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# Accepted Manuscript

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## How is subjective well-being related to quality of life?

### Do we need two concepts and both measures?

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**Keywords:** quality of life, well-being, health, theory, model

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ACCEPTED MANUSCRIPT

## 5 **Abstract**

6 Subjective well-being (SWB) and subjective quality of life (QoL) are key concepts describing  
7 experience, capacities, states, behaviours, appraisals, and emotional reactions to  
8 circumstances. Used widely in public discourse, policy, and research, their theoretical and  
9 empirical relations remain little explored. The present research aimed to develop an  
10 integrated model of SWB and QoL through empirically testing its overlapping and exclusive  
11 dimensions.

12 Survey data was obtained from  $N = 2,533$  in 11 countries. Adults completed the WHOQOL  
13 Spirituality, Religion and Personal Beliefs (SRPB) instrument which assesses 33 QoL facets  
14 in 6 domains. The facets operationalise components of the hedonic SWB model, extended  
15 with eudaimonia, as SWB+. Network analyses, and regression models with random effect for  
16 cultural centre, assessed the differential contributions of SWB+ and QoL in predicting  
17 general QoL, explanatory power, and model parsimony.

18 When all SWB+ and QoL variables are assessed together, the final model explains more  
19 variance in general QoL than either of the competing models; also it shows the most  
20 parsimonious fit. This fully integrated model contains only positive feelings from SWB+,  
21 with 13 other QoL facets drawn from all six domains when adjusted for health status and  
22 educational level.

23 These findings provide the foundation for a new *Life Quality and Well-being (LQW)* model  
24 that awaits confirmation. The LQW improves on existing models of SWB+ and QoL by  
25 better explaining general QoL than facets of either model on their own. The 14 selected facets  
26 potentially offer a new, single measure with considerable conceptual breadth, and  
27 international foundations.

28 **How is subjective well-being related to quality of life?**

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30 ***1. Introduction***

31 Subjective well-being (SWB) and subjective quality of life (QoL) are often used  
32 interchangeably in research, policy, and practice. For example, when announcing a strategy to  
33 assess outcomes “*beyond economic prosperity*”, UK Prime Minister David Cameron (2010)  
34 commissioned a “*new way of measuring wellbeing in Britain.*” ... “*We’ll start measuring our*  
35 *progress as a country, not just by how our economy is growing, but by how our lives are*  
36 *improving; not just by our standard of living, but by our quality of life.*”

37 [<https://www.gov.uk/government/speeches/pm-speech-on-wellbeing>]

38 Quality of life and SWB are not interchangeable terms as they are connected to  
39 different theoretical concepts (Stewart-Brown, 2015). Undifferentiated discussion and use,  
40 create confusion about whether they are theoretically different, similar or the same (Camfield  
41 & Skevington, 2008; Peasgood, Brazier, Mukaria et al, 2014), and confounds debates on  
42 happiness (World Health Organisation, 2015), and mental health (Böhnke & Croudace, 2016;  
43 Hinks, Tinkler & Allin, 2013). Furthermore QoL and SWB support separate measurement  
44 fields that are usually underpinned by theory, so measurement choice is complicated.  
45 Confusion has not been remedied by an apparent lack of research awareness about findings in  
46 the other field. Well-being specialists rarely acknowledge QoL measures (e.g. Triandis, 2000;  
47 Diener, Helliwell & Kahneman, 2010), and QoL experts often overlook SWB models, so  
48 debate is hindered. As person-centred approaches are now favoured for monitoring and  
49 evaluating international outcomes, and informing global policy-making in health care, and  
50 beyond (Stiglitz, Sen & Fitoussi, 2009; Skevington & Epton, 2018), an international

51 investigation could accelerate resolution of this conundrum, leading to better decision-  
52 making in future.

### 53 THEORETICAL BACKGROUND: SUBJECTIVE WELL-BEING & QUALITY OF LIFE

54 Historically, philosophy on the ‘good life’ was dichotomised into the pleasures and  
55 enjoyment of ‘hedonia’, and the flourishing, purposeful life of ‘eudaimonia’ (Bentham,  
56 1789). Representing a largely hedonic position, Diener (1984) defined SWB as central to a  
57 person’s experience consisting of positive aspects, and a global assessment of a person’s life.  
58 In 1995, negative affect, and cognitive evaluations were added to this definition of SWB:  
59 “*Subjective well-being also includes cognitive evaluations or appraisals of life satisfaction as*  
60 *a whole, and emotional reactions to life events*” (Diener & Diener, 1995). Developed  
61 measures based on SWB models prompted copious research (Busseri & Sadava, 2011; Hinks,  
62 Tinkler & Allin, 2013), and showed some cross-cultural support (e.g. Oishi, 2010).  
63 Nevertheless, how SWB relates to quality of life (QoL) remains obscure.

