that act as self-fulfilling prophecies.¹³ The behavioral pathways would work through healthy practices, where those with negative aging perceptions assume that health problems are an inevitable consequence of getting older and regard healthy practices as futile, whereas people with positive self-perceptions may be better at taking prescribed medicines,^{14,15} maintaining physical activity⁶ and preventative health behaviors.¹⁴ Previous research investigating the psychological mechanisms that may underlie the associations of aging perceptions and health found the association between positive aging perceptions and health was partially mediated by perceived control,¹⁷ while physical activity was a mediator on the behavioral pathway from perceptions of aging to self-rated health.¹⁸ This study makes the first attempt to verify these two pathways proposed in the stereotype embodiment theory, the behavioral and psychosocial pathways, in one model.

Key points

- Negative aging perceptions were associated with an accelerated decline in health outcomes.
- Poor self-rated health, depressive symptoms, loneliness, and low exercise mediate the relationships.

Why does this paper matter?

Adverse psychosocial causes in addition to health behaviors should be the focus for interventions in negative aging perceptions.

Aging perceptions may have a direct effect on health or an indirect effect, through resultant loneliness, depression, poor-self-rated health, and poor health behaviors: low exercise, smoking, and alcohol consumption, which may act as mediators on the pathway to poorer health and cognition.

We hypothesized that higher negative aging perceptions at baseline would be associated with a faster rate of decline in trajectories of cognition, and functional health over the follow-up period. Secondly, we aimed at verifying two potential competing pathways through which negative aging perceptions associations with cognitive and physical function operate: the psychosocial mediation pathway and the health behavior mediation pathway (Figure 1). We investigated the role of psychosocial variables: poor self-rated health, depressive symptoms, loneliness, and health behaviors—smoking, alcohol consumption, and physical activity, as mediators on the pathway from negative aging perceptions and poorer cognition and functional health. We decomposed the association to determine the differential independent effects of both health behaviors and psychosocial variables as mediators of the association of different levels of negative attitudes to aging and cognitive and functional health.

METHODS

Study population

We analyzed the Irish Longitudinal Study on Ageing (TILDA), a nationally representative study of adults aged ≥ 50 years in the Republic of Ireland. Details of the cohort and sampling frame have been described elsewhere.¹⁹ Briefly, at TILDA Wave 1 (2009–2011), 8173 adults aged ≥ 50 years (range 50–105) completed a computer-assisted personal interview (CAPI) in their home; 85% ($n = 6915$)



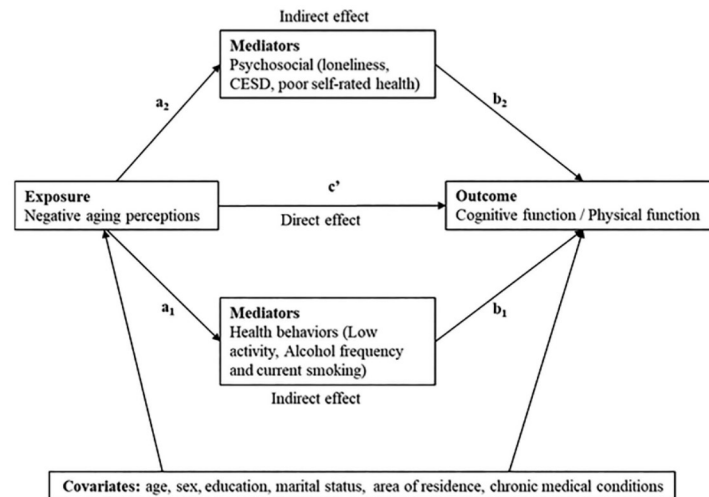


FIGURE 1 Proposed mediation pathways of the association between negative aging perceptions (APQ) and cognitive and physical function outcomes. The total effect refers to the effect of the association of negative aging perceptions with cognitive function and physical function class membership. The indirect effect represents the amount of mediation through the psychosocial variables—conditional on the health behaviors—and health behaviors variables—conditional on the psychosocial variables—on the association between the independent and dependent variable. The direct effect describes the effect of the association of the exposure variable with the outcome variable while controlling for the mediator variable

