Predictors of patterns of change in health-related quality of life in older women over 7 years: evidence from a prospective cohort study

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Abstract

Background: the evaluation of the determinants of change over time in health-related quality of life (HR-QoL) in older people is limited. This study aims to identify patterns of change in HR-QoL over 7 years and their determinants using data from the British Women’s Heart and Health Study, a representative sample of older women (n = 4286).

Methods: longitudinal latent class analysis was used to identify subpopulations of women with similar HR-QoL trajectories from 1999–2000 to 2007. HR-QoL was measured using the EQ-5D. Multivariate multinomial logistic regression was used to model the association of identified trajectories with baseline predictors after multiple imputation of missing data.

Results: four distinct EQ-5D trajectories were suggested: high (19% of women), high decline (22%), intermediate (42%) and low decline (16%). Prevalent arthritis (OR = 13.4; 95% CI: 8.8, 20.5), diabetes (OR = 4.6; 95% CI: 1.5, 14.2) and obesity (OR = 3.9; 95% CI: 2.5, 6.0) were the strongest predicting health conditions of adverse changes in HR-QoL and physical activity the strongest predicting lifestyle factor (OR = 2.8; 95% CI: 2.0, 3.9).

Conclusions: findings suggest that older women without obesity or pre-existing health conditions who undertake more physical activity are more likely to experience high HR-QoL, reinforcing the importance of these factors for healthy ageing.

Keywords: quality of life, ageing, prospective study, older people

Introduction

Increased life expectancies in high-income countries have led to interest in interventions to improve older people’s health, independence, social and economic participation, in effect, adding quality to extended years [1, 2]. International policy focus on well-being has further stimulated interest in quality of life (QoL) and health-related quality of life (HR-QoL), which have long been used as outcomes in the evaluation of health and social care interventions [3].

Despite its policy importance, evidence evaluating the determinants of change in HR-QoL in a comprehensive manner over long periods of time has been limited. Most research on HR-QoL has been cross-sectional, or been focused on the measurement of HR-QoL in groups with specific diseases, or measuring improvement following intervention [4, 5]. Much of the longitudinal observational evidence arises from the English Longitudinal Study of Ageing (ELSA). In ELSA functional limitation was found to be the key dimension of health associated with change in QoL over 4–6 years [6]. Findings of a decline over time in HR-QoL have been reported in the general population in UK and other European countries [7, 8].
Change in QoL varies between individuals over time, and individual variation in QoL may increase with age [9]. In ELSA, change in QoL was modelled using growth curves, demonstrating different patterns over 4 years between those experiencing different health and social conditions [10]. A British longitudinal survey of people aged 65 + found QoL self-ratings remained the same or improved after 18 months for half, but a third deteriorated [11]. However, no studies to date have attempted to describe patterns of change in HR-QoL over >4 years, or identify their determinants in the general population of older people. Public health policy would be informed by better evidence of the impact of modifiable life-style factors and co-existing morbidities on patterns of HR-QoL change. Therefore, we aimed to identify patterns of long-term change in HR-QoL over 7 years and their determinants in the British Women’s Heart and Health Study (BWHHS), a large representative sample of older women.

Materials and methods

BWHHS follows 4,286 women aged between 60 and 79 at baseline sampled from general practitioner (GP) registers in 23 towns across England, Wales and Scotland. Sampling procedure and data collection for the BWHHS are described elsewhere [12]. Baseline interviews and clinical examination occurred in 1999–2000 with follow-up questionnaires in 2003 and 2007. Deaths and cardiovascular disease (CVD) events have been prospectively studied via the NHS Central Registry and GP record reviews. Analyses are restricted to women who survived the 7-year period of follow-up. Local and multi-centre ethics approvals for the study were obtained. All women provided written informed consent for medical records to be reviewed.

Outcome

The European Quality of life Instrument (EuroQol; later named EQ-5D) is a five item, patient-based utility instrument which measures HR-QoL [13, 14]. EQ-5D was administered at baseline (1999–2000) and two follow-ups (2003 and 2007). Utility scores ranging from 0.81 (95% CI: 0.80, 0.82) in 2007 (95% CI: 0.74, 0.77) in 2007 and 0.594. We used longitudinal latent class analysis (LLCA) to identify subpopulations of women with similar HR-QoL trajectories over time (for details, see Supplementary data available in Age and Aging online, Appendix Methods 1). Modelling was undertaken in women with complete answers for EQ-5D questions at each follow-up. In a sensitivity analysis, missing data were included in the selected model without distinguishing between non-responders or deaths under the missing-at-random assumption. In a second sensitivity analysis, women who died during the follow-up were assigned an EQ-5D utility score of −0.594.

