CrossMark

Change in quality of life among community-dwelling older adults: population-based longitudinal study

Yves Henchoz[1] · Nazanin Abolhassani[1] · Christophe Büla[2] · Idris Guessous[3] · René Goy[4] ·
Brigitte Santos-Eggimann[1]

Abstract

Purpose This population-based study aimed to determine 5-year change in multidimensional QoL among community-dwelling older people, and to identify predictors of QoL change among demographic, socioeconomic, and health characteristics.

Methods Data of the 2011 and 2016 annual assessments of 1845 older men and women (age range 68–77 years) from the Lc65+ cohort study were used. QoL was assessed using a 28-item instrument yielding a QoL overall score and seven domain-specific QoL subscores. Additional ratings of QoL included a single item (excellent; very good; good; fair; poor), expected QoL in 1 year (better; worse; same as today), and retrospective assessment of QoL 5-year change (better; worse; same as 5 years ago). The predictors of 5-year change in the QoL score were assessed using linear regression, controlling for baseline QoL score.

Results All prospective and retrospective indicators of QoL converged towards a slight deterioration over 5 years. QoL subscores significantly decreased in domains "Close entourage" ($P = 0.004$), "Social and cultural life" ($P < 0.001$), "Esteem and recognition" ($P = 0.001$), "Health and mobility" ($P < 0.001$), and "Autonomy" ($P < 0.001$), whereas "Material resources" ($P = 0.345$) and "Feeling of safety" ($P = 0.380$) remained stable. A stronger decrease in QoL was observed in the most vulnerable profiles at baseline in terms of demographic, socioeconomic, and health characteristics. Changes in depressive symptoms and in disability—either worsening or improving—predicted QoL change in the expected direction.

Conclusions Age-related decline in QoL may be limited through the prevention of disability and depressive symptoms, and more generally by devoting special attention to vulnerable profiles.

Keywords Quality of life · Epidemiology of ageing · Gerontology · Cohort studies

✉ Yves Henchoz
  yves.henchoz@chuv.ch

[1] Institute of Social and Preventive Medicine (IUMSP),
   University of Lausanne Hospital Centre, Route de la
   Corniche 10, 1010 Lausanne, Switzerland

[2] Service of Geriatric Medicine and Geriatric Rehabilitation,
   University of Lausanne Hospital Centre, Lausanne,
   Switzerland

[3] Unit of Population Epidemiology, Department of Community
   Medicine and Primary Care and Emergency Medicine,
   University Hospital of Geneva, Geneva, Switzerland

[4] Pro Senectute Vaud, Lausanne, Switzerland

Introduction

The proportion of the world's population over 60 years is expected to double from about 11–22% between 2000 and 2050 [1]. In this context, modern societies urgently need effective strategies to maintain older people in good health, but also to optimize their quality of life (QoL) in a broader sense. Long-term care policies increasingly prioritize community living over institutionalization, and older people themselves also prefer ageing in place [2]. To enhance healthy ageing among community-dwelling older people, researchers, clinicians, and policy makers need a better understanding of which aspects of QoL are most affected by ageing.

According to the World Health Organization, QoL is a broad ranging concept that incorporates in a complex way an individual's physical health, psychological state, level

Springer

of independence, social relationships, personal beliefs, and relationships to salient features of the environment [3]. Longitudinal studies about QoL in community-dwelling older adults only recently appeared over the last 10 years, with a main focus on health-related QoL. Unsurprisingly, population-based studies indicated that health-related QoL tends to decrease with age [4–6]. Only few longitudinal studies conceptualized QoL as a larger construct, that is not restricted to health-related QoL but comprises further dimensions such as emotional-, financial-, or environmental-related QoL. Data from a nationally representative sample of English non-institutionalized adults aged over 50 years indicated a significant decrease over 5 years of the Control, Autonomy, Self-realisation, and Pleasure (CASP-19) score [7]. In contrast, a study conducted among community-dwelling persons aged 75 years in the Netherlands did not report significant changes over 4 years in the four domains of the World Health Organization QoL scale (WHOQOL-BREF) [8].

QoL is closely related to other concepts that are considered either synonymous (i.e. subjective well-being, happiness) or subordinate (i.e. life satisfaction) to QoL [9]. Only one longitudinal study focused on subjective well-being in older age and did not observe a significant change at 2-year follow-up [10]. In contrast, life satisfaction received more attention in the literature but findings are contradictory. For instance, whereas some study that investigated life satisfaction in adulthood and late life reported that it peaked at age 65 [11], other reported just the inverse with a minimum at age 60 [12]. Results from longitudinal observations of life satisfaction in older population are further confusing as they report improvement [13], deterioration [14, 15], or stability over time [16, 17]. A terminal decline in life satisfaction has also been described 4 years before death [18]. As suggested by a recent study, temporal changes seem to depend heavily on the domains of life satisfaction considered [19].

Observational epidemiological studies are needed to better understand factors that affect QoL among community-dwelling older people and further enhance their QoL through targeted preventive efforts. The present study aimed first to describe changes in QoL over a 5-year period among a population-based sample of community-dwelling older people. A second aim was to investigate the association between demographic, socioeconomic, and health characteristics at baseline, as well as their variation over the study period, and change in QoL at 5-year follow-up.