returned a self-completion questionnaire (SCQ) of whom 6121 completed the Aging Perceptions Questionnaire (APQ). Data were recollected biannually. Our analyses included participants who returned an SCQ at Wave 1 and took part in at least one other wave of data collection between 2009 and 2018. Details of inclusion are shown in Figure 2. An analysis of ≥ 65 was conducted ($n = 2359$) to determine whether associations remained in the older population. All participants provided informed written consent. Ethical approval for TILDA was granted by the Research Ethics Committee of the Faculty of Health Sciences of Trinity College Dublin.

Measures

Negative aging perceptions

The APQ has 32 Likert scale items that ask participants to rate their overall level of agreement with questions about their aging experience and future expectations about aging.²⁰ The questionnaire was derived from Leventhal's self-regulation model (SRM), which offers a framework for viewing and assessing the impact of illness

on the individual.²¹ It has good reliability (Cronbach alpha = 0.86).²² Following reverse coding of positively worded items, all items (coded 0–4) were combined to create a composite score; higher scores indicated greater negative aging perceptions (range 0–128).

Cognitive function

Cognitive function was measured using the Mini-Mental State Exam (MMSE), a 20-item measure testing five areas of cognitive function: orientation, registration, attention and calculation, recall, and language (range 0–30).²³

Physical function

ADL and IADL: Participants were asked if they had difficulties with personal activities of daily living (ADL): walking across a room, dressing, bathing, eating, getting in and out of bed, and using the toilet, and other instrumental ADL (IADL): preparing meals, shopping for groceries, making telephone calls, taking medications, and managing money, such as paying bills and keeping track

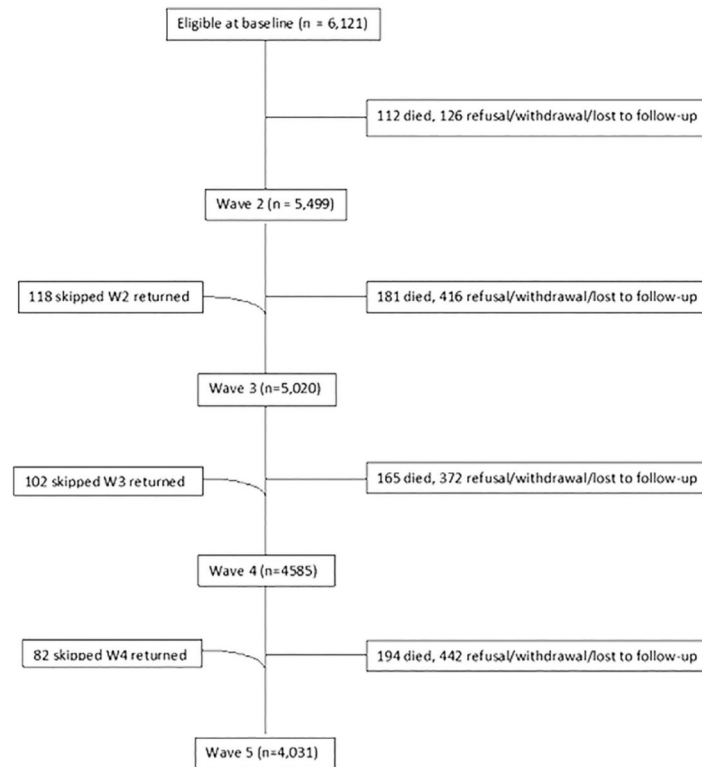


FIGURE 2 The Irish Longitudinal Study on Ageing (TILDA) Wave 1 to Wave 5

of expenses. These were summed as a continuous number of ADL and IADL disabilities.

Timed Up and Go (TUG) is a functional mobility test^{24,25}; participants started seated and were asked to stand up, walk 3 m to a line marked on the floor, turn around, walk back to the chair, and sit down. The time taken to complete this task was recorded using a stopwatch. Mean TUG was calculated.