64 Among other definitions, subjective QoL was defined in 1994 by an international  
65 World Health Organisation (WHO) research collaboration as:

66 *An individual’s perception of their position in life, in the context of the culture and*  
67 *value systems in which they live, and in relation to their goals, expectations,*  
68 *standards and concerns. It is a broad-ranging concept, incorporating in a complex*  
69 *way the person’s physical health, psychological state, level of independence, social*  
70 *relationships, personal beliefs, and relationship to salient features of the environment.*

71 (p 43) (The World Health Organisation Quality of Life Assessment Group,  
72 (WHOQOL) 1994).



73 This definition underpins the WHO model that was designed to improve QoL measurement  
74 cross-culturally (table 1; Skevington, Sartorius, Amir et al, 2004; Bowden & Fox-Rushby,  
75 2003).

76 INSERT TABLE 1 HERE

77 Since publication of these definitions, several questions have been raised, and  
78 discrepancies highlighted; these issues informed the current research. First, it was proposed to  
79 incorporate an existential eudaimonic element on a 'purposeful and worthwhile life' into  
80 SWB (Keyes, Shmotkin & Ryff, 2002). This was drawn from the psychological well-being  
81 (PWB) model (Ryff, 1989), and is related to SWB (Ring, Hofer, McGee, et al, 2006). In the  
82 present study we investigate the SWB model expanded by this eudaimonic element, and refer  
83 to it as SWB+.

84 Second, another revision of SWB replaced the 1995 version with a more abstract,  
85 generic statement: "*An umbrella term for different valuations that people make regarding*  
86 *their lives, the events that happen to them, their bodies and minds, and the circumstances in*  
87 *which they live*" (Diener, Kahneman, Graham, et al, 2005). Increased similarity between this  
88 new SWB definition and the earlier WHO definition (The WHOQOL Group, 1994),  
89 suggested that the SWB concept could be converging towards QoL. Revealing greater  
90 common ground, this similarity raised questions about whether both constructs might be  
91 embraced by a single, unified concept, and if so, whether one instrument could measure it?  
92 Investigating these questions has potential to resolve some of the confusion about these  
93 concepts and their measures in health, and beyond.

94 Third, the structure of the SWB model was questioned through a major review of  
95 findings from over 1000 studies (Busseri & Sadava, 2011). While evidence largely supports  
96 core elements of SWB (positive affect, negative affect, and life satisfaction), Busseri and

97 Sadava reported that a significant minority of studies showed small, insignificant associations  
98 between SWB components. Examining five plausible configurations of SWB's components,  
99 they could not confirm that one single model was the 'best', and concluded that full  
100 endorsement was 'premature' (Busseri & Sadava, 2011). For the present study this raised  
101 questions about plausible alternative models.

102 Fourth, short-comings in predicting well-being from 'objective' indices like income,  
103 wealth, and material goods, led Nobel laureate economists to recommend subjective  
104 multidimensional measures like SWB to the global community:

105 *Research has shown that it is possible to collect meaningful and reliable data*  
106 *on subjective, as well as objective wellbeing. Subjective wellbeing*  
107 *encompasses different aspects (cognitive evaluations of one's life, happiness,*  
108 *satisfaction, positive emotions such as joy and pride, and negative emotions*  
109 *such as pain and worry): each of them should be measured separately, to*  
110 *derive a more comprehensive appreciation of people's lives. (Stiglitz, Sen &*  
111 *Fitoussi, 2009)*

112 Despite contemporary interest in evaluating well-being by Western governments  
113 (e.g. Office of National Statistics in UK (2011)), relations between models and  
114 measures of SWB and QoL have not been closely examined with global data  
115 (Skevington & Epton, 2018).