Methods

Population

Data used in the present study came from the Lausanne cohort 65+ (Lc65+)—a population-based study initiated in 2004 to investigate age-related frailty in old age [20]. Two samples were randomly selected from the community-dwelling population in Lausanne (Switzerland). As detailed in Online Resource 1, enrolment in 2004 included 1564 persons born in 1934–1938, and enrolment in 2009 included 1489 persons born in 1939–1943. In 2011, 2459 (80.5%) individuals were still eligible for the present study (surviving, still living in Lausanne, non-institutionalized, and answer in person, i.e. no proxy), among which 2342 (95.2%) participated to the 2011 annual assessment. Five years later, a total of 1947 (83.1%) participants completed the 2016 annual assessment, among which 1845 (94.8%) provided data that allowed to calculate a QoL score in both 2011 and 2016 and were hence included in the main analyses. The protocol was approved by the Ethics Committee of the Faculty of Biology and Medicine of the University of Lausanne (Protocol No. 19/04). Written informed consent was obtained from the participants.

Measures

Quality of life (QoL)

The primary outcome was a measure of QoL resulting from a 28-item multidimensional questionnaire. The procedure has been previously described [21]. In brief, participants were asked to rate each item on their perceived discomfort or dissatisfaction (0 = a lot; 1 = a little; 2 = not at all). A QoL score was calculated by summing all items, dividing by 56 (i.e. maximum possible score), and multiplying by 100 so that the QoL score would range from 0 (poor QoL) to 100 (excellent QoL). Following a similar procedure, subscores were obtained in seven QoL domains (Material resources; Close entourage; Social and cultural life; Esteem and recognition; Health and mobility; Feeling of safety; and Autonomy), also ranging from 0 (poor domain-specific QoL) to 100 (excellent domain-specific QoL). This questionnaire was recently developed to reflect the convergence of health, social, cultural, and economic factors of older people's QoL (see Online Resource 2). Previous analyses conducted in an exploratory sample and in a validation sample of community-dwelling older people indicated a highly consistent factorial structure [21].

Participants also answered to a single item: 'How do you rate your current QoL?' (excellent; very good; good; fair; poor). Based on prospective answers to this single item in 2011 and 2016, overall QoL 5-year change was calculated (better; worse; no change). Expected QoL was assessed using a single question: 'how do you imagine your quality of life in a year?' (better; worse; same as today). Finally, in 2016, respondents retrospectively assessed how their QoL changed compared to 2011: 'Over the past 5 years, how did

your quality of life change?' (better; worse; same as 5 years ago).

Health status

Participants were asked whether they suffered from symptoms or received treatment over the previous 12 months for any of 12 common medical conditions, diagnosed by a physician: hypertension, myocardial ischemia, heart disease, stroke, diabetes, chronic lung disease, asthma, osteoporosis, arthritis, malignant neoplasm, ulcer, and Parkinson's disease. Owing to the common definition of multimorbidity as the co-occurrence of two or more medical conditions [22], the number of reported medical conditions was categorized as 0, 1, or ≥ 2. The presence of depressive symptoms was defined as a positive answer to either of the two following questions of the Primary Care Evaluation of Mental Disorders Procedure: "During the past month, have you often been bothered by (1) feeling down, depressed, or hopeless? (2) little interest or pleasure in doing things?" As compared to a standardized interview, these two questions had a sensitivity of 96% and a specificity of 57% in diagnosing depression [23]. To assess disability in basic activities of daily life (BADLs), participants indicated whether they had difficulty or needed help with any of dressing, bathing, eating, getting in/out of bed or an arm-chair, and using the toilet during the past 4 weeks [24].

Social status

Three indicators were used to assess social status. First, participants answered questions about their living arrangement, which was categorized as alone or with others. Second, emotional support was assessed using three questions from the MOS Social Support Survey scale [25]: ''How often is each of the following kinds of support available to you in case of need?" (1) Someone who shows you love and affection; (2) someone to share your most private worries and fears with; (3) someone to love and make you feel wanted? (0 = never; 1 = rarely; 2 = sometimes; 3 = often; 4 = very often; 5 = always). The sum of the three items was categorized as low (0–5), medium (6–11), and high (12–15) emotional support. Finally, respondents were asked: "How often do you participate in group activities in a month?" Given the large proportion of participants who reported no group activity, this variable was dichotomized into 'yes' or 'no', with a frequency of less than once a month being considered a "no".

Change in health and social status

Changes in health and social status characteristics over the study period were also considered in the analyses of the predictors of change in QoL between 2011 and 2016. For all variables, the reference category was the group of participants without change over the follow-up period. For binary variables (i.e. living arrangement, disability in BADLs, depressive symptoms, and group activities participation), participants who went from 0 in 2011 to 1 in 2016 were labelled 'getting alone', 'worsening', or 'stopping', whereas those who went from 1 in 2011 to 0 in 2016 were labelled 'getting with others', 'improving', or 'adopting'. For medical conditions and emotional support, 'improving' and 'worsening' were defined by a positive or negative difference in values of the continuous variable between 2011 and 2016.

Demographic and socioeconomic status

Information about age and gender was obtained from the Residents' Registration Office at the stage of study sampling and recruitment. Participants indicated the highest level of education that they achieved, which was further classified according to the International Standard Classification of Education (ISCED) [26]: Basic compulsory (ISCED level 0–2); Apprenticeship (ISCED level 3); Baccalaureate/professional degree (ISCED level 4–5); University (ISCED level 6–8). Country of birth was self-reported and dichotomized as Switzerland or foreign country.