Mediating variables

Psychosocial variables were baseline depressive symptoms (CES-D, 20-item, range 0–60, higher score

indicating greater symptoms), self-rated health (0, Excellent/very good/good: 1, Fair/poor), loneliness (UCLA loneliness scale, tertiles), and health behaviors: smoking (current smoker, Yes/No), low activity derived from the short form International Physical Activity Questionnaire (IPAQ) (0, moderate/high: 1, low),²⁶ and alcohol consumption (frequency in past week).

Covariates

We adjusted for variables shown to affect negative aging perceptions aging and physical and cognitive function: baseline age (continuous), age-squared,²⁷ sex,²⁸ highest

educational attainment (primary [8 years], secondary [12 years], or tertiary [>13 years]),²⁹ marital status (married, never married, separated/divorced, and widowed)³⁰ area of residence (Dublin, urban other, rural),³⁰ and number of chronic medical conditions (see Table 1) (0, 1, 2, or ≥ 3).³

Statistical analyses

We used latent class analysis to identify latent classes of physical function and cognitive health. We then used growth mixture modeling (GMM) techniques to identify divergent trajectories of individual's levels of cognition, IADL, ADL, and TUG between 2009 and 2018. Baseline negative APQ tertiles were used to predict class membership using chi-square tests and binary logistic (for 2 classes) and multinomial regression (for 3 classes of cognition) models, adjusted for covariates.

Finally, we examined our hypothesis that health behaviors (physical exercise, smoking, and alcohol consumption) and psychosocial variables (poor self-rated health, depressive symptoms, and loneliness) mediate the relationship between negative aging perceptions and cognitive and functional health outcomes. We performed mediation analysis using multinomial regression (cognition) or logistic regression (categorical outcomes) conducted with the Karlson, Holm, and Breen (KHB) method in Stata 14.0.³¹ This methodology is detailed in Appendix S1. We report the total percentage of the effect of negative aging perceptions that is explained by the mediators jointly and evaluate the percentage contribution of the effect that is explained individually by each mediator while controlling for confounding in Table S2 as described in Figure 1.

In addition, we evaluated whether associations between negative APQ and cognition were similar in men and women through interaction terms.²⁸ To test possible residual effects of depressive symptoms on negative aging perceptions, we conducted a sensitivity analysis excluding people with depression at baseline.

Latent growth curve modeling was performed using Mplus version 6.12³² and class membership prediction and mediation analysis using Stata/MP 14.0.³³ TILDA survey weights to account for differential selection into the cohort and attrition at each wave were used in fitting growth curves and in estimating changing cognitive and physical function. Missing data were accounted for using full information maximum likelihood (FIML); all available information is used to calculate parameter estimates including cases with missing data on covariates.

TABLE 1 Descriptive statistics of the TILDA sample at Wave 1

	Wave 1 (n = 6121) Mean (SD)/ n (%)
Age	63.1 (9.4)
Age group n (%)	
50–64	4668 (57.1)
65–74	2164 (26.5)
≥ 75	1342 (16.4)
Sex (n [%] Male)	2762 (47.1)
Educational attainment (n [%])	
Primary	1491 (25.5)
Secondary	2420 (41.3)
Higher	1947 (33.2)
Marital status (n [%])	
Married	4239 (72.3)
Single	527 (9.0)
Sep/divorced	372 (6.4)
Widowed	722 (12.3)
Number of chronic conditions (n [%])	
0	1258 (23.4)
1	1572 (29.3)
2	1247 (23.2)
≥ 3	1293 (24.1)
ADL disability (n [%])	443 (7.6)
IADL disability (n [%])	354 (6.0)
MMSE (mean [SD])	28.5 (2.0)
Timed up and go (TUG) (mean [SD])	9.0 (3.1)
Negative aging perceptions (APQ) (mean [SD])	23.85 (8.5)
Tertile 1	30.10 (9.6)
Tertile 2	47.76 (5.2)
Tertile 3	65.77 (9.6)
Poor self-rated health, n (%)	780 (13.3)
Depressive symptoms, mean (SD)	5.5 (6.9)
Loneliness, mean (SD)	1.9 (2.2)
Low activity (n [%])	735 (12.5)
Current smoker (n [%])	873 (16.6)
Alcohol frequency in past week (mean [SD])	1.6 (1.9)

