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More than health: quality of life trajectories among older adults—findings from The Irish Longitudinal Study of Ageing (TILDA)

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Abstract

Purpose To test whether ill-health is associated with a decrease in quality of life (QoL) over time and if positive social circumstances are beneficial to QoL, using the shorter form CASP-12 in a sample drawn from a nationally representative cohort of older adults. To do so, the association between factors from a number of life domains and QoL was investigated.

Methods Data were from the first three waves of The Irish Longitudinal Study on Ageing, a prospective nationally representative study of community dwelling older adults in the Republic of Ireland. QoL was measured using the shorter form CASP-12 and the latent growth curve method was used to describe within- and between-person variation in longitudinal QoL trajectories.

Results There was considerable variation in QoL scores cross-sectionally and longitudinally. QoL did not decline linearly with age but increased from age 50 and peaked at 68 years before declining in older age. QoL differed significantly between individuals and decreased over time. A variety of demographic, health, and social characteristics were associated with changes in QoL over time. These included cohabiting; self-rated health; functional limitations; fear of falling; mental health; loneliness; social networks; social activities; caring for grandchildren; income; and death of a spouse.

Conclusions Changes in QoL over time were not merely a function of ageing, or declining health but resulted from factors from a variety of domains with loneliness and social participation particularly important. Policies concerned with successful ageing and QoL among older adults must consider social circumstances as well as physical and psychological well-being.

Keywords Quality of life · CASP-12 · Older age · Latent growth curve model

Introduction

There has been increased interest in quality of life (QoL) in recent decades, particularly in older adults, motivated by greatly increased life expectancy that has resulted from medical advances, better environments, more prosperity, and improved health behaviours [1]. These successes mean it is important to ensure that increased longevity is matched by improved well-being so that older adults can continue to lead enjoyable lives into old age, even in cases of poor physical or psychological health [2–4].

Traditionally, QoL and successful ageing more broadly has been framed solely in terms of health and ill-health. Indeed health and QoL were oftentimes conflated [2, 4, 5]. More recently, it has been widely accepted that QoL is not reducible to the domain of health alone but rather is a multidimensional construct of which health is but one aspect [4, 6–8]. The departure from a bio-medical model of QoL to a more holistic construct has its roots in postmodernist social theory and ideas of positive ageing [9], Maslow's theory of needs satisfaction [10, 11], and Gilleard and Higgs cultures of ageing [12]. For example, an important constituent of successful ageing, informed by the activity theory of ageing, maintains that successful ageing occurs when individuals stay active and social interactions are maintained, with productive activities improving QoL by improving self-esteem [13–16].

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Given the multidimensional nature of QoL, it is not surprising that there is a variety of objective and subjective instruments used to measure it [7, 17]. Based on a needs-satisfaction model [4, 10, 11, 18], the CASP QoL scale is a theoretically informed measurement tool designed specifically for middle and older ages. CASP incorporates four specific needs that are affected by a range of factors from different life domains that include, but are not limited to health [18, 19]. The four domains of CASP correspond to these specific higher needs—control, autonomy, self-realisation, and pleasure. Control refers to one's ability to shape the environment in which they live, while the related need for autonomy refers to self-determination, both of which are necessary to be able to participate fully in society [18]. The self-realisation and pleasure domains relate to the degree to which human potential is met, and hedonic well-being [4, 9, 20, 21].

While the relationship between QoL and many features of health and physical functioning is well established [2, 5, 22–28], numerous studies have also identified a range of factors, other than health, that are also associated with variation in QoL. These factors are located in a variety of life domains, including socio-economic status, social support and participation, caregiving, financial well-being, and psychosocial [15, 16, 24, 25, 27, 29–34]. Beyond the more established health correlates, there are a numerous examples of factors located in these other domains previously shown to be associated with QoL in older adults. Polypharmacy was associated with lower QoL [35, 36], as was chronic pain [37]. Caring for grandchildren was associated with higher QoL [38] while providing regular care to a spouse or parent was associated with lower QoL [39]. Zaninotto et al. [34] found that cohabiting had a positive effect on QoL for men but not women. While the death of a spouse may lead to a reduction in QoL due to reduced social integration [40], others have found QoL to improve after the death of a partner and posit that this improvement may be due to a reduced burden due to caring for a spouse or partner who was in ill-health prior to death [41]. Lower QoL was found among older adults with a fear of falling [42], while larger social networks [43], social participation and volunteering [32, 44], and financial well-being [39] were all associated with better QoL.