We modelled associations between identified trajectories and potential baseline predictors using multivariate multinomial logistic regression. Separate models were fitted using lifestyle factors (smoking, alcohol consumption, healthy diet and physical activity) and health conditions (obesity, CVD, other vascular disease, diabetes, cancer, respiratory condition, osteoporosis, arthritis, eye disease), each adjusted for age and social variables (living alone, contact with other people, manual work, pension arrangements). Missing data in baseline predictors were addressed using multiple imputation via chained equations (for details, see Supplementary data available in Age and Aging online, Appendix Methods 2).

In another sensitivity analysis, we restricted the multinomial regression model to complete-case responders with complete covariate information.

Results

Study sample

A total of 1,846 women provided EQ-5D responses at all three time points and were included in the main analyses, of these 1338 had complete covariate data at baseline. Characteristics of 1846 complete-case responders are shown in Supplementary data available in Age and Aging online, Appendix Table A31. All baseline predictors were at least 91% complete. There is a trend for consistently declining EQ-5D utility scores, from 0.81 (95% CI: 0.80, 0.82) in 1999–2000 to 0.78 (95% CI: 0.77, 0.79) in 2003 to 0.76 (95% CI: 0.74, 0.77) in 2007 (P < 0.001) and evidence for a change over time for each individual question (Table 1).
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Table 1. Change in EQ-5D questions and mean utility score over time, complete-case responders (n = 1846)

<table>
<thead>
<tr>
<th>EQ-5D component questions</th>
<th>Baseline n (%)</th>
<th>Follow-up 1 n (%)</th>
<th>Follow-up 2 n (%)</th>
<th>Chi²</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain/discomfort</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have no pain or discomfort</td>
<td>877 (47.5)</td>
<td>720 (39.0)</td>
<td>750 (40.6)</td>
<td>44.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>I have moderate pain or discomfort</td>
<td>902 (48.9)</td>
<td>1039 (56.3)</td>
<td>988 (53.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have extreme pain or discomfort</td>
<td>67 (3.6)</td>
<td>87 (4.7)</td>
<td>108 (5.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Usual activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have no problems with performing my usual activities</td>
<td>1221 (66.1)</td>
<td>1181 (64.0)</td>
<td>1082 (58.6)</td>
<td>48.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>I have some problems with performing my usual activities</td>
<td>589 (31.9)</td>
<td>630 (34.1)</td>
<td>694 (37.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am unable to perform my usual activities</td>
<td>36 (2.0)</td>
<td>35 (1.9)</td>
<td>70 (3.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washing and dressing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have no problems with washing and dressing</td>
<td>1728 (93.6)</td>
<td>1684 (91.2)</td>
<td>1648 (89.3)</td>
<td>44.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>I have some problems with washing and dressing</td>
<td>116 (6.3)</td>
<td>153 (8.3)</td>
<td>181 (9.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am unable to wash and dress</td>
<td>2 (0.1)</td>
<td>9 (0.5)</td>
<td>17 (0.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have no problems with walking about</td>
<td>1496 (81)</td>
<td>1397 (75.7)</td>
<td>1254 (67.9)</td>
<td>162.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>I have some problems with walking about</td>
<td>348 (18.9)</td>
<td>442 (23.9)</td>
<td>576 (31.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am unable to walk about</td>
<td>2 (0.1)</td>
<td>7 (0.4)</td>
<td>16 (0.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anxiety/depression</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am not anxious or depressed</td>
<td>1446 (78.4)</td>
<td>1367 (74.0)</td>
<td>1374 (74.5)</td>
<td>15.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>I am moderately anxious or depressed</td>
<td>383 (20.7)</td>
<td>454 (24.6)</td>
<td>442 (23.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am extremely anxious or depressed</td>
<td>17 (0.9)</td>
<td>25 (1.4)</td>
<td>30 (1.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean utility score (95% CI):</td>
<td>Complete-case</td>
<td>0.81 (0.80, 0.82)</td>
<td>0.78 (0.77, 0.79)</td>
<td>0.76 (0.74, 0.77)</td>
<td>119.7</td>
</tr>
</tbody>
</table>

EQ-5D utility scores were lower for partial compared with complete-case responders at each follow-up, with stronger evidence at baseline and 2003 (Supplementary data are available in Age and Ageing online, Appendix Table AS2).