Note: Chronic conditions include heart attack/heart failure/angina, cataracts, hypertension, high cholesterol, stroke, diabetes, lung disease, asthma, arthritis, osteoporosis, cancer, Parkinson's disease, peptic ulcer, hip fracture.
Abbreviations: ADL, activities of daily living; IADL, Instrumental Activities of Daily Living; SD, standard deviation.



RESULTS

We conducted exploratory analysis to check for unusual features in the data and to check the validity of our initial assumptions for modeling.

The characteristics of the sample at baseline are shown in Table 1, and the distribution of tertiles of negative aging perceptions and the mediator variables by the latent trajectories of cognitive and physical function are shown in Table S1.

Latent class analysis—growth mixture models

Cognitive function

Three cognition trajectories were identified, *Stable*—older adults started with high MMSE and remained stable over time, *Slow Decline*—started with a mid-level MMSE score and declined over time, and *Moderate Decline*—started with a lower MMSE score and declined more rapidly over time (Figure S1). Comparing tertiles of negative APQ by cognitive change over 8 years of follow-up, the results show that individuals with the highest tertile of negative APQ had a higher probability of being in the declining cognition trajectories than those with the lowest negative APQ tertile, that is, RRR of 1.82 (95% CI 1.30, 2.54) and 1.41 (1.18, 1.69) for the *Moderate Decline Class* and *Slow Decline Class*, respectively (Figure 3). This relationship was independent of age, gender, years of education, marital status, area of residence, chronic medical conditions, health behaviors, and depressive symptoms. Mediation analysis found that this association was partially mediated by psychosocial variables (Table 2). The association of higher negative aging perceptions with declining cognition was partially mediated (40%) by the psychosocial variables, and loneliness and poor self-rated health explain about 22% and 7%, respectively, of this association with declining cognition over time (*Moderate Decline*) (Table S2).

Physical function

IADL disability

Two IADL disability trajectories were identified, *Stable Class*—older adults started with a low number of IADL disabilities remained stable over time and *Increasing Class*—started with some IADL disabilities and had an increasing number over time (Figure S2). Most of the population (75%) were in the *Stable Class*, whereas 25% were in the *Increasing Class*. Comparing tertiles of

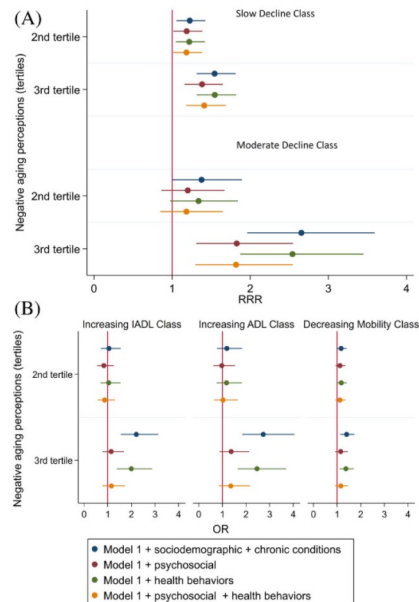


FIGURE 3 Relationship of negative aging perceptions (APQ) in tertiles with probability of (A) cognitive (RRR) and (B) physical function (OR) class membership. Panel A shows the relative risk ratio (RRR), 95% confidence intervals (CI) (Models 1–4), of being in Slow Decline and Moderate Decline cognitive function trajectory over time for those with middle and highest tertile of negative aging perceptions compared to lowest tertile. Panel B shows the odds ratios (OR) and 95% CI (Models 1–4), of being in increasing IADL and ADL disability and decreasing mobility trajectories by the tertile of negative aging perceptions. The panels examine the associations without and with the inclusion of mediator variables. Model 1 adjusts for sociodemographics and chronic medical conditions; Model 2 adjusts for Model 1 + mediators psychosocial variables: poor self-rated health, depressive symptoms, and loneliness; Model 3 adjusts for Model 1 + mediators health behavior variables: low activity, smoking, and frequency alcohol in the past week; Model 4 adjusts for Model 1 + mediators psychosocial and health behavior variables