Statistical analysis

Usual descriptive statistics were used to present sample characteristics. Participants included in the main analyses and those who were not included (either alive or deceased at follow-up) were compared using two-sample t tests for age and QoL score or using Pearson Chi-squared tests for categorical variables (gender, education, country of birth). Indicators of QoL at baseline and follow-up were compared using sign test of matched pairs. The mean QoL score at baseline and the mean 5-year change were calculated with 95% confidence intervals, and were compared according to baseline characteristics using one-way analysis of variance. Pearson correlations were calculated to evaluate bivariate associations between 5-year changes in the seven QoL domains.

Among multiple indicators of QoL change that were available in the present study (i.e. QoL score assessed at baseline and follow-up, single item assessed at baseline and follow-up, expected QoL in 1 year assessed at baseline and follow-up, and retrospective QoL 5-year change assessed at follow-up), the QoL score was chosen as main outcome measure because it provides an overall score that is based on a multidimensional assessment and that can be interpreted easily. The predictors of 5-year change in QoL were assessed using conditional change linear regression models [27], with QoL score change (i.e. difference in QoL

score between 2016 and 2011) as dependant variable and QoL score at baseline as covariate. A major advantage of conditional change models is to take into account the negative association that often exists between change scores and baseline values, which is generally known as "regression to the mean" [28]. Hence, this approach considers the fact that QoL is more likely to decrease in a group of individuals with high QoL at baseline compared to a group with low QoL at baseline. Baseline characteristics were entered as independent variables either one-by-one in separate models or all in the same model (mutually adjusted model). In a second step, changes in health and social status over the follow-up period were added as independent variables in the models. For each regression model, both unstandardized (B) and standardized (β) coefficients were calculated. Including β coefficients allows the comparison of predictors on a common scale.

Analyses were performed using Stata V.15.0 software (StataCorp, College Station, Texas, USA). Significance was set at $P < 0.05$.

Sensitivity analyses

Two sensitivity analyses were performed to test models' robustness. First, sampling weights were applied to keep participants at follow-up representative of the baseline sample in terms of gender, education, and country of birth. The second sensitivity analysis was conducted because of the skewed distribution of the QoL scores. This ceiling effect is a common phenomenon observed in health or QoL data [29, 30]. The mutually adjusted models were re-run using two-part models, in which the first part models the probability that the dependent variable (i.e. QoL score at follow-up)

reaches the maximum score, and the second part models the distribution if the full score is not attained [30]. Part 1 and part 2 were modelled using logistic regression and linear regression, respectively.

Results

Table 1 provides a comparison between participants included in the main analyses ($N = 1845$) and excluded participants—either alive ($N = 328$) or deceased ($N = 169$) in 2016. Compared to participants included in the main analyses, excluded participants who were alive in 2016 were slightly but significantly younger ($P < 0.001$), reported a lower level of education ($P = 0.001$), more frequently a foreign country of birth ($P < 0.001$), and had a lower QoL score ($P < 0.001$), whereas excluded individuals who died at follow-up were slightly but significantly younger ($P = 0.004$), were more often men ($P < 0.001$), and had a lower QoL score ($P < 0.001$).

Descriptive findings

Participants' mean QoL score significantly decreased from 88.3 (95% confidence interval (CI) 87.6–89.0) in 2011 to 85.9 (95% CI 85.1–86.7) 5 years later (Table 2). Similarly, the overall rating of QoL—excellent to poor—significantly changed towards poorer ratings in 2016 ($P < 0.001$), with almost twice as much worsening (21.4%) as improvement (11.9%). These trends were further observed in participant's retrospective assessment of QoL change between 2011 and 2016. Whereas 41.7% of participants perceived a worsening, only 7.5% perceived an improvement. Participants were,

Table 1 Comparison of participants included and excluded from the main analyses

	Included in main analyses ($N = 1845$)	Not included in main analyses ($N = 497$)			
		Alive in 2016 ($N = 328$)	P^a	Deceased in 2016 ($N = 169$)	P^a
Age in 2011 (years)	72.1 (71.9; 72.2)	72.7 (72.4; 73.0)	< 0.001	72.7 (72.3; 73.2)	0.004
Gender					
Women	1133 (61.4%)	201 (61.3%)	0.965	69 (40.8%)	< 0.001
Men	712 (38.6%)	127 (38.7%)		100 (59.2%)	
Education					
Basic compulsory	325 (17.6%)	121 (37.1%)	< 0.001	37 (22.0%)	0.128
Apprenticeship	748 (40.6%)	114 (35.0%)		76 (45.2%)	
Baccalaureate/Prof. degree	478 (26.0%)	57 (17.5%)		36 (21.4%)	
University/high school	291 (15.8%)	34 (10.4%)		19 (11.3%)	
Country of birth					
Switzerland	1390 (75.5%)	191 (58.4%)	< 0.001	120 (71.0%)	0.200
Other country	452 (24.5%)	136 (41.6%)		49 (29.0%)	
QoL score in 2011	88.3 (87.6; 89.0)	82.7 (80.4; 85.0)	< 0.001	82.3 (79.1; 85.5)	< 0.001

Data are mean (95% confidence interval) or number (percent)

[a]P value of comparison with participants included in main analyses (two-sample t test or Pearson Chi-squared test)

Table 2 Quality of life reported by community-dwelling older adults at baseline (2011) and follow-up (2016)

