Ageing Perception and Social Relationships Moderate the Associations between Health Stressors and Life Satisfaction in the Very Old: Evidence from the ELSA Study

Babatola Dominic Olawa[1,2,3], Abigail Olubola Taiwo[3] and Lizette Nolte

[1]Department of Psychology, Federal University Oye-Ekiti, Oye-Ekiti, Nigeria

[2]Institute for Gerontology, University of Vechta, Vechta, Germany

[3] School of Life and Medical Sciences, University of Hertfordshire, Hatfield, United Kingdom

Corresponding author: Babatola Dominic Olawa

Email: babatola.olawa@fuoye.edu.ng

Abstract

Little evidence exists regarding the moderating effects of social relationships and ageing perception on the association between health stressors and life satisfaction. This study investigated whether social relationships and ageing perceptions, which refers to beliefs and expectations individual older adults have regarding their ageing and the evaluation of the ageing process in general, moderate the roles of pain severity and mobility limitations on life satisfaction in very old age (80+ years, N = 4,220) using data from waves 6-9 of the English Longitudinal Study of Ageing (ELSA). Data were analysed in R Lavaan using structural equation modelling with latent interactions. Generally, very old adults with a more positive perception of ageing reported high life satisfaction despite high mobility limitations. In wave 6, among very old adults with low mobility limitations, life satisfaction was higher for those with high-quality relationships with relatives than their counterparts with low-quality relationships with relatives. For very old adults with high mobility limitations in wave 8, life satisfaction was better for those with high-quality relationships with children than their counterparts with low-quality relationships with children. In wave 9, life satisfaction was poor for very older adults with high pain severity and low-quality relationships with friends. Interventions to increase subjective well-being in advanced old age can target positive views of ageing and the quality of social relationships.

In wave 6, for older adults with low mobility limitations, life satisfaction was higher for those with high-quality relationships with relatives than for their counterparts with low-quality relationships.

Keywords: Ageing perception, Mobility limitations, Pain, Life satisfaction, Social relationships

Introduction

Life satisfaction, which refers to the cognitive component of subjective well-being, represents the extent to which people perceive that they have met their life goals, how well they are faring compared to others, and a feeling of cheerful disposition towards one's life (Diener, 1984; Wiest et al., 2013). It is an overall subjective evaluation of how one has progressed in life domains, including education, income, health, social conditions and personal fulfilment, rather than just an appraisal of current feelings (OECD, 2020). Life satisfaction is essential to longevity, given its relationship with lower mortality risk in both adulthood (Lee & Singh, 2020) and old age (Boehm et al., 2015; Wiest et al., 2013). Longitudinal studies suggest that life satisfaction starts relatively high, drops from emerging adulthood to midlife, rises steadily in old age and suffers some declines at very old age (i.e., aged 80+) (Baird et al., 2010; Gerstorf et al., 2010; Nemitz, 2022). The decline in life satisfaction at very old age may be connected to the strong decline in well-being at this life stage from terminal decline (Hartung et al., 2022).

The bottom-up theory recognises that pleasurable and unpleasurable life circumstances, such as the experience of ill health, can determine how people subjectively assess their well-being (Brief et al., 1993; Diener, 1984). Likewise, the "disability hypothesis" suggests that health problems can adversely affect subjective well-being by generating negative affect (Watson & Pennebaker, 1989). As individuals transit from the young-old (60 – 69 years) to the very old (80+), they experience more declines in health functioning because of increased multimorbidity (Barnett et al., 2012;

Freid et al., 2012). The negative affectivity from high comorbidity rates at over 80+ and the thoughts of nearing the end of life may explain why life satisfaction plummets during this advanced life stage (e.g., Baird et al., 2010).

Two significant health stressors that may impact life satisfaction in old age are pain severity and mobility limitations (Mills et al., 2019; von Bonsdorff & Rantanen, 2011), with mobility limitations worse for very old adults and pain common among those nearing the end of life (Freiberger et al., 2020; Gibson & Schroder, 2001). In a very large sample of older adults in Sweden, Dong et al. (2020) showed that very old adults with chronic pain specifically reported low satisfaction with somatic health, psychological health and overall life satisfaction. There is evidence that musculoskeletal symptoms, including pain, could significantly predict the life satisfaction of very old adults three years later (Enkvist et al., 2012). Similarly, mobility limitations, which refer to reduced capacity in bodily movements, are associated with life satisfaction in old age (Collins et al., 2008). Because very old adults have higher mobility limitations and detrimental health conditions than younger age groups, they are likelier to report lower life satisfaction (Angelini et al., 2012).