negative aging perceptions by functional change over time, higher negative aging perceptions were associated with increased IADL disability trajectory over 8 years of follow-up, and those in the highest tertile of negative APQ were more likely to have increasing IADL disability over time (OR 2.21, [1.55, 3.14]) when adjusted for

TABLE 2 The mediation of psychosocial variables and health behavior variables of the association of negative aging perceptions (APQ) with cognitive (MMSE) and physical (IADL and ADL disability, Timed-up-and-go [TUG]) function class membership: The Irish Longitudinal study on Ageing (TILDA)

Class	Cognitive function		Functional disability		Physical function	
	MMSE	MMSE	IADL disability	ADL disability	Timed Up and Go	
	Slow Decline group compared with group who remained stable	Moderate Decline group compared with group who remained stable	Increasing Class compared with group who remained Stable	Increasing Class compared with group who remained stable	Decreasing mobility Class compared with group who remained stable	OR (95% CI)
Effect (base lowest tertile)	RRR (95% CI)	RRR (95% CI)	OR (95% CI)	OR (95% CI)		
Middle tertile						
Total effect	1.23** (1.05, 1.43)	1.38 (0.99, 1.91)	1.04 (0.69, 1.56)	1.23 (0.78, 1.93)	1.23* (1.02, 1.47)	
Direct effect	1.18* (1.01, 1.38)	1.18 (0.85, 1.65)	0.87 (0.57, 1.31)	1.02 (0.64, 1.61)	1.13 (0.94, 1.37)	
Indirect effect	1.04** (1.01, 1.07)	1.16*** (1.08, 1.25)	1.20*** (1.10, 1.31)	1.21*** (1.10, 1.33)	1.08** (1.03, 1.14)	
% mediated overall	18.1				38.4	
Highest tertile						
Total effect	1.57*** (1.33, 1.85)	2.73*** (1.99, 3.73)	2.04** (1.40, 2.90)	2.43*** (1.60, 3.72)	1.50*** (1.20, 1.87)	
Direct effect	1.41*** (1.18, 1.69)	1.82** (1.30, 2.54)	1.15 (0.77, 1.72)	1.35 (0.86, 2.13)	1.17 (0.92, 1.47)	
Indirect effect	1.11** (1.04, 1.20)	1.50*** (1.32, 1.70)	1.78*** (1.54, 2.06)	1.80*** (1.54, 2.10)	1.29*** (1.16, 1.42)	
% mediated overall	23.9	40.4	80.7	66.0	62.1	

Note: Each cell shows relative risk ratio (RRR) or odds ratio (OR) 95% confidence interval (CI), and p-value for the total, direct, and indirect effect from the KHB mediation analysis, which also adjusted for age, age-squared, gender, educational attainment, marital status, area of residence, and number of chronic medical conditions. The upper panel examined the associations of the middle tertile of negative APQ with each of the cognitive and functional outcomes in the columns, alone (total effect) and, together with mediators (direct effect), estimated the effect through the psychosocial and health behavior mediators (indirect effect) and the percentage of the association that is explained by the psychosocial and behavior variables. The lower panel examined these same associations with the highest tertile of negative APQ.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

demographics and chronic conditions (Figure 3). Mediation analysis showed this association was fully mediated through the psychosocial and health behavior mediators (Table 2). These associations were largely explained by psychosocial factors, however, and mediation analysis showed partial mediation for the health behavior pathway with low activity explained 9% and smoking 3% of the effect and the psychosocial variables explaining most of the association with increasing IADL disability trajectory: depressive symptoms (31%), loneliness (19%) and poor self-rated health (19%) (Table S2).