A number of longitudinal studies have measured individual differences and population level trajectories in QoL over time [16, 22, 28, 34, 45–47] and these have shown that QoL varies between individuals and groups. Importantly, while QoL does decline over time, the relationship between QoL and age is not a linear one but rather, QoL tends to continue to increase through early older age before decreasing in later older age [34, 41, 46].

While Layte et al. have previously identified correlates of QoL in this cohort cross-sectionally using the full CASP-19, QoL has not been examined longitudinally using the shorter form CASP-12. Our aim therefore is to identify different ageing trajectories in QoL and to examine the role of a wide range of factors in shaping these trajectories. Specifically, we tested whether ill-health is associated with a decrease in QoL over time and if positive social circumstances are beneficial to QoL. A secondary aim is to assess the utility of CASP-12, as constructed by Sexton et al., in detecting the effect of these factors on QoL longitudinally.

Methods

Data are from The Irish Longitudinal Study on Ageing (TILDA), a prospective nationally representative study of community dwelling adults aged ≥ 50 years resident in the Republic of Ireland. Details of the methodology employed by TILDA are fully described elsewhere [48–50]. Briefly, TILDA participants were selected using multi-stage stratified random sampling whereby 640 geographical areas, stratified by socio-economic characteristics, were selected, followed by 40 households within each area. The Irish GeoDirectory listing of all residential addresses provided the sampling frame. The first Wave of data collection was conducted between 2009 and 2011, with subsequent Waves collected at 2 year intervals. Details of the sample maintenance strategies used by TILDA are also available elsewhere [51]. TILDA employs three modes of data collection: computer-assisted personal interview (CAPI); self-completion questionnaire (SCQ); and a health assessment carried out by research nurses at Waves 1 and 3. The CASP items were collected at each Wave as part of the SCQ. As shown in Fig. S1, at Wave 1, 8175 CAPI interviews were completed with a response rate of 62%, and 85% ($n = 6915$) of these respondents returned SCQs. The corresponding figures at Wave 2 were 7134 for the CAPI and 6003 SCQs (84%), while at Wave 3, 6425 CAPI interviews were completed and 5353 completed a SCQ (83%). The analytic sample here consisted of all respondents for whom a QoL score was available at all three time points (Fig. S1; $N = 3646$).

Dependent variable

QoL is measured here using the 12-item self-report measurement, CASP-12 [19, 52]. This measurement tool has been adapted from the original CASP-19 multi-item indicator and has been shown to have better psychometric qualities than the original longer version [18, 19, 27]. Both the Survey of Health, Ageing and Retirement in Europe (SHARE) [16, 45, 53, 54] and TILDA use shorter 12 items versions of CASP-19 although the item composition differs between the two studies [19, 53]. Here, each statement in the scale has four response categories (often, sometimes, not often,

never) responding to how well the "statement applies to me". Each of the 12 items was scored from zero to three and then summed, giving a range of 0–36 with higher scores indicating better QoL. We found CASP-12 to have good internal reliability at each wave (Cronbach's $\alpha = 0.78$, 0.80, 0.80).

Independent variables

Two time-invariant socio-demographic characteristics were included: gender and education (primary or less, secondary, tertiary), while a time-varying item that captured whether respondents lived with a partner or not was also included at each wave.

Physical and mental health

Self-rated health relative to others of the same age was included (good or better vs poor or worse). A number of measures of functional impairment were included. Respondents were asked whether their activities were limited by an illness or disability and the cumulative number of physical limitations from 12 possibilities was included. In addition, dummy variables were included to capture the presence of difficulties with basic (ADL) and instrumental activities of daily living (IADL). ADL activities included difficulties with dressing, walking across a room, bathing or showering, eating, getting in or out of bed, and using the toilet, while IADLs included preparing meals, doing household chores, shopping, using the telephone, taking medications, and managing money. The presence of mild to severe chronic pain and polypharmacy which refers to taking five or more medications concurrently [55] were also included. Finally, fear of falling (yes or no) was also considered.

In addition to these markers of physical health, two measures of psychological well-being were also included in our analysis: self-rated mental health in comparison with others of a similar age (good or better vs fair or worse), and number of depressive symptoms. The latter was measured using the short 8-item version of the Centre for Epidemiological Studies Depression (CES-D) scale. This scale measures the frequency that respondents have experienced a variety of depressive symptoms within the past week, with higher scores indicating increased depressive symptomology [56, 57].