The Roles of Ageing Perception and Social Relationships on Life Satisfaction

As pain severity and mobility limitation are risk factors for life satisfaction in old age, social relationships and positive ageing perception tend to be protective. The stress-buffering model states that social relationships can reduce the effects of health stressors on well-being through their functional aspects (e.g. social support) (Cohen & Wills, 1985). For instance, the perceived availability of social support to come to one's aid during difficult times may attenuate the impact of health stressors by strengthening an individual's coping resources (Kawachi & Berkman, 2001). Also, in positive social relationships, the perceived support at one's disposal in the face of stressful

situations may promote a more benign appraisal of the event, thus preventing a surge of attendant negative behavioural and emotional responses (Thoits, 1986), capable of deflating individual's life satisfaction. For those in their advanced old age who may have experienced a significant loss of loved ones because of death and various life transitions, maintaining the existing social relationships remaining in their convoys of social supporters (i.e. children, relatives and friends) becomes crucial to offset the impact of health stressors (Kahn & Antonucci, 1980). The benefits derived from these supporters depend on the structure, quality, and level of closeness to the older adult (Antonucci & Akiyama, 1987). Very recently, (Park & Kang, 2023) reported that frequent talking with children and friends and social interaction with other seniors at the community centres enhanced the life satisfaction of very old adults. Also, maintaining social ties in old age (which include family/friends and social participation) moderates the impact of mobility limitations on emotional dysfunction (Gyasi et al., 2023). Social relationships with children, relatives and family predict an increase in life satisfaction six years later from the English Longitudinal Study of Ageing (Rafnsson et al., 2015).

Ageing perception refers to the beliefs and expectations individual older adults have regarding their ageing and the evaluation of the ageing process in general and has been regarded to be a vital part of the personal coping mechanism in the ageing process (Levy et al., 2002; Ranzijn & Luszcz, 1999). The stereotype embodiment theory proposes that expectations about one's ageing process develop throughout one's life via the accumulation and internalisation of societal ageing stereotypes and perceptions (Levy, 2009). When individuals experience critical age-related changes such as pain or mobility limitations, these internalised stereotypes surface to become self-perception of ageing with an overarching influence on well-being (Velaithan et al., 2024). Ageing perception may moderate the impact of health stressors on well-being outcomes along three routes:

psychological, health promotional, and physiological (Levy, 2009). First, psychologically, expectations and perceptions of one's ageing process can generate self-fulfilling prophesies. For example, an individual may stereotypically believe that old age is generally a time of significant loss of mobility, and this belief may be directed at a pertinent outcome, where these expectations come true in old age. Second, due to the self-fulfilling prophecies, one may not engage in health-promoting behaviours (e.g. physical activity and health-seeking behaviour), thus affecting health outcomes. Physiologically, the self-view of ageing can affect immunocompetency by heightening or reducing cardiovascular stress response (Levy, 2009). Holding a positive view of ageing may enable individuals to adaptively respond to challenges of ageing (e.g. pain and mobility limitation) by engaging in health-promoting behaviours, benignly appraising the negative impact of these challenges and increasing immunocompetency to ensure well-being and life satisfaction. A very recent systematic review, which included 32 studies (Velaithan et al., 2023), reported a strong association between positive views of ageing and life satisfaction and general quality of life. A positive perception of the ageing process could reflect high psychological resilience and may protect life satisfaction in the presence of functional limitations (Wurm et al., 2008).

Study Aims

Though there is a strong indication that pain severity and mobility limitations are risk factors for life satisfaction and that social relationships and positive ageing perception may enhance it, no empirical evidence demonstrates how the interaction between these risks and enhancing factors predicts life satisfaction in advanced old age. For example, we do not know whether the combinations of increased functional limitations and positive perception of ageing (or positive social relationships) predict better life satisfaction (and vice versa). Or do combinations of increased pain severity and positive perception of ageing (or positive social relationships) predict

better life satisfaction (vice versa)? One related study examined the interaction effects of functional limitations (but not mobility limitations) and ageing perception on life satisfaction and found no interaction effect (Wurm et al., 2008). However, the sample consists predominantly of middle-aged and very young adults (< 60 years old) who may not have experienced serious mobility limitations, thus limiting conclusions on the moderating roles of ageing perception on the relationship between mobility limitations and life satisfaction. Because mobility limitations and pains are most severe at very old age with an associated decline in life satisfaction and that ageing perception and social relationships have potential moderating effects, this study tests whether the positive perception of ageing and the quality of social relationships with children, relatives, and friends can attenuate the impact of the health stressors on life satisfaction of very old adults in the English Longitudinal Study of Ageing.