QoL indicator	N	Baseline (2011)	Follow-up (2016)	P
QoL score, mean (95% CI) (28 items)	1845	88.3 (87.6; 89.0)	85.9 (85.1; 86.7)	< 0.001[a]
Overall QoL, N (%) (single item)	1577			
Excellent		202 (12.8%)	149 (9.5%)	< 0.001[a]
Very good		599 (38.0%)	536 (34.0%)	
Good		713 (45.2%)	797 (50.5%)	
Fair		59 (3.7%)	82 (5.2%)	
Poor		4 (0.3%)	13 (0.8%)	
Overall QoL 5-year change	1577			
No change		–	964 (52.3%)	–
Better than 5 years ago		–	219 (11.9%)	
Worse than 5 years ago		–	394 (21.4%)	
Retrospective QoL 5-year change, N (%)	1802			
No change		–	894 (48.5%)	–
Better than 5 years ago		–	138 (7.5%)	
Worse than 5 years ago		–	770 (41.7%)	
Expected QoL in 1 year, N (%)	1726			
No change		1425 (82.6%)	1369 (79.3%)	0.064[a]
Better than today		155 (9.0%)	115 (6.7%)	
Worse than today		146 (8.5%)	242 (14.0%)	

QoL quality of life, *CI* confidence interval

[a]Sign test of matched pairs

however, less pessimistic in their answers on expected QoL in 1 year. While similar proportions close to 9% expected an improvement or a worsening in 2011, these proportions were, respectively, 6.7% and 14.0% 5 years later ($P = 0.064$). Nevertheless, around eight in ten participants expected no change at both time points.

As indicated in Table 3, the QoL score in 2011 differed significantly according to all baseline characteristics except gender ($P = 0.158$). QoL was lowest in older individuals ($P = 0.007$), in those reporting a lower level of education ($P < 0.001$), a foreign country of birth ($P < 0.001$), a higher number of medical conditions ($P < 0.001$), depressive symptoms ($P < 0.001$), disability in BADLs ($P < 0.001$), low emotional support ($P < 0.001$), living alone ($P = 0.025$), and no group activity ($P < 0.001$). The unadjusted QoL score change from 2011 to 2016 differed significantly according to age ($P = 0.046$), the presence of depressive symptoms ($P = 0.037$), living arrangement ($P = 0.049$), and group activities participation ($P = 0.040$). Mean changes in Table 3 should be interpreted with caution because they are not adjusted for baseline QoL score. For instance, the mean change is the same (-2.4) in individuals with or without difficulty in BADLs at baseline but one should keep in mind that these two groups have a significantly different QoL score at baseline.

Online Resource 3 provides more detailed information on the 5-year changes within each of the seven QoL domains. A significant decrease was observed in five domains: "Close

entourage" ($\Delta = -1.7$; $P = 0.004$), "Social and cultural life" ($\Delta = -2.2$; $P < 0.001$), "Esteem and recognition" ($\Delta = -2.5$; $P = 0.001$), "Health and mobility" ($\Delta = -4.9$; $P < 0.001$), and "Autonomy" ($\Delta = -2.1$; $P < 0.001$). A decrease in QoL score was also observed in the two remaining domains but it did not reach statistical significance: "Material resources" ($\Delta = -0.9$; $P = 0.345$) and "Feeling of safety" ($\Delta = -1.5$; $P = 0.380$). Bivariate correlations between 5-year changes in the seven QoL domains were all significant ($P < 0.001$) and ranged from 0.26 to 0.66 (Online Resource 4).

Conditional change models

The associations between baseline characteristics and change in QoL score between 2011 and 2016, adjusted for baseline (2011) QoL score, are reported in Table 4, first separately for each baseline characteristics (first column), then in a single model where all baseline characteristics were mutually adjusted (second column). In the separate models, all baseline characteristics except gender and country of birth were significantly associated with the change in QoL score. Decreased QoL was observed in participants reporting the lowest educational level (standardized coefficient (β) $= -0.10$), ≥ 2 medical conditions ($\beta = -0.10$), depressive symptoms ($\beta = -0.17$), disability in BADLs ($\beta = -0.10$), living alone ($\beta = -0.07$), low emotional support ($\beta = -0.10$), and no group activity ($\beta = -0.08$). In the mutually adjusted model, these associations were slightly

Table 3 Comparisons of QoL score at baseline (2011) and of change in QoL score at 5-year follow-up (2011–2016) according to baseline characteristics