Social participation and support

In the social domain, we included social connectedness based on the Berkman–Syme Social Network Index, a composite measure of social connections that incorporates marital status (married = 1, not married = 0), frequency of contacts with children (few = 0, many = 1), close relatives and close friends (few = 0, many = 1), and membership of church groups (yes = 1, no = 0) or community organisations (yes = 1, no = 0). Scores from the four domains were summed, giving a range of 0–4 with lower scores indicating greater social isolation [58]. Loneliness was measured using the five-item University of California at Los Angeles (UCLA) Loneliness Scale, which measures perceived social isolation with higher scores indicating greater isolation [59]. We also created a dummy variable for taking part in social activities at least once per month (vs less than once per month). The activities included were attending films, plays and concerts; classes and lectures; playing games such as cards and bingo; going to a public house; eating out; and participating in sports or exercise [60]. To capture aspects of caregiving, we included two indicators—whether or not respondents cared for a child or grandchild at least 1 h per week, and whether they provided regular care to their own parent(s) with ADLs or IADLs.

Socio-economic

We chose household income as our measure of socio-economic status in order to best capture an indication of the material or economic resources available to older adults at each time point. In doing so were also more likely to capture changes in these resources compared to other potential measures, such as wealth, occupation, and education, as these tended to be fixed over the short 4-year time frame considered here. Household income was recorded during the CAPI. To counter item non-response, the unfolding brackets method was used whereby respondents were presented with income ranges in which to place themselves. The midpoint of this range was then taken as indicative of income. For the remaining missing income values (between 5 and 10% across the three waves), the uvis multiple imputation program implemented in Stata 14.2 was used to impute income [61, 62]. This command imputes missing values for a single variable as a function of several covariates. Income was imputed for the missing cases at Wave 1 based on sex, age, education, number of years worked, household composition, urban/rural location, father's social class, mother's social class, and respondents own social class, and sampling cluster level social class. Missing income values were imputed in the same way for Wave 2 and 3 but with the income from preceding rounds also included in the estimation. This procedure resulted in < 1% missing income values at both Waves 1 and 2, and 3.1% at Wave 3. Income was then equivalised or weighted to account for the composition of respondents households. This was executed in accordance with the Organisation for Economic Cooperation and Development (OECD) equivalence scale, whereby a weight of 1 is applied to the first adult household member, 0.66 to each subsequent adult, and 0.33 to each child (aged less than

14 years). Household equivalised income were then included as quintiles in our analysis.

Finally, in an effort to capture significant life events that we suspect may influence QoL, we also captured whether respondents had experienced the death of a child, spouse, or parent between Waves 1 and 3 (2009–2015). Factor variables were dichotomised in order to provide parsimonious results.

Statistical approach

Following the approach taken earlier by Zaninotto, Falaschetti, and Sacker, we used the latent growth curve (LGC) method from the structural equation modelling (SEM) framework to examine trajectories of QoL over time [63–66]. The latent part of our LGC model is the intercept (mean baseline score of QoL) and the slope, which is the rate of change observed over time. Here the slope is estimated over three time points. To define the slope component of our model, the parameters were fixed to zero at baseline (Wave 1), 1 at Wave 2, and 2 at Wave 3. Conceptually, this model estimates the latent trajectory of change that gives rise to the scores on QoL.

The LGC models were fit using Mplus version 6.12 [66]. To account for the complex multi-stage sampling design, we applied survey weights, and adjusted for clustering and stratification using the complex survey option. The survey weights also adjusted for non-response due to attrition. A number of goodness-of-fit indices are available to assess model fit [66–68]. The adjusted Chi-square statistic, tends to reject the model when sample sizes are large [69, 70] and so alternative indices were also assessed. These were the root mean square error of approximation (RMSEA), as well as two comparative fit indices, the Comparative Fit Index (CFI) and the Tucker–Lewis Index (TLI). The RMSEA goodness-of fit test has a recommended cut-off of < 0.05 [70, 71]. The CFI and TLI return values between 0 and 1 with values > 0.90 and > 0.95, respectively, indicating satisfactory and excellent fit [67, 70, 72]. Predicted 4-year trajectories from the LGC are also presented graphically in the form of an ageing-vector graph, fitted using Stata/MP 14.2.