116 Lastly, language versions of the new SWB measures have not been developed using  
117 advanced cultural-adaptation procedures that improve equivalence when comparing different  
118 language versions (Herdman, Fox-Rushby, & Badia, 1997). The SWB concept and measure  
119 were originally designed in USA. As no other cultures contributed to the derivation of  
120 conceptual meanings and item wording, subsequent translations are not entirely compatible

121 with the original. The simultaneous ‘spoke-wheel’ cross-cultural methodology designed by  
122 the WHOQOL Group and used to develop its suite of measures, is geared to making multiple  
123 language versions more equivalent than previously (Skevington, 2002).

## 124 AIMS OF THIS STUDY

125 We aimed to improve understanding about the empirical relationship between SWB  
126 and subjective QoL. Arising from the questions and discrepancies, we predicted that these  
127 two perspectives would not be entirely exclusive, and would display evidence of overlapping  
128 components. As positive feelings/affect is both important to SWB and QoL, and as happiness  
129 stands alone in its own field of study, we predicted this component would be an area of  
130 commonality.

131 More importantly we predicted that an overarching subjective framework for SWB  
132 and QoL could plausibly be merited, and refer to this as the "*Life Quality and Well-being*"  
133 (*LQW*) model. Any such model would potentially represent a new perspective that could be  
134 prospectively tested. As expected from an overarching concept, we predicted that the LQW  
135 model would include a wide-range of facets, possibly drawn from each domain. The present  
136 research represents a typical, single-sample test of a pre-defined framework that derives its  
137 specific strength from applying an internationally diverse sample.

## 138 **2. Methods**

### 139 **2.1 Design**

140 Cross-sectional WHOQOL SRPB data was collected simultaneously within 18  
141 cultures world-wide, following an internationally agreed protocol (The World Health  
142 Organisation Quality of Life Assessment – Spirituality, Religion and Personal Beliefs Group  
143 (WHOQOL SRPB), 2006). Quota sampling was applied to culture (240 adults per centre),

144 age-band (50%; split at 45 years), and gender (50%). Representative sampling was not  
145 feasible, as national statistics necessary to design a sampling frame were not available for  
146 every participating country.

## 147 **2.2 Sample**

148 The full WHOQOL SRPB dataset ( $N= 5,087$ ; 18 centres) was originally used to  
149 investigate psychometric properties of the WHOQOL SRPB instrument (The WHOQOL  
150 SRPB Group, 2006). In the present study we conduct secondary analysis on a subset of this  
151 data. Some centres were excluded: (i) where data was entirely missing for a variable crucial  
152 to hypothesis testing (i.e. spiritual/general facets: China, Kenya, Argentina); (ii) if 'clean'  
153 country samples were unduly small (Japan,  $n=43$ ; Italy,  $n=101$ ), or (iii) if national data was  
154 collected by more than one centre, duplicating its contribution (Brazil, India). Where the  
155 latter occurred, data from the primary national centre was preferred to maintain comparison  
156 with previous research. Selection resulted in analysing  $N = 2,533$  cases contributed by 11  
157 culturally diverse centres located in *South America*: Porto Alegre, Brazil; Calabria, Uruguay;  
158 *Middle East*: Alexandria, Egypt; Beer Sheva, Israel; *Northern Europe*: Vilnius, Lithuania;  
159 Bath, UK; *Southern Europe*: Barcelona, Spain; Izmir, Turkey; *South Asia*: Kubang, Malaysia;  
160 Bangkok, Thailand; and the *Sub-continent*: Bangalore, India.

161 The total sample contained 51% women, and 48% men, with ages ranging from 16 to  
162 90 (53.7% < 45 years). Highest educational level completed was: 18.5% primary, 40.2%  
163 secondary, 29.5% tertiary, and 11.4% postgraduate. Forty-four percent reported an illness and  
164 the primary illness was classified as: high blood pressure (14%), cardiac (12%),  
165 musculoskeletal (9%), cancer (8%), respiratory (6%), broken/fractured bone (6%), diabetes  
166 (5%), HIV (2%), rectal growth/bleeding (2%), cataract (1%), Parkinson's disease (1%) or  
167 stroke (.4%). The total sample contained agnostics, atheists, Buddhists, Zen Buddhists,

168 Muslims, Hindus, Jews, Christians, and indigenous beliefs (The WHOQOL SRPB Group,  
169 2006).

170 Ethical approval for the study was granted by the Ethics committee of the World  
171 Health Organisation, Geneva to the WHO Division of Mental Health and Substance Abuse.  
172 The protocol conformed to Declaration of Helsinki principles. Local ethical approval was  
173 also obtained in all field sites.