Characteristics	N	QoL score at baseline (2011) Mean (SD)	QoL score change (2011–2016) Mean (95% CI)
All	1845	88.3 (15.0)	−2.4 (−3.2; −1.6)
Age in 2011			
68–72 years	1033	89.1 (14.1)**	−1.7 (−2.6; −0.8)*
73–77 years	812	87.2 (16.0)	−3.3 (−4.5; −2.0)
Gender			
Women	1133	87.9 (15.0)	−2.2 (−3.2; −1.6)
Men	712	88.9 (15.0)	−2.7 (−4.0; −1.4)
Education			
Basic compulsory	325	83.9 (19.2)***	−3.5 (−5.8; −1.1)
Apprenticeship	748	88.1 (14.8)	−2.6 (−3.9; −1.3)
Baccalaureate/Prof. degree	478	89.7 (12.9)	−1.3 (−2.6; 0.0)
University level	291	91.4 (11.4)	−2.6 (−3.8; −1.3)
Country of birth			
Switzerland	1390	89.6 (12.8)***	−2.7 (−3.5; −1.9)
Other country	452	84.3 (19.8)	−1.4 (−3.3; 0.6)
Medical conditions			
0	640	89.8 (14.5)***	−1.4 (−2.7; −0.2)
1	631	88.8 (15.1)	−2.5 (−3.9; −1.2)
≥ 2	567	85.9 (15.2)	−3.4 (−4.8; −2.0)
Depressive symptoms			
No	1315	90.8 (13.6)***	−1.9 (−2.7; −1.0)*
Yes	514	81.7 (16.5)	−3.7 (−5.3; −2.1)
Disability in BADLs			
No	1634	89.5 (13.8)***	−2.4 (−3.2; −1.6)
Yes	195	78.2 (19.9)	−2.4 (−5.4; 0.6)
Living arrangement			
Alone	718	87.3 (14.6)*	−3.4 (−4.6; −2.1)*
With others	1121	88.9 (15.2)	−1.8 (−2.8; −0.8)
Emotional support			
Low	114	75.9 (22.4)***	−1.9 (−6.3; 2.6)
Medium	532	85.7 (14.0)	−3.4 (−4.9; −1.9)
High	1189	90.6 (13.8)	−2.1 (−3.0; −1.2)
Group activities participation			
No	785	86.8 (16.0)***	−3.3 (−4.6; −2.1)*
Yes	1048	89.4 (14.1)	−1.7 (−2.7; −0.8)

SD standard deviation, *CI* confidence interval

*P < 0.05; **P < 0.01; ***P < 0.001 (one-way analysis of variance)

weaker but remained significant. Next to baseline QoL score ($\beta = -0.50$), the presence of depressive symptoms ($\beta = -0.14$) was the strongest predictor of change in QoL score at follow-up.

In the full models that included changes in health and social status over the follow-up period (Table 5), significant changes in QoL were associated with worsening ($B = -5.8$) or improving ($B = 6.6$) depressive symptoms; worsening ($B = -8.6$) or improving ($B = 10.0$) disability

in BADLs; getting alone ($B = -3.0$); worsening emotional support ($B = -3.4$); and stopping group activities ($B = -3.7$). All the related changes in QoL were in the expected directions. In the mutually adjusted model, changes in health and social status that were most strongly associated with QoL changes at follow-up were changes in BADLs disability, either worsening ($\beta = -0.11$) or improving ($\beta = 0.11$), and changes in depressives symptoms, either worsening ($\beta = -0.08$) or improving ($\beta = 0.08$).

Table 4 Conditional change models predicting change in QoL between 2011 and 2016 by baseline characteristics

Predictors	Separate models[a]			Mutually adjusted model		
	B (95% CI)	β	P	B (95% CI)	β	P
QoL score at baseline[b]	−0.44 (−0.49; −0.39)	−0.39	<0.001	−0.57 (−0.62; −0.52)	−0.50	<0.001
Age in 2011 (years)[b]	−0.50 (−0.74; −0.25)	−0.09	<0.001	−0.36 (−0.60; −0.12)	−0.06	0.004
Female gender	0.02 (−1.43; 1.47)	0.00	0.978	1.40 (−0.16; 2.96)	0.04	0.079
Education (ref: University)						
Baccalaureate/Prof. degree	0.53 (−1.71; 2.78)	0.01	0.640	0.63 (−1.62; 2.89)	0.02	0.582
Apprenticeship	−1.51 (−3.60; 0.57)	−0.04	0.155	−1.19 (−3.32; 0.93)	−0.03	0.271
Basic compulsory	−4.26 (−6.72; −1.80)	−0.10	0.001	−3.38 (−5.90; −0.86)	−0.08	0.009
Foreign country of birth	−0.90 (−2.56; 0.76)	−0.02	0.286	−1.19 (−2.87; 0.50)	−0.03	0.167
Medical conditions (ref: 0)						
1	−1.57 (−3.26; 0.12)	−0.04	0.069	−1.02 (−2.70; 0.66)	−0.03	0.234
≥ 2	−3.66 (−5.41; −1.91)	−0.10	<0.001	−2.41 (−4.17; −0.64)	−0.07	0.008
Depressive symptoms	−6.26 (−7.87; −4.64)	−0.17	<0.001	−5.16 (−6.81; −3.51)	−0.14	<0.001
Disability in BADLs	−5.18 (−7.52; −2.83)	−0.10	<0.001	−3.92 (−6.28; −1.56)	−0.07	0.001
Living alone	−2.30 (−3.75; −0.85)	−0.07	0.002	−1.75 (−3.28; −0.22)	−0.05	0.025
Emotional support (ref: High)						
Medium	−3.62 (−5.21; −2.04)	−0.10	<0.001	−3.16 (−4.75; −1.57)	−0.08	<0.001
Low	−6.75 (−9.78; −3.72)	−0.10	<0.001	−4.82 (−7.87; −1.77)	−0.07	0.002
No group activity	−2.84 (−4.27; −1.40)	−0.08	<0.001	−2.29 (−3.73; −0.85)	−0.07	0.002
Constant				3.86 (1.57; 6.15)	–	0.001
Adjusted R^2				0.21		

B unstandardized coefficients, *β* standardized coefficients, *CI* confidence interval, *QoL* quality of life, *BADLs* basic activities of daily living

[a]Adjusted for QoL score at baseline (except in the first line)

[b]Values are mean-centred

Sensitivity analyses

Results shown in Tables 4 and 5 remained almost unchanged when using sampling weights to keep participants at follow-up representative of the baseline sample (Online Resource 5). Finally, the same predictors of changes in QoL were found when applying two-part models to account for ceiling effect (Online Resource 6).