A number of models were run to find the best fitting model for our data. To test whether calculating gender-specific models would be beneficial, we ran a multiple-group LGC model with both intercept and slope for men and women constrained to be equal. While there was a significant difference between the two models, this result was likely inflated due to the large sample size. Furthermore, the model fit statistics differed little between men and women, and while a graphical inspection of the sample and estimated means showed that women had a higher intercept, the growth trajectories (slopes) were similar for both. The results of this gender-specific analysis are provided in supplementary Tables S1, S2.

Missing values

Missing data were addressed using full information maximum likelihood (FIML) estimation, so that parameter estimates were calculated using all available information, including cases with missing data on covariates [73].

Results

The characteristics of the analytic, full TILDA sample at baseline, and comparable population estimates from the census of population are provided in Table 1. Among our analytic sample, the mean CASP-12 QoL score was 28.2 (SE 0.11) and the mean age was 62 years (SE 0.19). The majority of the sample was cohabiting. Almost one-third had a third-level education qualification and mean income was in the third quintile. The most prevalent health conditions were physical impairment, chronic pain, and longstanding limiting illness. A substantial majority had a fear of falling and one-in-five used five or more pharmaceutical medications. One-in-ten rated their mental health as fair or poor and a mean of 2.8 (SE 0.08) depressive symptoms were recorded. Almost all were socially active at least monthly. The average score on the Social Network Index was 2.8 from a maximum of score of four. Furthermore, 6% of respondents were classified as being the most socially isolated (scored zero or one) while 29% were in the most integrated category. One-third provided care for grandchildren and one-in-ten assisted a parent. Comparing these characteristics to all TILDA participants who completed the SCQ at Wave 1 shows that participants included in our analyses had a higher QoL on average (28.2 vs 27.7) and were younger (mean 62 years vs 63.7); had higher levels of education and household income; better physical and mental health; lower UCLA loneliness scores; were more likely to be socially active monthly; and slightly more likely to provide regular care for a parent. In the main, these differences were small and in the direction typical of patterns of attrition found in longitudinal cohort studies of older adults. In comparison to the wider population from which the TILDA cohort was drawn, our sample was younger and more highly educated.

Baseline model

In our first model that estimated baseline QoL (intercept) and change over time (slope), while controlling for age, we found that QoL differed significantly between individuals, and QoL for the sample decreased over time (Table 2). There was considerable variance in initial QoL scores and in the rate of change between waves: intercept variance was 20.13 (SE 1.08) and slope variance was 2.18 (SE 0.40). QoL score decreased by an average of 0.69 (SE 0.06) between each

Table 1 Characteristics of analytic sample, full TILDA sample at Wave 1, and census of population estimates

	Analytic sample ($N=3646$)	Full TILDA sample ($N=6915$)	Census of population 2011[a]
	% (95% CI)	% (95% CI)	%
Quality of life (CASP 12) (mean)	28.2 (28.0, 28.4)	27.7 (27.5, 27.9)	
Socio-demographics			
Male (%)	49.3 (47.9, 50.8)	48.3 (47.0, 49.6)	49.5
Age (mean)	62.0 (61.6, 62.4)	63.7 (63.3, 64.1)	
Age 50–59 years	44.7 (43.1, 46.3)	41.5 (39.8, 43.3)	40.8
60–74 years	46.1 (44.5, 47.7)	40.3 (38.6, 42.0)	41.1
75+ years	9.2 (8.3, 10.2)	18.2 (16.7, 19.8)	18.1
Living with spouse/partner (%)	70.4 (68.5, 72.3)	65.0 (63.2, 66.8)	66.4
Socio-economic			
Education (% primary)	22.2 (20.5, 24.1)	31.3 (29.5, 33.1)	31.8
% secondary	49.6 (47.7, 51.5)	46.4 (44.7, 48.0)	49.6
% third level	28.1 (26.4, 29.9)	22.4 (21.0. 23.8)	18.6
Household income quintiles (mean)	3.1 (3.1, 3.2)	2.9 (2.9, 3.0)	
Physical health			
Self-rated health (% fair or poor)	12.0 (10.8, 13.3)	15.2 (14.0, 16.5)	
Limiting illness (%)	21.7 (20.2, 23.3)	24.2 (22.7, 25.7)	
Chronic pain (%)	34.5 (32.6, 36.5)	36.6 (34.9. 38.4)	
Any ADLs difficulties (% ≥ 1)	6.4 (5.5, 7.3)	8.5 (7.6, 9.5)	
Any IADLs difficulties (% ≥ 1)	5.1 (4.3, 6.0)	7.2 (6.3, 8.2)	
Number of physical impairments (% ≥ 1)	67.2 (65.0, 69.2)	70.2 (68.3, 72.0)	
No fear of falling (%)	79.4 (77.9, 80.8)	75.7 (74.3, 77.1)	
Polypharmacy (> 4 medications) (%)	17.0 (15.7, 18.3)	20.9 (19.6, 22.2)	
Mental health			
Self-rated mental health (% fair or poor)	8.5 (7.5, 9.6)	10.5 (9.5, 11.6)	
Number of depressive symptoms (CES-D) (mean)	2.8 (2.6, 3.0)	3.1 (2.9, 3.2)	
Social			
UCLA loneliness score (mean)	1.8 (1.7, 1.9)	2.0 (2.0, 2.1)	
Social Network Index (mean)	2.8 (2.8, 2.9)	2.8 (2.7, 2.8)	
At least monthly social activities (%)	90.9 (89.6, 92. 0)	88.0 (86.8, 89.1)	
Caring for grandchild(ren) (%)	34.2 (32.2, 36.3)	32.5 (30.7, 34.4)	
Caring for parent(s) (%)	12.5 (11.3, 13.8)	11.3 (10.3, 12.3)	