### 174 **2.3 Measures**

175 The original WHOQOL-100 was developed by an international multi-centre  
176 collaboration, following standard, agreed protocols, to obtain a validated set of 100 items that  
177 assess 25 facets of QoL (The WHOQOL Group, 1998; Monod, Brennan, Rochat, et al, 2011).  
178 The WHOQOL SRPB instrument analysed in the current study combines the WHOQOL-100  
179 items with an additional module of 32 items organized in eight facets. These extra ‘SRPB’  
180 facets elaborate QoL outcomes from spiritual, religious and personal beliefs (The WHOQOL  
181 SRPB Group, 2006; see table 1). The WHOQOL SRPB is scored in six QoL domains. The  
182 WHOQOL-SRPB aligns with the SWB+ model, as it contains two facets assessing positive  
183 and negative feelings (hedonia), and two facets on meaning in life and purpose in life  
184 (eudaimonia).

185 All WHOQOL instruments also contain an overarching, general QoL and health facet  
186 (g facet). This was developed as an internal validity criterion within the original WHOQOL-  
187 100 protocol (The WHOQOL Group, 1998). Several 5-point interval, response scales enable  
188 upper to lower poles of well-being to be rated. Some item scores are reversed so that high  
189 total scores consistently indicate good QoL.

190 Due to its international, multi-stakeholder development, the WHOQOL-100 and  
191 WHOQOL SRPB have high content validity, and relevance. The construct validity of these

192 facets and domains (dimensions) has been the subject of several WHOQOL-100 and  
193 WHOQOL SRPB studies. Across these findings, items within facets, and facets within  
194 domains correlate highly, and show high reliabilities, but inter-domain correlations are high  
195 also, potentially pointing to one or two general QoL latent variables (e.g., O'Connell &  
196 Skevington, 2010; Chan, Skevington, & Verplanken, 2017; Krägeloh, Billington, Henning, et  
197 al. 2015).

198 Additional data collected with the WHOQOL SRPB were self-reported health (rated  
199 from 1=very poor, to 5 very good), present/absent current illness, and socio-demographic  
200 variables of gender, age, marital status, and educational level.

#### 201 ***2.4 Analysis Plan***

202 With its additional 32 items, the WHOQOL SRPB provides a set of validated facets that  
203 are broader than the SWB+ model, and revisiting the WHOQOL SRPB survey (The  
204 WHOQOL SRPB Group, 2006) offered a unique chance to conduct an international test of  
205 the proposed LQW model. We were interested in the relative importance of the WHOQOL  
206 SRPB facets when predicting the g facet; of four items, two are on general QoL, and one each  
207 on health, and life satisfaction.

208 While in our study life satisfaction is part of the dependent variable, as seen in some  
209 SWB+ models (e.g. Busseri & Sadava, 2011), other WHOQOL SRPB facets were mapped  
210 conceptually onto key SWB+ components as potential predictor variables. Positive feelings  
211 of happiness and contentment (e.g. '*How much do you experience positive feelings in life?*')  
212 operationalize positive affect. Negative feelings (e.g. anxiety and depression) operationalize  
213 negative affect (e.g. '*How often do you experience negative feelings?*'). Together these mood  
214 facets from the psychological domain represent hedonia (see table 1). It was unclear whether  
215 a 'worthwhile life' of eudaimonia would be best operationalized by purpose in life (e.g. '*To*

216 *what extent do you feel that life has a purpose?’*), or meaning in life facets (e.g. *‘To what*  
217 *extent do you find your life to be meaningful?’*); consequently both spiritual facets were  
218 included for comparison. Some SWB models incorporate ‘cognitive evaluation’ which could  
219 have been operationalized by the cognitions facet, but this was rejected due to inconsistent  
220 inclusion in SWB models (Busseri & Sadava, 2011). Although the WHOQOL SRPB does not  
221 directly assess ‘subjective well-being’ as a facet *per se*, models tested in the present study are  
222 commensurate with Diener’s indirect assessment of SWB via its components (Diener, Suh,  
223 Lucas, et al., 1999).