ADL disability

Two ADL disability trajectories were identified, *Stable Class*—older adults started with a low number of ADL disabilities and remained stable over time (75%) and *Increasing Class*—started with some ADL disabilities and an increasing number over time (25%) (Figure S3). Comparing tertiles of negative aging perceptions by functional change over time, higher negative aging perceptions were associated with increasing ADL disability over time, and those in the highest tertile of negative APQ were more likely to have increasing ADL disability over time compared to those with lower negative aging perceptions, following adjustment for sociodemographics: (OR 2.73, [1.84, 4.04]) (Figure 3). These associations were no longer significant in Model 4 when adjusted for psychosocial and health behavior variables. Mediation analysis showed this association was fully mediated (Table 2). Examination of the relative contribution of the mediators to the mediation as shown in Table S2 showed there was mediation through both pathways and low exercise and smoking explained 5% and 3% of the association between negative APQ and increasing ADL disability, respectively, although the strongest mediation was through the psychosocial pathway: Poor self-rated health (19%), depressive symptoms (23%), and loneliness (17%) explained the majority of the association.

TUG

Two TUG trajectories were identified: *Decreasing Mobility Class*—longer to complete TUG, and with slower speed over time, and *Stable Mobility Class*—TUG remained stable over time. Most of the population were in the *Decreasing Mobility Class* (78%) (Figure S4). Comparing tertiles of negative aging perceptions by changing mobility over time, higher negative aging perceptions were associated with the decreasing mobility over 8 years of follow-up. Those in the middle and highest tertiles of negative APQ were more likely to have decreasing mobility compared to those in the lowest tertile of negative APQ (Figure 3), following adjustment for sociodemographics and chronic conditions (OR 1.40, [1.13, 1.74]). Mediation analysis

showed this association was fully mediated in Model 4 when adjusted for psychosocial and health behavior (Figure 3, Table 2). These associations of higher negative aging perceptions with worsening TUG performance were mainly explained by depressive symptoms, 14% and 21%, and poor self-rated health, 9% and 21%, respectively (Table S2).

Supplementary analysis of ≥ 65 years

Repeating the analyses with just those aged ≥ 65 years to determine whether these associations remained when excluding the younger portion of the cohort found similar results for each cognitive and health outcome (Tables S3 and S4, Figure S5), although loneliness became the strongest mediator of the associations between higher negative aging perceptions and worsening TUG performance (Table S4).

Sensitivity analyses excluding those with high depressive symptomology (CES-D > 15) at baseline found similar results in each model, although the effect sizes were reduced (Tables S5–S7). No interactions were identified.

DISCUSSION

In a longitudinal study with a nationally representative sample of adults aged ≥ 50 years, middle-aged and older adults who expressed stronger beliefs in the lack of control and negative consequences of aging at baseline experienced a more rapid decline in both global cognition and physical function: measured as increased functional disability and objective physical function, over 8 years than those who did not. These associations were maintained following adjustment for demographics and baseline health conditions and when only those aged ≥ 65 years were included. Furthermore, associations with cognitive function remained following adjustment for psychosocial and health behaviors, and in analyses excluding those with high depressive symptomology at baseline, suggesting that negative aging perceptions may confer independent risks for cognitive decline.

Our findings are consistent with and extend previous findings from this^{5,6} and other studies^{9,10,17} reporting associations between negative aging perceptions and lower cognitive and physical function. Our study extends the existing literature by for the first time providing an insight into the competing pathways through which negative aging perceptions are likely to work, supports the importance of two of the pathways named in the stereotype embodiment theory,⁴ and estimates the relative contribution of mediators to the association with health



outcomes. Given that studies have documented strong linkages between negative age stereotypes and physical activity, health behaviors,^{12,14} and psychosocial outcomes,^{7,30} they may provide two potential mechanisms for the association of negative aging perceptions and cognitive and physical function. In this study, we note that estimates for the associations of negative aging perceptions with cognitive and physical function trajectories were consistently mediated through psychosocial measures and physical activity at baseline. We found no evidence to support the contention of smoking and alcohol as important mediators of the total effect.