Discussion

In this longitudinal study on the QoL of community-dwelling older people, all indicators converge towards a slight but significant deterioration over the 5-year study period. Furthermore, an important contribution of this study that used a multidimensional assessment of QoL is to show that this significant decrease affected all but two specific domains of QoL.

Analyses that controlled for baseline QoL also provide original information on significant predictors of QoL change over time. In particular, results showed that improvements in depressive symptoms, as well as in BADLs disability over the study period, were both independently associated with significant increase in QoL at follow-up. This unique contribution further emphasizes the critical role of these impairments on QoL in older persons [7, 8]. In contrast, worsening emotional support was associated with decreased QoL at follow-up. Overall, these results add new evidence supporting the potential causal role of these factors in affecting QoL evolution and contribute to settle a firm basis on which the promotion of older people's QoL should be based. To promote healthy ageing among community-dwelling older people, policy makers, field actors, and researchers should develop strategies and actions targeted at preventing depression, disability, and decline in emotional support.

Change in QoL was predicted by most baseline demographic, socioeconomic, and health characteristics in both separate models and mutually adjusted models, thereby indicating independent associations. These links were in the expected direction, i.e. decrease in QoL in the most vulnerable profiles such as higher age, lower education, multimorbidity, and living alone. In contrast, country of birth and gender were not associated with change in QoL. Although some previous study also reported the lack of significant association between country of birth and QoL [10], findings are inconsistent regarding gender [7, 8, 10, 31, 32]. Finally, whereas changes in emotional support, disability,

Table 5 Conditional change models predicting change in QoL between 2011 and 2016 by 5-year change in health and social status

Predictors	N	Separate models[a]			Mutually adjusted model[b]		
		B (95% CI)	β	P	B (95% CI)	β	P
Medical conditions							
No change	913	Ref			Ref		
Worsening	550	− 1.31 (− 2.95; 0.33)	− 0.04	0.117	− 0.41 (− 2.01; 1.19)	− 0.01	0.619
Improving	369	0.49 (− 1.54; 2.52)	0.01	0.635	0.46 (− 1.53; 2.46)	0.01	0.650
Depressive symptoms							
No change	1409	Ref			Ref		
Worsening	242	− 5.84 (− 7.95; − 3.73)	− 0.12	<0.001	− 3.83 (− 5.96; − 1.70)	− 0.08	<0.001
Improving	169	6.59 (3.81; 9.38)	0.11	<0.001	4.89 (2.06; 7.72)	0.08	0.001
Disability in BADLs							
No change	1539	Ref			Ref		
Worsening	207	− 8.61 (− 10.82; − 6.40)	− 0.16	<0.001	− 6.00 (− 8.28; − 3.72)	− 0.11	<0.001
Improving	80	9.99 (5.69; 14.30)	0.12	<0.001	9.25 (4.83; 13.67)	0.11	<0.001
Living arrangement							
No change	1680	Ref			Ref		
Getting alone	125	− 2.95 (− 5.80; − 0.10)	− 0.04	0.043	− 0.73 (− 3.59; 2.14)	− 0.01	0.618
Getting with others	24	− 5.12 (− 11.35; 1.11)	− 0.04	0.107	− 5.33 (− 11.98; 1.31)	− 0.03	0.116
Emotional support							
No change	1172	Ref			Ref		
Worsening	379	− 3.42 (− 5.19; − 1.64)	− 0.08	<0.001	− 2.28 (− 4.04; − 0.52)	− 0.06	0.011
Improving	269	2.02 (− 0.17; 4.20)	0.04	0.070	1.26 (− 0.90; 3.41)	0.03	0.254
Group activities							
No change	1408	Ref			Ref		
Stopping	238	− 3.70 (− 5.92; − 1.48)	− 0.07	0.001	− 1.69 (− 3.86; 0.49)	− 0.03	0.128
Adopting	161	0.43 (− 2.22; 3.07)	0.01	0.752	− 0.64 (− 3.23; 1.94)	− 0.01	0.626
Constant					5.72 (3.29; 8.16)		<0.001
Adjusted R^2					0.25		

B unstandardized coefficients, *β* standardized coefficients, *CI* confidence interval, *QoL* quality of life, *BADLs* basic activities of daily living

[a]Adjusted for QoL score at baseline and predictors at baseline (one-by-one)

[b]All baseline predictors were included in the model but results are not shown

and depressive symptoms were all independent predictors of QoL evolution over time, getting alone and stopping group activities were significant predictors only in the separate models, suggesting that their associations with QoL operate through mediating or confounding factors.

An additional contribution of this study is to provide further information on both prospective and retrospective evaluations of QoL change among community-dwelling older people. Although both prospective and retrospective assessments of QoL indicated worsening over 5 years, this proportion was almost twice as high according to the retrospective assessment as compared to the prospective assessment. These results add to findings from the few previous studies in various clinical settings where retrospective questions were found to lead to larger estimates of change in QoL than prospective measures [33]. Several explanations have been proposed to explain the difference between prospective and retrospective measures of change in QoL assessment

[34]. First, prospective evaluations may be biased by scale recalibration, which means that participants understand the response scale differently at baseline and at follow-up because of changes in their internal standards of interpretation. During the study period, participants may have met individuals who experienced considerable difficulty in their life, thereby changing their understanding of the scale and leading them to choose more favourable responses at follow-up compared to baseline for a given level of QoL. Second, retrospective evaluations may be biased by recall bias, which refers to a wrong assessment of former QoL because of memory effects. Among the aspects of participants' life that have changed over the study period, negative rather than positive ones may have been selectively forgotten, leading participants to overestimate their former QoL.