LLCA analysis

Measures of the model fit from the LLCA point to a four-class solution (Supplementary data are available in Age and Ageing online, Appendix Table AS3). The shape of the four trajectories is presented in Figure 1A. The largest subgroup has an intermediate EQ-5D score of ~0.76 across the three follow-ups (‘Intermediate’; n = 790, 42% of women). The second largest subgroup (‘High decline’; n = 411, 22%) has a score of 1 at baseline declining over time, although this remains higher than ‘Intermediate’ at both 2003 and 2007. The third largest subgroup has very high EQ-5D at all three follow-ups (‘High’; n = 356, 19%). The smallest trajectory (‘Low decline’; n = 289; 16%) has a lower score at baseline, declining consistently over time. Class-specific probabilities and mean utility scores are given in Supplementary data available in Age and Ageing online, Appendix Table AS4. In sensitivity analyses including individuals with missing EQ-5D scores (n = 4286), class shape was broadly consistent with the complete-case model (Figure 1B). The ‘High’ class had lower average utility, consistent with lower scores reported by partial responders (Supplementary data available in Age and Ageing online, Appendix Table AS2), but utilities remained higher than ‘Intermediate’ at all measurements. Some differences in class prevalence were also found; ‘Intermediate’ became smaller, whereas ‘High decline’ and ‘Low decline’ increased.

When 369 women who died during the follow-up and had non-missing EQ-5D prior to death were included (Figure 1C, Supplementary data are available in Age and Ageing online, Appendix Table AS5), inspection of the 5-class solution suggests an additional ‘Terminal decline’ trajectory (n = 577, 18%), with the shape of other trajectories broadly similar to the complete-case model. Class prevalence differs from the complete-case model with ‘High decline’ increasing in size at the expense of ‘Intermediate’ and ‘Best state’.

‘High decline’ women reported a marked increase in moderate pain between 1999–2000 and 2003, alongside problems performing usual activities and anxiety/depression (Supplementary data are available in Age and Ageing online, Appendix Table AS6). The majority of ‘Low decline’ women reported some pain, problems performing usual activities and walking at baseline, with severity increasing over time.

Baseline predictors of EQ-5D trajectory

The odds of experiencing a given EQ-5D trajectory according to baseline characteristics compared with the reference ‘High’ are given in Table 2.

Women in the ‘High decline’ trajectory were more likely to suffer from medical conditions including other vascular diseases (OR = 1.8, 1.1–3.0, P = 0.020), osteoporosis (OR = 2.1, 0.9–4.9, P = 0.070) and arthritis (OR = 1.6, 1.1–2.4, P = 0.007) at baseline. Women in the ‘Intermediate’ group were more likely to report low levels of physical activity (OR = 2.0, 1.5–2.6, P < 0.001) and were also more likely to suffer from all health conditions except cancer, with the highest odds ratios for arthritis (OR = 5.4, 3.9–7.4,
Figure 1. Trajectories of EQ-5D in the BWHHS: (A) complete case (n = 1846), (B) including missing data (n = 4286), (C) including death information (n = 2215).

Table 2. Fully adjusted model of predictors of EQ-5D trajectory in 1846 complete-case responders