224 Facets of the WHOQOL SRPB were scored according to the assessment protocol. Health  
225 influences assessment of QoL, and is included within the general facet of the WHOQOL  
226 SRPB. However as health is not recognised as a formal SWB+ component, it was controlled  
227 as a covariate by including the independent health status rating, and current illness measures.  
228 Marital status was recoded as living together/married (1) vs. single, separated, divorced or  
229 widowed (0). As educational level varies considerably across countries, it was recoded as an  
230 ordinal variable: primary (0), secondary (1), and university/post-graduate (2).

#### 231 a. Network Analysis

232 Before conducting the mixed-effects regression, we used a network model (Costantini, et  
233 al., 2015; Kossakowski et al., 2016) to descriptively analyse the undirected relationships  
234 between all facets and control variables, and also to evaluate the plausibility of the g facet as  
235 a dependent variable. Network models represent spatial interrelations between variables in a  
236 set, as a collection of ‘nodes’ (circles represent observed variables) and ‘edges’ (lines represent  
237 the strength of relationships between variables, ‘weights’; see figure 1). Two quantitative  
238 measures provide insight into the relative associations between variables: (i) the higher the  
239 ‘closeness’ of a variable, the more and stronger correlational paths connect this variable to all

240 other network variables, and (ii) the higher the 'betweenness' of a variable, the more shortest  
241 paths between two variables pass through this variable (see details in Costantini et al., 2015).  
242 The size of both statistics depends on the number of nodes, and weights (correlations)  
243 applied, and is not interpreted.

244 To take account of the nested structure of the data, we determined the within-country  
245 pair-wise correlation matrix by separating the correlations between variables into their intra-  
246 class, within- and between-country correlations (R Core Team, 2017; Revelle, 2017).  
247 Network analysis was performed on the estimated within-country correlation matrix  
248 (Epskamp et al., 2012). First, a network was estimated of the bivariate correlations - a purely  
249 descriptive presentation of the data. Second, we estimated a network of partial correlations,  
250 where the correlation between two variables is controlled for all other network variables  
251 (with LASSO regularisation to control for overfitting). This network allows us to assess  
252 which nodes are still connected to the g facet, after controlling for all variables, i.e. which  
253 have uniquely predictive power; also to evaluate whether several item groups exist,  
254 representing different content.

#### 255 b. Mixed Model Regression Analysis

256 We then conducted mixed model regression analysis to evaluate the differential  
257 predictive value of facets. From total respondents in 11 centres, 87% completed data for  
258 every analysed variable. Most missing values were for education level ( $n_{\text{Miss}}=179$ ), then sex-  
259 life ( $n_{\text{Miss}}=62$ ), being currently ill ( $n_{\text{Miss}}=28$ ), and faith ( $n_{\text{Miss}}=12$ ). All other variables showed  
260 less than 10 missing. Multiple imputation by chained equations was applied (Azur, Stuart,  
261 Fangakis, et al., 2011), to provide multivariate predictions of missing values, which assumes  
262 data are randomly missing (Rubin, 1976). All variables included in the full regression model  
263 were used for the imputation. Fixed effects for survey centre (culture) were added into the



264 prediction (Azur, Stuart, Fangakis, et al., 2011). Ordinary least squares regression was used  
265 for continuous variables; ordinal logistic regression for the 5-point health status rating, and  
266 educational level. Logistic regression was used for all dichotomous variables (gender, marital  
267 status, education, currently ill). Prediction model parameters were estimated through  
268 sampling with replacement using 20 "burn-in" iterations, after random starting values for  
269 each of 20 imputed data sets were generated.

270 Modelling was conducted in four stages with the aim of comprehensively testing  
271 relations between SWB+ and QoL models. First, socio-demographic and health variables  
272 alone were examined in model 1, to control for inter-individual differences, and assess the  
273 variance in the general facet due to these variables. This variable block was retained within  
274 each subsequent model. Second, variance explained by the four key SWB+ components  
275 alone, was tested in model 2. For model 3, variance explained by QoL variables that were **not**  
276 included in model 2, was now examined. Finally, a full model (model 4) examined the  
277 variance explained by every SWB+, QoL and demographic/health variable together. Since  
278 relevant facets for each model (SWB+, QoL) are identified by prior theory, variable selection  
279 was not performed.