Expectations regarding future QoL indicated a more pessimistic view at follow-up compared to baseline. Previous authors suggested that older adults actively construct

representations of the future that are consistent with the normative age-related declines and losses [35]. Although a negative view of one's future may seem counterproductive, lowering expectations with age may also be a mechanism by which older people are able to maintain their life satisfaction despite age-related losses [36]. In a longitudinal study, underestimation of future life satisfaction was associated with positive health outcomes within the following decade [37].

Several potential limitations should be considered. First, socioeconomic status was limited to the highest level of education achieved and did not include any indicator of financial status. However, given the strong link generally observed between education and financial status in population-based studies, further adjustment for financial status is unlikely to have a substantial impact on the present results. Second, despite extensive retention strategies used in the Lc65 + study [20], participants included in the main analyses were of higher education, were more often born in Switzerland, and had a higher QoL score at baseline, as compared to survivors at follow-up who did not complete the questionnaire. The potential impact of non-response bias was explored in a sensitivity analysis where sampling weights were applied to keep participants at follow-up representative of the baseline sample. Results were essentially unchanged. Since a higher QoL was previously reported in Swiss older people compared to other European countries [38], the present findings should still be interpreted cautiously in countries with a less favourable QoL. Finally, although the longitudinal design of this study was an advantage, having only two time points only allowed modelling a linear trajectory of QoL.

In conclusion, this longitudinal population-based study found a small but significant decrease over 5 years in the QoL reported by community-dwelling older adults and identified several demographic, socioeconomic, and health characteristics that predicted change in QoL at follow-up. Among those, changes in depressive symptoms and in BADLs disability independently predicted both a worsening and an improvement in older people's QoL. This latter finding strongly suggests pathways for interventions to enhance QoL evolution in this population.

Compliance with ethical standards

Conflict of interest The authors have no conflict of interest to declare.

Ethical approval All procedures were in accordance with the ethical standards of the local Ethics Committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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

References

1. World Health Organization. (2012). *World Health Day: Are You Ready? What You Need to Know About Ageing*. Geneva. Retrieved February 25, 2015 from http://www.who.int/world-health-day/2012/toolkit/background/en/index.html.
2. Vanleerberghe, P., De Witte, N., Claes, C., Schalock, R. L., & Verte, D. (2017) The quality of life of older people aging in place: A literature review. *Quality of Life Research 26*, 2899.
3. WHO. (1995). The World Health Organization Quality of Life assessment (WHOQOL): Position paper from the World Health Organization. *Social Science and Medicine, 41*, 1403–1409.
4. Laslett, L. L., Quinn, S. J., Winzenberg, T. M., Sanderson, K., Cicuttini, F., & Jones, G. (2012). A prospective study of the impact of musculoskeletal pain and radiographic osteoarthritis on health related quality of life in community dwelling older people. *BMC Musculoskeletal Disorders, 13*, 168.
5. Bindawas, S. M., Al Snih, S., Ottenbacher, A. J., Graham, J., Protas, E. E., & Markides, K. S. et al. (2015). Association between lower extremity performance and health-related quality of life in elderly Mexican Americans. *Journal on Aging Health, 27*, 1026–1045.
6. Eisele, M., Kaduszkiewicz, H., Konig, H. H., Lange, C., Wiese, B., & Prokein, J. et al. (2015). Determinants of health-related quality of life in older primary care patients: Results of the longitudinal observational AgeCoDe study. *British Journal of General Practice, 65*, e716–e723.
7. Webb, E., Blane, D., McMunn, A., & Netuveli, G. (2011). Proximal predictors of change in quality of life at older ages. *Journal of Epidemiology and Community Healths, 65*, 542–547.
8. Gobbens, R. J., & van Assen, M. A. (2014). The prediction of quality of life by physical, psychological and social components of frailty in community-dwelling older people. *Quality of Life Researchs, 23*, 2289–2300.
9. Camfield, L., & Skevington, S. M. (2008). On subjective well-being and quality of life. *Journal of Health Psychologys, 13*, 764–775.
10. Cramm, J. M., & Nieboer, A. P. (2015). Social cohesion and belonging predict the well-being of community-dwelling older people. *BMC Geriatrics, 15*, 30.
11. Mroczek, D. K., & Spiro, A. 3rd (2005). Change in life satisfaction during adulthood: Findings from the veterans affairs normative aging study. *Journal of Personality and Social Psychology, 88*, 189–202.
12. Hudson, N. W., Lucas, R. E., & Donnellan, M. B. (2016). Getting older, feeling less? A cross-sectional and longitudinal investigation of developmental patterns in experiential well-being. *Psychology and Aging, 31*, 847–861.

13. Gana, K., Bailly, N., Saada, Y., Joulain, M., & Alaphilippe, D. (2013). Does life satisfaction change in old age: Results from an 8-year longitudinal study. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences, 68*, 540–552.

14. Baird, B. M., Lucas, R. E., & Donnellan, M. B. (2010). Life satisfaction across the lifespan: Findings from two nationally representative panel studies. *Social Indicators Research, 99*, 183–203.