Method

Sample and Procedure

Very old adults (80+ years) were drawn from the English Longitudinal Study of Ageing (ELSA), a large biannual longitudinal study of a nationally representative sample of the English population aged 50 years and over (Steptoe et al., 2013). The ELSA is in its tenth wave, with data from the latest wave scheduled for release by December 2023 (ELSA, 2022). Our study focused on the last four data waves between 2012 and 2019. We analysed data using the four ELSA waves separately to observe possible patterns and consistency in the results. A cross-sectional analysis was performed on mobility limitations, pain severity, social relationships, and life satisfaction from waves 6 (n = 1063, 56% women, and 47.2% married) to 9 (2018/2019, n = 1255, 57.3% women and 48.8% married), while analysis of positive ageing perception was limited to waves 7 (2014/2015, n = 1071, 57% women and 46.9% married) and 8 (2016/2017, n = 1149, 57.8% women and 47.9% married) being the only two waves the variable was measured. Only about 30%

(n = 318) of respondents in wave 6 participated in the rest of the waves. Table 1 details the socio-demographic information measured in the ELSA study. All participants provided written informed consent. The National Research Ethics Service (MREC/01/2/91) approved the ELSA research. Further information on the study and gaining access to the data can be found at https://www.elsa-project.ac.uk/.

[Insert Table 1 about here]

Instruments

Life Satisfaction

The Satisfaction with Life Scale (SWLS) assessed life satisfaction with five items measured on a 7-point Likert scale from *Strongly disagree* (1) to *Strongly agree* (7) (Diener et al., 1985). The items are: "In most ways my life is close to his/her ideal;" "So far I have gotten the important things I want in life;" "The conditions of my life are excellent;" "If I could live my life over;" "I would change almost nothing" and "I am satisfied with my life." Past studies show that SWLS has adequate internal consistency with coefficients ranging from .80 to .90, moderate stability over time, and acceptable sensitivity to variations over time (Pavot & Diener, 2008). High scores represent an increase in life satisfaction.

Mobility Limitations and Pain Severity

Mobility limitations were assessed with ten items asking respondents whether they experienced difficulties lasting more than three months (as a result of ill health) in performing ten mobility-related activities. Sample activities include "walking 100 yards", "climbing several flights of stairs without resting," "stooping, kneeling, or crouching," "pulling or pushing large objects like a living room chair" and "lifting or carrying weights over 10 pounds like a heavy bag of groceries." Participants responded by either mentioning (1) or not mentioning (0) whether they had any

difficulties. All "1" responses were added to generate a composite score of mobility limitations. Pain severity was measured by a single item asking participants to rate how bad their experience of pain is most of the time, from mild (1) to moderate (2) and severe pain (3). High scores on the variables denote high mobility limitations and pain. Please see the full list of items in supplementary file 2.

Perception of Ageing

The ELSA assessed the perception of ageing (PoA) with 12 items using a 5-point Likert scale from *Strongly agree* (1) to *disagree Strongly (5)*. The PoA scale was designed following answers to two open ended questions during ELSA Wave 2 pilot study: "What would you say are the most positive things about growing older?" and "What would you say are the most negative things about growing older?" The instructions for completing the questionnaire require participants to reflect on their own ageing experience and how they generally perceive old age. Six items were related to self-perceptions of ageing (e.g., As I grow older, I become more tolerant) and six items measured the general views of old age (e.g., When I think of old people, I think of them as grumpy and miserable). The PoA scale was also constructed along six positively and six negatively worded items. Despite assessing self and general views of ageing, past studies usually treat the scale as a unidimensional construct (e.g., Warmoth et al., 2018). Given the nature of the PoA scale, we assumed it may have an underlying latent construct and was subjected to an exploratory and confirmatory factor analysis. Factor analyses retained only five items, further analysed in this study (please see more explanations in the result section). Four of the items are oriented to self-perception of ageing ("As I grow older, I become more tolerant"; "As I get older I expect to be able to do things I've always done"; "I don't think of myself as old"; "Growing older doesn't bother me") while the remaining item is oriented towards general views of ageing ("Retirement

is a time of leisure"). All the twelve items can be found in supplementary file two. The response code was reversed, so high scores indicated a more positive perception of ageing.