ADL activities of daily living, *IADL* instrumental activities of daily living

[a]Population values are provided for comparison with the sample characteristics where this information was available in a comparable format from the Irish Census of Population 2011 (https://www.cso.ie/en/census/interactivetables/). The denominator used to calculate these population estimates is all adults aged 50 years and older in the Republic of Ireland on April 10, 2010 and unlike the TILDA sample is therefore not limited to individuals who were resident in private households

wave which equates to a decrease of 0.35 per year. Model fit was excellent with all fit indices exceeding the recommended thresholds (RMSEA = 0.04, 90% CI 0.02, 0.05; CFI = 1.00; TLI = 0.98).

Growth model

Next, the full LGC model containing time-varying and time-invariant factors shown in Table 3 aimed to determine whether socio-economic, social, and health variables influenced QoL at baseline or changes in QoL over time. The coefficients reported in Table 3 correspond to the difference in QoL score associated with each independent variable at each of the three measurement points. For example, compared to respondents with no limiting illness, those with a limiting illness scored on average 0.37 lower on QoL at Wave 1, 0.60 less at Wave 2, and 0.54 less at Wave 3. For an indication of the effect size of these differences, participants with a limiting illness had a QoL score

Table 2 Latent growth curve model of quality of life (CASP-12) with increasing age

	Estimate	95% CI
Growth parameters		
Intercept	28.64	28.34, 28.95
Intercept variance	20.13	18.03, 22.25
Slope	−0.69	−0.81, −0.57
Slope variance	2.18	1.40, 2.95
Time-invariant		
Intercept regressed on (Age-62)	0.05	0.03, 0.07
Intercept regressed on (Age-62)^2	−0.01	−0.01, −0.00
Slope regressed on (Age-62)	−0.03	−0.04, −0.02
Slope regressed on (Age-62)^2	0.00	−0.00, 0.00
Model fit statistics		
Chi-square (*df*)	16.47 (3)***	
CFI	1.00	
TLI	0.98	
RMSEA	0.04	0.02, 0.05
N	3646	

of 24.7 (SE 0.21) at baseline compared to a score of 28.8 (SE 0.10) among those not limited by illness.

The model fit the data well (RMSEA = 0.03, 90% CI 0.03, 0.03; CFI = 0.95; TLI = 0.92). The average estimated QoL at baseline (intercept) was 27.6 (SE 0.54) and this declined to 26.7 between 2009 and 2015. This decline was significant and there was significant heterogeneity in the rate of change between individuals. The residual variances of the slope and the intercept in the full LGC model were substantially smaller than those in the baseline model indicating that the predictor variables explained much of the variance in baseline QoL values and change over time.