15. St John, P. D., Tyas, S. L., & Montgomery, P. R. (2013). Life satisfaction and frailty in community-based older adults: Cross-sectional and prospective analyses. *International Psychogeriatrics, 25*, 1709–1716.

16. Hsu, H. C. (2012). Trajectories and covariates of life satisfaction among older adults in Taiwan. *Archives of Gerontology and Geriatricsss, 55*, 210–216.

17. Lim, H. J., Min, D. K., Thorpe, L., & Lee, C. H. (2017). Trajectories of life satisfaction and their predictors among Korean older adults. *BMC Geriatrics, 17*, 89.

18. Gerstorf, D., Ram, N., Estabrook, R., Schupp, J., Wagner, G. G., & Lindenberger, U. (2008). Life satisfaction shows terminal decline in old age: Longitudinal evidence from the German socioeconomic panel study (SOEP). *Developmental Psychology, 44*, 1148–1159.

19. Lim, H. J., Min, D. K., Thorpe, L., & Lee, C. H. (2016). Multidimensional construct of life satisfaction in older adults in Korea: A six-year follow-up study. *BMC Geriatrics, 16*, 197.

20. Santos-Eggimann, B., Karmaniola, A., Seematter-Bagnoud, L., Spagnoli, J., Büla, C., & Cornuz, J. et al. (2008). The Lausanne cohort Lc65+: A population-based prospective study of the manifestations, determinants and outcomes of frailty. *BMC Geriatrics, 8*, 20.

21. Henchoz, Y., Meylan, L., Goy, R., Guessous, I., Bula, C., & Demont, M. et al. (2015). Domains of importance to the quality of life of older people from two Swiss regions. *Age and Ageing, 44*, 979–985.

22. Calderon-Larranaga, A., Vetrano, D. L., Onder, G., Gimeno-Feliu, L. A., Coscollar-Santaliestra, C., Carfí, A. et al. (2017). Assessing and measuring chronic multimorbidity in the older population: A proposal for its operationalization. *The Journals of Gerontology Series A Biological Sciences and Medical Sciences, 72*, 1417–1423.

23. Whooley, M. A., Avins, A. L., Miranda, J., & Browner, W. S. (1997). Case-finding instruments for depression. Two questions are as good as many. *Journal of General Internal Medicine, 12*, 439–445.

24. Katz, S., Downs, T. D., Cash, H. R., & Grotz, R. C. (1970). Progress in development of the index of ADL. *Gerontologist, 10*, 20–30.

25. Sherbourne, C. D., & Stewart, A. L. (1991). The MOS social support survey. *Social Science and Medicine, 32*, 705–714.

26. UNESCO. International Standard Classification of Education. UNESCO Institute for Statistics; 2011 [Accessed 26 October 2016]; Retrieved October 26, 2016 from http://www.uis.unesc o.org/Education/Pages/international-standard-classification-of-education.aspx.

27. Finkel, S. E. (1995) Causal analysis with panel data. Thousand Oaks: SAGE Publications.

28. Aickin, M. (2009). Dealing with change: Using the conditional change model for clinical research. *The Permanente Journal, 13*, 80–84.

29. Basu, A., & Manca, A. (2012). Regression estimators for generic health-related quality of life and quality-adjusted life years. *Medical Decision Making, 32*, 56–69.

30. Huang, I. C., Frangakis, C., Atkinson, M. J., Willke, R. J., Leite, W. L., & Vogel, W. B. et al. (2008). Addressing ceiling effects in health status measures: A comparison of techniques applied to measures for people with HIV disease. *Health Services Research, 43*, 327–339.

31. Bowling, A., & Stenner, P. (2011). Which measure of quality of life performs best in older age? A comparison of the OPQOL, CASP-19 and WHOQOL-OLD. *Journal of Epidemiology and Community Health, 65*, 273–280.

32. Gale, C. R., Cooper, C., Deary, I. J., & Aihie Sayer, A. (2014). Psychological well-being and incident frailty in men and women: The English Longitudinal Study of Ageing. *Psychological Medicine, 44*, 697–706.

33. Nieuwkerk, P. T., Tollenaar, M. S., Oort, F. J., & Sprangers, M. A. (2007). Are retrospective measures of change in quality of life more valid than prospective measures? *Medical Care, 45*, 199–205.

34. Blome, C., & Augustin, M. (2015). Measuring change in quality of life: Bias in prospective and retrospective evaluation. *Value Health, 18*, 110–115.

35. Cheng, S. T., Fung, H. H., & Chan, A. C. (2009). Self-perception and psychological well-being: The benefits of foreseeing a worse future. *Psychology and Aging, 24*, 623–633.

36. Sarkisian, C. A., Hays, R. D., & Mangione, C. M. (2002). Do older adults expect to age successfully? The association between expectations regarding aging and beliefs regarding healthcare seeking among older adults. *Journal of the American Geriatrics Society, 50*, 1837–1843.

37. Lang, F. R., Weiss, D., Gerstorf, D., & Wagner, G. G. (2013). Forecasting life satisfaction across adulthood: Benefits of seeing a dark future? *Psychology and Aging, 28*, 249–261.

38. Conde-Sala, J. L., Portellano-Ortiz, C., Calvo-Perxas, L., & Garre-Olmo, J. (2017). Quality of life in people aged 65 + in Europe: Associated factors and models of social welfare-analysis of data from the SHARE project (Wave 5). *Quality of Life Research, 26*, 1059–1070.