Social Relationships

Eleven items each (with the exact wordings) were used to measure social relationships with children, relatives, and friends (e.g. *How much you can rely on children/relatives/friends if you have a problem; How much children/relatives/friends get on your nerves; How often you meet up with children/relatives/friends on average*). Items 1 to 7 were measured on a four-point Likert scale format ranging from *A lot* (1) to *Not at all* (4), while the rest were assessed on a six-point scale: *Three or more times a week* (1) to *Less than once a year or never* (6). Only five items focusing on positive social relationships were utilised in this study. The items are: (1*) How much your children/relatives/friends understand the way you feel about things* (2) *How much you can rely on your children/relatives/friends if they have a problem* (3) *How much can you open up to your children/relatives/friends about your worries* (4) *How often do you meet up with your children/relatives/friends on average* and 5) *How often do you speak on the phone with your children/relatives/friends.* The response format was reversed so that high scores would reflect increased positive social relationships with children/relatives/friends. All the eleven items can be found in supplementary file two.

Control Variables

Sex ("0" male, "1" female), marital status ("0" without partner, "1" with partner), education ("0" no qualification, "1" with qualification), age and wealth were included in the regression models as control variables. As in Rafnsson et al. (2015), total (non-pension) net wealth in quintiles was used as the respondent's socio-economic indicator.

Statistical Analysis

Data were analysed using Structural equation modelling (SEM) in Rstudio and the Lavaan and SEM tools packages. In handling missing data, the full information maximum likelihood (FIML) method was used to estimate both the measurement and the structural models, given that its parameter estimates are less biased and have less sampling variability than other missing data handling techniques, in addition to having "high statistical power of interaction effects" (Cham et al., 2017; Enders, 2001). Latent interactions were carried out using the double mean-centring approach, better than the single mean-centring method and the orthogonalisation strategy, especially when the normality assumption may be violated (Lin et al., 2010). In the regression models for each wave, the latent construct of life satisfaction was separately regressed on the latent predictors (i.e., mobility limitations and pain severity), the moderators (i.e., ageing perception and social relationships), and the latent interactions between the predictors and the moderators, while adjusting for sex, age, marital status, education, age and total (non-pension) net wealth. Although social relationships - the study's moderating variable - could be bi-directionally associated with pain and mobility limitations (the predictor variables) (Ashton-James et al., 2022), there is evidence that social ties can also play a moderating role by mitigating the impact of mobility limitations on psychological outcomes (Gyasi et al., 2023) and interact with pain to "bolster more effective psychological responses under painful conditions" (Sturgeon & Zautra, 2015, p. 63).

The slope test (which determines if the association between an independent variable and a dependent variable is significant at a specific level of a moderator) was carried out using the "-1 and +1" standard deviation with the aid of the "probe2WayMC" function built into the SEM tools package. Model fit was assessed by using relative fit indices such as the robust comparative fit index (CFI), standardised root-mean-square residual (SRMR), and robust root-mean-square of

approximation (RMSEA). CFI close to .95, SRMR close to .08, and RMSEA close to .06 indicate good model fit (Hu & Bentler, 1999). However, a CFI value of around .90 and an RMSEA value close to .08 can still be acceptable (Schumacker & Lomax, 2010). Pre-analysis data inspection generally showed that kurtosis and skewness scores on indicators were within the recommended cut-off of 5 and 3, respectively, suggesting that data distribution was moderately normal (Byrne, 2010; Kline, 2011).

Results

Because the moderation models were tested using latent interactions, it was appropriate to initially evaluate the fitness of the study measures using a confirmatory factor analysis (Maslowsky et al., 2015). In this section, we first reported the partial and full measurement model results, the latent correlations among main study variables, and the moderated associations between health stressors and life satisfaction.

Full Measurement Model

The fitness of individual measures was assessed before examining the full measurement model, leading to the deletion of a few items (see supplementary file 1). The full measurement model in waves 6 through 9 consists of 5 latent variables and 26 observed variables, including mobility limitations (10 indicators), pain (1 indicator), relationship with children (5 indicators), relatives (5 indicators) and friends (5 indicators). Waves 7 and 8 comprise an additional latent variable, ageing perception, with five indicators. Table 2 summarises model fit statistics from waves 6 through 9.