Women had significantly higher QoL than men at baseline (β 0.79, SE 0.15) (Table 3). However, time-invariant factors, gender, education, mean-centred age, and quadratic did not fully explain the decline in QoL. At baseline, not living with a spouse/partner, higher social network score, monthly social activities, caring for grandchildren, and higher household income were all associated with higher QoL scores. Conversely, loneliness was associated with lower QoL. Poorer physical and mental health were also associated with lower QoL at baseline. Specifically, poorer self-rated health, limiting illness, increasing number of IADL limitations, physical impairments, polypharmacy, poorer self-rated mental health, and depressive symptoms were all associated with significantly lower QoL. The direction and strength of the association between most of these factors and QoL were similar at Wave 2.

At the final Wave, poorer physical health was again associated with lower QoL scores though neither ADL nor IADL limitations reached statistical significance. Polypharmacy was also associated with significant lower scores. Caring for grandchildren between Waves 2 and 3 was not associated with change in QoL. Finally, the death of a spouse between Waves 1 and 3 was associated with higher QoL scores at Wave 3. In terms of the magnitude of the effect sizes, self-rated physical and mental health had the strongest consistent negative effect on QoL of the health-related indicators. Social activities and loneliness had the strongest effect of the indicators from the social domain. The effect of loneliness on QoL is particularly noteworthy as a one unit change in loneliness score (from within a range of 0 to 9) was associated with a corresponding difference of almost 1 unit in QoL score (Wave 1: −0.97, SE 0.05; Wave 2: −0.83, SE 0.04; Wave 3: −0.92, SE 0.04).

Finally, results from the LGC model are presented graphically in Fig. 1 by way of an ageing-vector graph. Each vector, represented by an arrow, shows the predicted change (slope) of QoL at 4 year intervals. This figure shows that QoL did not decline linearly with age but instead increased from an average score of 27.6 at age 50 to a peak of 28.9 at age 68. QoL decreased below the value observed among 50 year olds from 85 years of age and decreased steadily from that age onwards. Larger 4 year decline in QoL was generally observed in older ages with, for example, a decline of 1.5 between the ages of 84 and 88 years. Conversely, the smallest rates of decline were typically found among younger participants with QoL declining by only 0.6 between the ages of 53 and 57.

Discussion

This study examined factors associated with change in QoL over time using the shorter version CASP-12. Unlike similar analysis conducted with ELSA data [34], we found a positive relationship between age and QoL (intercept) in our baseline model. While not a linear trajectory, our baseline model showed that QoL decreases (slope) with age and that there is significant heterogeneity between individuals in the rate of change. The association between age and QoL scores, although weakened, did remain after the inclusion of time-varying and time-invariant factors. However, changes in QoL over time were not merely a function of ageing, instead they were associated with a variety of demographic, health, and social characteristics.

The main objective of our analysis was to identify factors from a variety of life domains that potentially influence within-person and intra-individual variation in QoL trajectories. Our findings support the contention of others [13–16] that staying active and maintaining social interactions are important constituents of successful ageing with social network scores, social activities, and less subjective social isolation all associated with higher QoL.

Table 3 Latent growth curve analysis of quality of life (CASP-12) over a 4-year period

Time-varying parameters	Quality of life at Wave 1		Quality of life at Wave 2		Quality of life at Wave 3	
	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Living with spouse/partner (no spouse at wave)	1.02	0.63, 1.40	0.55	0.19, 0.91	0.46	0.04, 0.88
Self-rated health (fair or poor)	−0.93	−1.45, −0.40	−0.63	−1.08, −0.18	−0.97	−1.54, −0.39
Limiting illness (limited)	−0.37	−0.73, −0.01	−0.60	−0.98, −0.22	−0.54	−0.91, −0.17
Chronic pain (chronic pain)	−0.28	−0.56, 0.00	−0.55	−0.86, −0.23	−0.54	−0.86, −0.22
Number of ADLs	−0.22	−0.81, 0.36	−0.70	−1.40, 0.00	−0.05	−0.85, 0.76
Number of IADLs	−0.90	−1.62, −0.18	−0.26	−0.96, 0.44	−0.58	−1.27, 0.12
Number of physical impairments	−0.31	−0.40, −0.22	−0.34	−0.43, −0.25	−0.29	−0.38, −0.20
Fear of falling (no fear)	0.00	−0.09, 0.08	0.10	0.02, 0.17	0.09	0.01, 0.17
Polypharmacy	−0.50	−0.88, −0.12	−0.14	−0.47, 0.18	−0.37	−0.73, −0.02
Self-rated mental health (fair/poor)	−1.34	−1.97, −0.71	−1.23	−1.87, −0.59	−0.57	−1.23, 0.09
Number of depressive symptoms	−0.16	−0.22, −0.11	−0.21	−0.26, −0.16	−0.18	−0.23, −0.12
UCLA loneliness score	−0.97	−1.06, −0.88	−0.83	−0.91, −0.75	−0.92	−1.01, −0.84
Social Network Index	0.31	0.13, 0.49	0.30	0.14, 0.47	0.34	0.14, 0.54
Social activities (at least monthly)	0.70	0.22, 1.17	0.95	0.46, 1.43	0.92	0.44, 1.41
Caring for grandchild(ren) (yes)	0.43	0.15, 0.70	0.28	0.00, 0.55	0.08	−0.22, 0.37
Caring for parent(s) (no)	−0.22	−0.60, 0.15	−0.26	−0.76, 0.24	−0.52	−1.07, 0.02
Household income quintiles	0.28	0.19, 0.37	0.14	0.05, 0.24	0.30	0.20, 0.41
Spouse died between Wave 1 and 3					1.01	0.25, 1.78