There are other potential explanations for the associations of negative aging perceptions and decline in cognitive and physical functions. Considering the psychosocial pathways, studies have shown that negative aging perceptions are associated with depression and anxiety⁷ and depression has been shown to be associated with incident gait abnormalities.³⁴ While negative aging perceptions have also been associated with TUG, which in turn has been shown to be associated with prospective incident disability³⁵ and lower cognitive function.³⁶ Thus, the cognitive and physical functions are likely to be interrelated rather than independent outcomes. Societal agism can contribute to these internalized negative attitudes to aging. Constant external representations of aging as negative can have a lasting impact on an individual's concept of their own aging. Experimental studies have demonstrated how these negative influences can influence mood and that more positive attitudes and perceptions can be learnt, even at an older age.³⁷

The physiological pathway for the influence of negative aging perceptions on health is complex and incompletely understood but may work through several biological processes. Increased psychological distress may lead to the activation of the autonomic, neuroendocrine, metabolic, and immune systems^{38,39} with corresponding reduced activity of the parasympathetic nervous system, which may lead to chronic low-grade inflammation.⁴⁰ Resultant inflammatory responses may lead to future adverse health and cognitive outcomes.^{39,41} Previous research examining potential physiological explanations for the association of aging perceptions with mortality found it was partially mediated through inflammation, measured as C-reactive protein.⁴² Further research should investigate the putative biological mechanisms and the underlying biology of the psychosocial mediating factors identified in this study.

Agism, demonstrated through discriminatory attitudes and behaviors towards older adults, influences both how society perceives older adults and how both younger and older adults perceive themselves in the future.⁴³ Meta-analysis finds that agism occurring at both the

individual and structural level is associated with worse health outcomes in multi-domains and both high- and low-income countries. Effects are greatest in low-income countries and associated with lower educational attainment and confirm agism as a social determinant of health.⁴⁴ Furthermore, personal experience of structural age discrimination is associated with negative aging perceptions in later life and subsequent poor health behaviors including smoking and increased alcohol consumption.⁴⁵ We found no evidence that smoking or increased alcohol consumption mediated the association between negative aging perceptions and cognitive or physical decline in our study, although low activity explained some of the associations with declining physical function. Ireland reports one of the lowest levels of perceptions of discrimination against older people in Europe (7% report very widespread, and 25% fairly widespread),⁴⁶ while 29% of the United States population reported they had experienced age discrimination.⁴⁷ Ireland is also one of the youngest countries in Europe with 13.8% of the population aged ≥65 years, although it is estimated that by 2040, the proportion aged ≥65 years will be larger than the youngest 0–14 age group. Age stereotypes may become more negative as the proportion of the population aged ≥65 years increases,⁴⁸ and so the impact of negative aging perceptions will increase.

Several limitations should be considered in this study. Firstly, as this is an observational cohort, causal inference cannot be drawn; however, the longitudinal nature and the analyses methodology measuring trajectories of change over time have added to the evidence base. Reverse causation is possible, whereby individuals beginning to decline cognitively or already less healthy may have more negative aging perceptions at baseline. While assessing declining function following baseline negative aging perceptions removes some of this possibility, it cannot remove it completely, as the trajectory declines in health may have already started prior to baseline. Bidirectionality should also be considered: negative aging perceptions are also associated with TUG, which in turn is associated with prospective incident disability³⁵ and lower cognitive function,³⁶ although only in cross-sectional analyses. However, there is evidence from studies examining bidirectionality to support the contention that aging perceptions have more effect on outcomes, rather than the opposite.^{10,49} This study examined each health outcome as a separate model, and these outcomes are not independent. The measures of health behaviors do not account for positive behaviors taken to mitigate against chronic disease. Nevertheless, this study has offered some evidence to support potential explanations for the associations of negative aging perceptions and decline in cognitive and physical functions.