[Insert Table 2 about here]

Latent Correlations

Life satisfaction significantly correlated with the predictor and moderating variables in all the waves and in the expected direction, as indicated in Table 3. A positive and moderate relationship

existed between life satisfaction and positive ageing perception in waves 7 and 8 (r = .52, $p < 001$). The negative relationship between mobility limitations and life satisfaction was moderate throughout the waves (r = -.31 to .39, p < .001). At weak levels, pain severity and life satisfaction were significantly and negatively related in all the waves except in wave 7 (r = -.09, p = 09). Social relationships with children, family, and friends were positively related to life satisfaction in all the waves, with coefficients ranging between .10 and .28.

Latent correlations between the predictor and the moderating variables showed a significant but weak relationship between mobility limitations and ageing perception in waves 7 and 8 (r = -.19, p < .001). In contrast, pain severity was not significantly related to ageing perception (wave 7: r = -.10, p = .12; wave 8: r = .01, p = .86) and social relationships in all the waves. Similarly, mobility limitation was not correlated with social relationships except in wave 6, where a weak relationship with closeness to children was observed (r = -.10, p = .04).

[Insert Table 3 about here]

Moderated Relationships between Mobility Limitations and Life Satisfaction

The moderated relationship between mobility limitations and life satisfaction is presented in Table 4. Results showed that the interactions between mobility limitations and social relationship with children were significant on life satisfaction in wave 7 (B = -0.55, p = .047) and 8 (B = 0.77, p = .003). In wave 7, however, the results of the unadjusted model indicated that the interaction effect of mobility limitations and relationship with children on life satisfaction was not statistically significant on life satisfaction (B = -0.53, p = .06, 95%CI [-1.07, 0.02]) but became significant after the inclusion of total (non-pension) net wealth in the adjusted model, thus suggesting a suppression effect and a potential bias (Lenz & Sahn, 2021). In addition, social relationship with relatives moderated the association of mobility limitations and life satisfaction in wave 6 (B = -

0.51, p = .04). Figure 1 shows the interaction plot of the moderated association between mobility limitations and life satisfaction by relationship with children in wave 8. The simple slope tests revealed that the negative relationship between mobility limitations and life satisfaction significantly decreased from less (-.61: *B* = -2.11, p < .001), moderate (0: *B* = -1.62, p < .001) to a more quality relationship with children (.61: *B* = -1.14, p < .001). Also, the negative association between mobility limitations and life satisfaction was significant at less (-.70: *B* = -1.29, p < .001), moderate (0: *B* = -1.64, p < .001) and high-quality relationship with relatives (.70: *B* = -1.99, p < .001) in wave 6. Figure 2 displays the interaction plot of the moderated relationship between mobility limitation and life satisfaction by relationship with relatives in wave 6.

[Insert Table 4 about here]

[Insert Figure 1 about here]

[Insert Figure 2 about here]

The interaction between mobility limitations and ageing perception significantly influenced life satisfaction in waves 7 (*B* = .62, p = .008) and 8 (*B* = 1.15, p = .005). Figure 3 and Figure 4 show the interaction plot of the moderated relationship by ageing perception in waves 7 and 8, respectively. The slope tests indicated that the negative association between mobility limitations and life satisfaction significantly decreased from low (*B* = -1.15, p < .001 vs *B* = -1.41, p < .001), moderate (*B* = -.92, p < .001 vs *B* = -1.14, p < .001) to a more positive ageing perception (*B* = -.70, p = .001 vs B = -.86, p < .001) in waves 7 and 8 respectively.

[Insert Figure 3 about here]

[Insert Figure 4 about here]

Moderated Relationships between Pain Severity and Life Satisfaction

Table 5 presents the moderated relationship between pain severity and life satisfaction. Pain severity and relationship with children interactively influenced life satisfaction in wave 7 (B = -0.54, p = .016). Figure 5 presents the interaction plot of the moderated relationship. The simple slope tests revealed that the negative relationship between pain severity and life satisfaction was only significant at a high-quality relationship with children (B = -0.35, p = .02) in wave 7. In wave 9, relationships with friends played a significant moderating role (β = .13, p = .015). The negative association between pain and life satisfaction significantly reduced from low (B = -.56, p < .001) to a moderately close relationship with friends (B = -.26, p = .002) but not at a high-quality relationship with friends (B = .04, p = .77). Figure 6 displays the interaction plot. Ageing perception was not a significant moderator in waves 7 (B = .05, p = .88) and 8 (B = -.057, p = .22).