<table>
<thead>
<tr>
<th>Predictor</th>
<th>High decline EQ-5D</th>
<th>Intermediate EQ-5D</th>
<th>Low decline EQ-5D</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Odds ratio (95% CI)</strong></td>
<td><strong>P-value</strong></td>
<td><strong>Odds ratio (95% CI)</strong></td>
<td><strong>P-value</strong></td>
</tr>
<tr>
<td><strong>Lifestyle factor model</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current smoker</td>
<td>1.06 (0.59–1.88)</td>
<td>0.85</td>
<td>0.97 (0.58–1.61)</td>
</tr>
<tr>
<td>Alcohol consumption</td>
<td>0.81 (0.52–1.25)</td>
<td>0.34</td>
<td>1.22 (0.81–1.84)</td>
</tr>
<tr>
<td>Healthy diet</td>
<td>1.05 (0.78–1.41)</td>
<td>0.77</td>
<td>0.85 (0.65–1.11)</td>
</tr>
<tr>
<td>Low physical activity</td>
<td>1.22 (0.91–1.65)</td>
<td>0.18</td>
<td>1.98 (1.53–2.58)</td>
</tr>
<tr>
<td><strong>Health condition model</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obesity</td>
<td>1.40 (0.92–2.11)</td>
<td>0.11</td>
<td>2.01 (1.38–2.92)</td>
</tr>
<tr>
<td>Cardiovascular disease</td>
<td>1.19 (0.63–2.25)</td>
<td>0.60</td>
<td>1.94 (1.10–3.43)</td>
</tr>
<tr>
<td>Other vascular disease</td>
<td>1.82 (1.10–3.02)</td>
<td>0.020</td>
<td>2.66 (1.67–4.23)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>2.12 (0.73–6.16)</td>
<td>0.17</td>
<td>2.79 (1.02–7.62)</td>
</tr>
<tr>
<td>Cancer</td>
<td>0.89 (0.49–1.61)</td>
<td>0.70</td>
<td>1.31 (0.77–2.22)</td>
</tr>
<tr>
<td>Respiratory condition</td>
<td>1.00 (0.75–1.35)</td>
<td>0.98</td>
<td>1.25 (0.95–1.64)</td>
</tr>
<tr>
<td>Osteoporosis</td>
<td>2.13 (0.93–4.86)</td>
<td>0.07</td>
<td>2.46 (1.12–5.41)</td>
</tr>
<tr>
<td>Arthritis</td>
<td>1.64 (1.14–2.36)</td>
<td>0.007</td>
<td>5.36 (3.88–7.41)</td>
</tr>
<tr>
<td>Eye disease</td>
<td>1.50 (0.90–2.52)</td>
<td>0.12</td>
<td>2.04 (1.26–3.31)</td>
</tr>
</tbody>
</table>

Odds ratios, corresponding 95% confidence intervals (95% CI) and P values were derived from multivariate multinomial regression models adjusted for age and social characteristics after multiple imputation of missing data in the covariates.

An odds ratio larger than 1 indicates that the risk of being in the respective EQ-5D trajectory is higher than of being in the ‘High EQ-5D’ trajectory.
Results were similar when restricted to women with complete covariate data (Supplementary data are available in *Age and Ageing* online, Appendix Table AS7), except obesity was also weakly associated with ‘Low decline’ (OR = 1.6, 1.0–2.6, P = 0.049). Respiratory conditions were no longer found to be associated with any of the trajectories. Evidence for the association between diabetes and ‘Intermediate’ and eye disease with ‘Low decline’ also became weaker.

**Discussion**

This population-based study provides the first evidence on the existence of naturally occurring patterns of HR-QoL over time in older women and their main determinants after adjusting for age and social variables. In five women reported very high HR-QoL over 7 years. These women were more likely to be physically active, lean and free from major chronic diseases, suggesting that policy goals of excellent HR-QoL at advanced ages are already being achieved by a relatively large proportion of women during their seventies. Four distinct trajectories of HR-QoL were suggested and associated with different lifestyle behaviours and health conditions at baseline. With the exception of alcohol and healthy-diet, other lifestyle factors and co-morbidities show an increasing association gradient with lower odds for more favourable HR-QoL trajectories. The consistent gradient provides further support for the true nature of these associations.

Cross-sectional analysis of ELSA found QoL was highest in those aged 68, but was lower at younger and older ages [9]. QoL may increase in populations of younger older people alongside favourable circumstances following exit from the labour force, the so-called ‘third age’ [3, 9]. Alternatively, some older people may re-evaluate their QoL in the context of their peer group, age and life satisfaction. We cannot exclude the possibility of differential bias in those reporting high HR-QoL over time, however, this is unlikely given the greater levels of physical activity and fewer health conditions and obesity associated with more favourable HR-QoL. Obesity has previously been identified as a predictor of adverse QoL in older people in other studies [6]. It is argued that the BMI is important for maintenance of physical functioning and that the optimal BMI in older people may lie between 23 and 30 kg/m^2 [18], including what is normally considered overweight, but beneath obese. Physical activity has also previously been found to have a positive impact on QoL in older adults [19].

Sixteen percent of women had low EQ-5D at baseline that continued to decline over 7 years. These women were more likely to have arthritis, diabetes, obesity, osteoporosis and cardiovascular disease. They were also more likely to smoke, and less likely to be physically active. The needs of this group are an important target for intervention given the extended period of life lived with low HR-QoL.