	Estimate	95% CI
Growth parameters		
Intercept	27.57	26.51, 28.64
Intercept variance	6.91	5.78, 8.04
Slope	−0.83	−1.55, −0.11
Slope variance	1.30	0.75, 1.84
Time-invariant parameters		
Intercept regressed on (Age-62)	0.04	0.02, 0.06
Intercept regressed on (Age-62)^2	0.00	−0.01, 0.00
Intercept regressed on sex (women)	0.79	0.50, 1.08
Intercept regressed on education	0.18	−0.02, 0.37
Slope regressed on (Age-62)	−0.01	−0.15, 0.18
Slope regressed on (Age-62)^2	0.00	−0.17, 0.07
Slope regressed on sex (women)	0.02	−0.02, 0.00
Slope regressed on education	−0.05	0.00, 0.00
Model fit		
Chi-square (*df*)	455.17 (109)	
CFI	0.95	
TLI	0.92	
RMSEA	0.03	0.03, 0.03
N	3646	

ADL activities of daily living, *IADL* instrumental activities of daily living

By including a number of time-varying and time-invariant factors in our analysis, we also demonstrated that factors other than ageing, gender, or education explain differences in QoL trajectories over time. CASP-12 is a multidimensional measure of QoL and therefore it is unsurprising no one factor from the domains (physical and mental health, social participation and support, socio-economic) considered here was dominant. Instead, factors from a number of life domains impacted QoL to different degrees. When we examined the effect of each domain on the amount of unexplained variance of baseline QoL and the rate of change (supplemental analysis not shown here), we found that

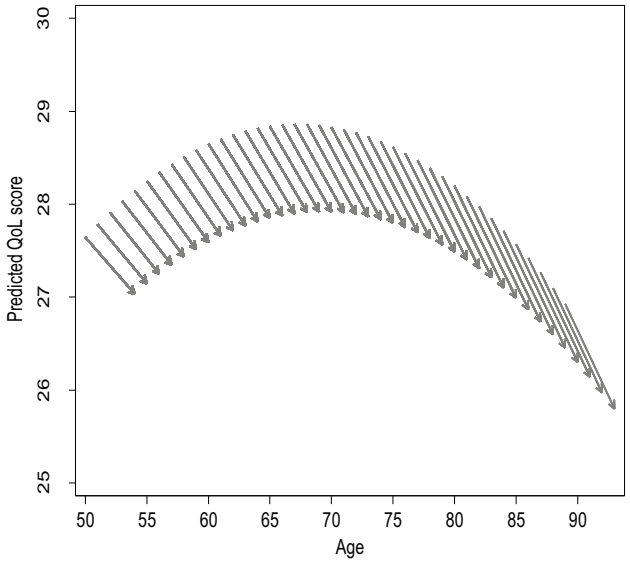

Fig. 1 Vector graph for predicted 4-year ageing vectors of quality of life for full LGC model