[Insert Table 5 about here]

[Insert Figure 5 about here]

[Insert Figure 6 about here]

Summary of Findings. Positive ageing perception attenuated the negative influence of mobility limitations (but not pain severity) on life satisfaction at very old age. Also, the quality of social relationships with children, relatives and friends partly moderated the influence of pain severity and mobility limitations on life satisfaction.

Discussion

There is evidence that health difficulties such as pain and mobility limitations are risks to life satisfaction in very old age, while social relationships and positive perception of ageing are protective (Dong et al., 2020; Enkvist et al., 2012; Rafnsson et al., 2015; Velaithan et al., 2023). However, there is no empirical evidence of how these risk and protective factors interactively

predict life satisfaction, especially in advanced old age, when health stressors are intensified (Barnett et al., 2012; Ding et al., 2017). Accordingly, this study examined how positive perceptions of ageing and social relationships with children, relatives and friends moderate the influence of pain severity and mobility limitations on life satisfaction among very old adults.

We confirmed that high mobility limitations and pain severity correlated with low life satisfaction. Mobility limitations had a moderate relationship with life satisfaction, while pain had a weak relationship. In the regression models, mobility limitation was significant on life satisfaction in all the data waves, while pain was only significant in wave 9. These findings suggest that the limitations associated with movement at very old age may profoundly influence life satisfaction more than the pain experience. However, both may contribute to each other in how they impact life satisfaction, given that movement can cause pain while pain can limit movement (Nawai, 2019; Raggi et al., 2020). These results generally agree with the bottom-up theory of subjective well-being and past studies suggesting that life difficulties such as pain experience and mobility limitations can induce negative emotions and, consequently, low satisfaction (Cheng et al., 2022; Diener, 1984; Dong et al., 2020).

Moreover, we confirmed that favourable views of ageing and social relationships protect life satisfaction. Ageing perception was more moderately associated with life satisfaction, while social relationships with children, relatives, and friends formed weak associations. These results suggest that the self-views of ageing may be more critical to very old adults' life satisfaction than the gains from social relationships with others. Although positive ageing perception may be dependent on good social relationships with others (Santini et al., 2019) in its association with life satisfaction, ageing perception, which is a product of the cognitive process (Levy, 2009), can also be independent of social relationship quality (Skoblow & Proulx, 2020) as it relates to satisfaction

with life. Notwithstanding the difference in the associative strengths, our study provides support to the convoy model, the stereotype embodiment theory and empirical works suggesting that the quality of social relationships and self-view of ageing can determine subjective well-being (Antonucci & Akiyama, 1987; Rafnsson et al., 2015; Velaithan et al., 2023).

Interactions of Ageing Perception with Mobility Limitations and Pain Severity

As hypothesised, the interaction between mobility limitations and ageing perception was significant on life satisfaction. In waves 7 and 8, very old adults with a more positive perception of ageing reported high life satisfaction, whether they had high or low mobility limitations. In contrast, very old adults with a less positive perception of ageing reported low life satisfaction irrespective of mobility limitations levels. Specifically, lower life satisfaction was reported by those with high mobility limitations and a less positive perception of ageing. Contrariwise, those with low mobility limitations and a more positive perception of ageing reported higher life satisfaction. These results underscore the moderating role of positive perception of ageing against the detrimental influence of mobility limitations on life satisfaction, thus confirming the beneficial role of positive views of ageing in the wake of negative health conditions (Wurm et al., 2008). A positive self-view of ageing may reduce the burdens of health stressors on life satisfaction by promoting benign appraisal of the stressors, strengthening immunocompetency and enhancing engagement in health-promoting behaviours to improve one's health(Levy, 2009; Levy et al., 2002). Findings also highlight how the overlapping connections between the perception of ageing and physical functioning (Pan et al., 2019; Warmoth et al., 2018) could be associated with well-being in advanced old age. However, we did not confirm the interaction effect of pain and ageing perception on life satisfaction. Pain is a condition experienced in one way or another throughout life and may not be limited to very old age, like mobility limitations; hence, the interaction between

positive views of ageing and pain severity may have little or no influence on subjective well-being at this life stage (Ding et al., 2017).