CONCLUSION

Much of the focus in aging perceptions have been around physical activity and improving health behaviors, given their known links to cancer and cardiovascular disease. However, in the present study, we find that when estimated simultaneously, the psychosocial pathway is the strongest mediator in the relationship between negative aging perceptions and health outcomes. Randomized interventions have shown that the activation of positive stereotypes of aging can partially reverse age-related changes in gait in older people.⁵⁰ Given the known associations between loneliness, depressive symptoms, poor self-rated health, and health outcomes,^{51,52} this study suggests that it may be important to focus on these modifiable risks in addition to health behaviors. Chronological age-specific criteria have been used during the COVID-19 pandemic to determine access to Intensive Care Units under pressure, and this will impact agism on a societal level and impact on people's ability to perceive themselves positively. Interventions focusing on aging perceptions should direct attention to reducing the adverse psychosocial causes that explain the association between negative aging perceptions and declines in cognitive and physical function, in particular loneliness and poor self-rated health.

This study showed that negative aging perceptions were a strong predictor of decline in both cognitive and physical functions. This study provides further evidence for the damaging role of negative aging perceptions on objective health outcomes and highlights the need for awareness of these potentially modifiable effects. Our findings add to the potentially modifiable risk factors that should be targeted to improve population health with increased longevity.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

AUTHOR CONTRIBUTIONS

Research questions and review of the literature, study design, preparation and analysis of data, interpretation of the results, drafting of the manuscript, editing of the final manuscript: **Christine A. McGarrigle**. Research questions and data analysis, interpretation of the results, and editing of the final manuscript: **Mark Ward**. Principal investigator of the study, devising and designing of TILDA and data collection, and writing and editing of the final manuscript: **Rose Anne Kenny**.

SPONSOR'S ROLE

None.


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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

Appendix S1. Estimating mediation and decomposing the methods using the Karlson, Holm, and Breen (KHB) method in Stata 14.0.

Figure S1. Latent growth trajectories of cognitive function: Stable, Slow Decline and Moderate Decline Class.

Figure S2. Latent growth trajectories of Instrumental Activities of Daily Living (IADL) disability: Stable and Increasing Class.

Figure S3. Latent growth trajectories of Activities of daily living (ADL) disability: Stable and Increasing Class.

Figure S4. Latent growth trajectories of Timed Up and Go (TUG): Decreasing Mobility and Stable Class.

Figure S5. Results of categorical latent variable multinomial and bivariate logistic regressions, tertiles of negative aging perceptions (APQ), and probability of cognitive (RRR) and physical function (OR) class membership: ≥ 65 years.

Table S1. Tertiles of baseline Negative Aging Perceptions Questionnaire (APQ) and psychosocial and health behavior mediators by latent class membership of trajectories of MMSE, IADL disability, ADL disability, and TUG.

Table S2. The percentage of the total effect of the association of negative aging perceptions (APQ) with cognitive (MMSE), physical (IADL and ADL disability, TUG)

function class membership explained by psychosocial and health behavior variables using the KHB decomposition.

Table S3. The mediation of psychosocial variables and health behavior variables of the association of negative aging perceptions (APQ) with cognitive (MMSE) and physical (IADL and ADL disability, TUG) function class membership: The Irish Longitudinal study on Ageing (TILDA): aged ≥ 65 years.

Table S4. The percentage of the total effect of the association of negative aging perceptions (APQ) with cognitive (MMSE), physical (IADL and ADL disability, TUG) function class membership explained by psychosocial and health behavior variables using the KHB decomposition: ≥ 65 .

Table S5. Results of categorical latent variable multinomial and bivariate logistic regressions excluding participants with CES-D > 15 at baseline.

Table S6. The mediation of psychosocial variables and health behavior variables of the association of negative aging perceptions with cognition, disability (IADL and ADL) and TUG excluding CES-D > 15 at baseline: The Irish Longitudinal study on Ageing (TILDA).

Table S7. The percentage of the total effect of the association of negative aging perceptions (APQ) with cognition, disability (IADL and ADL), and TUG explained by psychosocial and health behavior variables using the KHB decomposition, excluding CES-D > 15 at baseline.

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