social factors, including loneliness, social networks, and social activities led to the greatest reduction in the residual variances of both baseline QoL and change, while health-related factors, particularly self-rated health, and functional limitations were the next most powerful explanatory factors. Therefore, while social factors are critically important for the maintenance of good QoL, physical and mental health also remained influential domains [2, 5, 22–28]. In particular, like others we found that functional limitation(s) was a key health-related determinant of QoL [22, 23, 26, 43, 45]. These findings provide further support to the view that positive ageing more broadly, and QoL in particular, is not confined to health alone [4, 9]. Instead, while recognising that health is an important constituent of the ageing process, successful ageing is also dependent on a broad range of aspects of the lives of older adults, including productive and social activities, and positive inter-personal relationships. In practical terms, this suggests that a positive psychosocial environment may buffer against the negative effects of declining health. In lieu of this, these findings also highlight the importance of conceptualising QoL in broader terms that account for holistic notions of positive ageing as espoused by Gilleard and Higgs [12], and others [11, 13, 14].

Finally, to our knowledge this is the first time that this version of CASP-12, rather than the longer form CASP-19, has been examined longitudinally in a large population sample, and as such, an important finding of our study is that this shorter form CASP-12 can be used to identify within and between changes in QoL. We also found that CASP-12 had good internal reliability and it was possible, based on the intercept variance, to distinguish differences in QoL scores between individuals and groups differing in socio-demographic, health, social, and other characteristics, and to detect change over time. These results also lend support to the utility of the factor structure proposed by Sexton et al. for use with longitudinal data.

There were some limitations to our analysis. Firstly, because our sample was selected from community dwelling older adults, and respondents were younger and more highly educated than the population from which it was drawn, our estimate of average QoL score is likely to be higher than what would be found in the wider population. Common to other longitudinal cohort studies, our analyses are potentially biased by missing data due to item non-response and attrition. Our use of survey weights that were adjusted for attrition and FIML estimation, which uses all available data, minimises the risk inherent in missing data. Furthermore, a complete case analysis showed that the direction and strength of the estimates were similar for the analytic and complete case sample.

We are unaware of any previously published guidelines as to what constitutes a clinically significant change in CASP-12 and therefore are not in a position to comment on the practical importance of changes to QoL associated with any particular independent variables. However, it remains important to highlight the role of individual factors implicated in changes to QoL as a means of better understanding enablers and inhibitors of healthy ageing.

Our analyses are also limited by the relatively short timeframe under study, which means it is not wholly surprising that we did not find a dramatic change in QoL over this period. However, future research that includes subsequent waves of data collection will equip us to further examine longitudinal changes in QoL among older adults in Ireland.

Conclusion

While QoL was traditionally framed in terms of health and ill-health [2, 4, 5], we find here that QoL measured by CASP-12 captures the effect of factors beyond health on older adults' well-being. Also, the shorter CASP-12 demonstrates good discriminatory power and performs as well as the longer 19-item version in capturing changes in QoL over time.

Just as QoL is itself multidimensional, it should be noted that factors that influence QoL do not occur in isolation, and future research in this area should endeavour to explore the interplay of combinations of factors in accounting for changes in QoL scores. Earlier studies by Blane et al. and Sexton et al. provide useful examples of how this might be achieved. Although life course pathways do not appear to directly influence QoL in later life [74], we have shown that more recent circumstances do influence the trajectory of QoL in the short to medium term.

Differences in QoL scores attributable to any one factor are small relative to the full distribution of scores which shows that QoL in older age is determined by a range of factors. For this reason, policies designed to maintain or indeed improve QoL among this cohort must be cognisant of the social circumstances of older adults as well as their physical and psychological well-being if they are to have the desired impact. In particular, as well as investment in illness prevention and health maintenance, public health policies would benefit from facilitating the social participation of older adults in their communities. Social prescribing, whereby clinical staff refer their patients to non-clinical community groups and services, provides an example of how the social, as well as physical, needs of older adults may be met. This may be critically important as positive social circumstances may attenuate the negative impact of deteriorating health on QoL. In conclusion, poorer QoL is not a necessary fact of the ageing process and the maintenance of social interactions and activities appear central to enabling older adults to continue to lead enjoyable lives into old age, even in cases of poor physical or psychological health.

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Compliance with ethical standards

Conflict of interest The authors declare no conflict of interest.

Ethical approval The study was conducted according to the guidelines set out in the 1964 Helsinki Declaration and its later amendments. Ethical approval for TILDA was granted by the Faculty of Health Sciences Research Ethics Committee of Trinity College Dublin.

Informed consent Informed consent was obtained from all individual participants included in the study.

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