Interaction of Social Relationships with Mobility Limitations and Pain Severity

Although not cutting across all the waves, we confirmed the hypotheses on the moderating effects of social relationships with children, relatives and friends. In wave 6, very old adults with low mobility limitations and high-quality relationships with friends had higher life satisfaction than their counterparts with low mobility limitations and low-quality relationships with friends. However, life satisfaction was poor for those with high mobility limitations regardless of the quality of their relationships with friends (though poorer for those with low-quality relationships with friends). In wave 8, life satisfaction was worse for those with high mobility limitations and low-quality relationships with children than for those with high mobility limitations and high-quality relationships with children. However, those with low mobility limitations reported high life satisfaction no matter the quality of their relationship with children, although having high-quality relationships slightly increases life satisfaction. A similar finding appeared in wave 9, where life satisfaction was poor for very older adults with high pain severity and low-quality relationships with friends. Altogether, these findings demonstrate that positive social relationships with children, relatives and friends have some moderating effects on life satisfaction (Park & Kang, 2023; Rafnsson et al., 2015) from the experience of pain and mobility limitations. Social support sources (i.e. family, friends and significant other) have significant roles to play in mitigating the adverse relationship between health stressors and life satisfaction in old age (Antonucci et al., 2014). Diverse social bonds are advantageous in old age by offering broad access to essential support and resources that promote health (Rafnsson et al., 2015). Study findings in some ways also support the stress-buffering model, positing that social relationships via the perceived

availability of a social support system at one's disposal can reduce the impact of health burdens by enhancing an individual's coping resources and promoting a benign appraisal of the health difficulties to mitigate negative emotions that may deflate life satisfaction (Cohen & Wills, 1985; Kawachi & Berkman, 2001; Thoits, 1986).

Our findings have some implications for gerontological social work. Given the findings that positive ageing perception may reduce the negative influence of mobility limitations (associated with advanced old age) on life satisfaction, it may be necessary for social workers to include counselling and psychotherapeutic interventions that will facilitate positive views of ageing in order to reduce the burdens of health stressors associated with advanced old age to promote the quality of life and well-being among clients and residents. Interventions may be incorporated in cognitive-behavioural therapy sessions targeting clients' beliefs and perceptions about their own ageing. Also, in social work, continual promotion of harmonious relationships and closeness between very older adults and their children/relatives may help clients bask in the joy of being socially connected to their age-long convoy of informal social supporters and reassurance of their potential care as they undergo health difficulties, thereby fostering positive emotions to lessen the negative influence of health stressors in advanced old age.

Limitations of study

Although this study provides new insights into how personal and social resources may ameliorate the impact of health stressors on life satisfaction at an advanced old age, the findings should be interpreted in light of some limitations. A single-item measure of pain severity may be limited in capturing the construct of pain and providing reliability evidence (Spadoni et al., 2004). However, recent evidence shows that assessing pain with a single item can be as effective as using scales with multiple items (Kim & Jung, 2020). In addition, this study's very old adult sample consists

predominantly of British Whites. As such, generalising results to other ethnic nationalities and minority groups may be limited. For example, the self-view of ageing may be culturally variant (Segel-Karpas & Bergman, 2022), while social relationships with support sources have been shown to differ in individualistic and collectivist cultures (Triandis et al., 1988). Though data were analysed using data from four ELSA waves, the framework was still cross-sectional and did not allow us to draw cause-effect relationships among the variables. Future studies may replicate findings in a more diverse sample using a longitudinal moderation approach.

Conclusion

This study demonstrates that having a more positive perception of ageing may reduce the detrimental influence of mobility limitations (but not pain severity) on life satisfaction in advanced old age. Compared to other social support sources, relationships with children tend to serve as a protective factor in the associations of pain severity and mobility limitations on life satisfaction. Interventions aiming to increase subjective well-being from mobility limitations must target greater favourable self-views of ageing at advanced old age. A positive perception of the ageing process can assist very old adults achieve positive evaluations and an understanding of health-induced mobility restrictions for better satisfaction with life. In addition, forming social bonds with children and friends may help weaken the deleterious influence of health stressors on life satisfaction in advanced old age.

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Consent to participate: Study participants provided written consent for the survey.

Consent for publication: Participants provided their consent for publication of research outcomes.

Availability of data and material: Data can be found at https://www.elsa-project.ac.uk/

Authors' contributions: All authors contributed to the study's conception, design, and material preparation. Babatola Dominic Olawa performed data analyses. Babatola Dominic Olawa wrote the first draft of the manuscript. All authors read, revised and approved the final manuscript.

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