**Strengths and limitations**

This study is unique in considering variation in trajectories of EQ-5D in older women sampled from the general British population with three measurements over a period of 7 years. As with any prospective study, missing data due to deaths and differential losses-to-follow up could bias results. However, we addressed missing data in three ways and found results generally robust. LLCA modelling was repeated using all women to ensure that complete-case EQ-5D trajectories were representative of the full sample. Information on deaths was included and the original survivor trajectories were found to be relatively stable, with a new separate ‘Terminal Decline’ trajectory introduced. We did find descriptive evidence for lower EQ-5D utility among partial responders at baseline and 2003, suggesting that the complete-case sample may represent a selection of women with more favourable EQ-5D. However, missing data in the covariates were addressed using multiple imputation and results were comparable with those from the complete-cases.

QoL is multi-faceted, encompassing macro societal and socio-demographic influences as well as micro concerns, such as individuals’ experiences, social circumstances, health, values and perceptions. EQ-5D measures HR-QoL rather than more generic QoL measured by OPQOL or CASP-19 [3, 20]. Hence, it is possible that HR-QoL trajectories and their predictors may differ from those of more generic QoL. For example, HR-QoL may decline consistently with biological ageing, whereas QoL may increase. EQ-5D has previously been described as insensitive to changes in the health status important to patients [21, 22], therefore change in HR-QoL may be underestimated in this study. Conversely, EQ-5D has been judged superior to other preference-based measures of the health status [23], and is recommended where a succinct measure is needed and substantial change in the health status expected [24]. Self-reported HR-QoL may be unreliably or inconsistently reported [25].

Modal classification of women into EQ-5D trajectories will underestimate variability in subsequent analyses. However, this decision is justified by the high entropy for the 4-class solution. We did not include a measure of disability to avoid potential circularity with the outcome variable EQ-5D.

Changes in health behaviours and new diagnoses of health conditions are likely to influence the patterns of HR-QoL over time and could not be addressed here, but will be an important topic for further research.
Arthritis, diabetes and obesity were found to be particularly strong predictors of adverse HR-QoL. Encouraging physical activity as people age may therefore represent a key lever to reduce obesity and improve HR-QoL in future populations of older people.

The absence of adverse health conditions was found to be important for maintaining high HR-QoL. In older people with arthritis and osteoporosis effective treatment to control pain is vital to improve HR-QoL. Sustained physical activity for prevention and control of cardiovascular disease and diabetes and cessation of smoking may present further opportunities to avoid poor HR-QoL, but older people may need specialist support and intervention programmes.

Conclusions

This analysis suggests distinct groups of HR-QoL experience over 7 years in a community population of older women associated with different lifestyle factors and health conditions at baseline. Almost one-fifth of women report consistently high HR-QoL associated with lower obesity, fewer health conditions and more physical activity suggesting that these factors are important levers for achieving healthy ageing policy goals.

Key points

- Improving HR-QoL in older people is an important policy goal in many countries.
- However patterns and determinants of HR-QoL in older people are unknown.
- We identify different patterns of HR-QoL over 7 years in a representative sample of UK older women.
- Arthritis, diabetes and obesity were found to be particularly strong predictors of adverse HR-QoL.

Acknowledgements

We thank all BWHHS participants, the general practitioners and their staff who have supported data collection since the study inception. We are grateful to Richard Silverwood for helpful discussions about latent class modelling.

Conflicts of interest

None declared.

Implications

Findings suggest that older women without obesity and pre-existing health conditions who undertake more physical activity are more likely to enjoy sustained high HR-QoL. Given that our study sample represents a generation for whom obesity was relatively less common, the ‘obesity epidemic’ may challenge policy goals to extend HR-QoL in future generations of older people. Encouraging physical activity as people age may therefore represent a key lever to reduce obesity and improve HR-QoL in future populations of older people.

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Funding

This work was supported by grants from the Department of Health Policy Research Programme (England) (grant 0900494) and the British Heart Foundation (grant PG/09/022). E.N. was a recipient of a Marie Curie Intra-European Fellowship for Career Development (grant No FP7-PEOPLE-2010-IEF-273673). The funders had no role in the study design; in the collection, analysis and interpretation data; in the writing of the report or in the decision to submit the paper for publication.

Supplementary data

Supplementary data mentioned in the text is available to subscribers in Age and Ageing online.

References

Opioids, antiepileptic and anticholinergic drugs and the risk of fractures in patients 65 years of age and older: a prospective population-based study

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Abstract

Background: in men, the concomitant use of two or more benzodiazepines or two or more antipsychotics is associated with an increased risk of fracture(s). Potential associations between the concomitant use of drugs with central nervous system effects and fracture risk have not been studied.


Received 28 February 2012; accepted in revised form 12 December 2012