280 Data analysis used a mixed-model with fixed effects for all regressors, and a random  
281 effect for survey centre (culture) to account for clustering of sample cultures. To fit the  
282 models, first the Monte Carlo error for the estimated coefficients across the 20 imputed  
283 datasets was evaluated, providing the variance due to the imputation design. For randomly  
284 selected imputed data sets,  $R^2$  was calculated between model predictions, and the non-  
285 imputed original g facet scores. Information criteria (AIC, BIC; Sclove, 1987; Wagenmakers  
286 & Farrell, 2004) compared models containing more predictors with less, to ascertain whether  
287 those with more parameters remained parsimonious (i.e. lower values). Additionally,  
288 Likelihood ratio tests compared the absolute fit between models with increasing numbers of

289 predictors, to provide important information about whether the full, final model containing  
290 every variable (i.e. model 4), showed improved fit over SWB+ variables alone (model 2), and  
291 QoL variables alone (model 3). Regression analyses were performed in Stata 14 (College  
292 Station, TX, 2015).

### 293 **3.0 Results**

294 Figure 1 presents the network based on bivariate correlations between variables. Paths  
295 between two variables ("edges") represent direct correlations. Green edges represent positive,  
296 and red edges negative correlations; wider edges indicate stronger correlation between two  
297 variables. The spatial distance between variables is optimised by an algorithm that translates  
298 the correlation structure as closely as possible onto two-dimensional space, with objects  
299 farther away from each other also being less closely related. In this case, the extreme is  
300 gender, which shows only one very weak correlation with another variable, and is at  
301 maximum distance from all other nodes.

302 Panel A shows that all QoL facets are closely and positively related. There are  
303 potentially two closely related clusters: one focusing on the SRPB components in the  
304 WHOQOL SRPB (top nine nodes), and another with all WHOQOL facets not focused on  
305 SRPB components (similar to findings by Krägeloh, et al., 2015). The g facet is the most  
306 central variable in this network which is also expressed by measures of closeness (.01;  
307 followed by positive feelings (.009), and relations (.009)), and betweenness (208; followed by  
308 spirit (82), and bodily image (66)).

309 After controlling for all facets and health variables in Panel B, there are still  
310 potentially two clusters in the data, and the g facet assessment sits centrally within this  
311 network. The three variables most central to the network are closely linked to this structure:  
312 in terms of closeness (shortest and strongest associations); positive feelings (.0018) is most

313 central, followed by the g facet (.0018), and self-esteem (.0016). In terms of betweenness  
314 (more connections between two other nodes through this node), again positive feelings is  
315 most central (358), followed by the g facet (262), and hope (160). All identified nodes are  
316 close to the bridge between the original WHOQOL-100 items, and SRPB modular items in  
317 the WHOQOL SRPB. Based on this descriptive evaluation, the g facet is a plausible validity  
318 criterion for our regression models, as it is central in the interrelationships between the facets.  
319 Furthermore, SRPB facets appear to offer an assessment slightly different from the g facet,  
320 including both facets of meaning and purpose in life (eudaimonia).

321 INSERT FIGURE 1 HERE

322 The four regression models are reported in increasing complexity (i.e. left to right) in  
323 table 2. Model 1 shows the fit based solely on socio-demographic and health variables. The  
324 second model shows demographics with SWB+ variables. The third includes demographics  
325 and QoL. Finally, model 4 shows all three aspects together, so examining the *Life Quality*  
326 *and Well-being (LQW)* model. Overall fit statistics (bottom rows: table 2) reveal that  
327 demographics alone in model 1, show the worst fit (lowest R<sup>2</sup>; highest AIC and BIC). This  
328 was followed by model 2 on SWB+ only; then model 3 on QoL alone. The full, final model 4  
329 comprising all three aspects, showed the best fit of all four models. Transforming AIC and  
330 BIC values into evidence weights evaluates the relative evidence strength for these four  
331 models (Wagenmakers & Farrell, 2004). On both metrics, the evidence weight for model 4  
332 approximates to "1", so affirming the comparative advantage of the full model over all others.  
333 The advantage attributed to model 4 is further corroborated by the Likelihood Ratio tests  
334 which compared increasing complexity across models. In summary, the results show that  
335 separate SWB+ and QoL models fit significantly better than demographics alone, but the full,  
336 final model 4 fits significantly better than either of the other two models that exclusively test  
337 the facets of either concept.

338 Table 2 reports unstandardised regression coefficients, and their respective standard  
339 errors (SE; brackets). Demographic variables show that the predictive relationship of  
340 educational level changes across models. When neither QoL nor SWB+ are included (model  
341 1), highly educated participants reported higher g facet scores compared with those who only  
342 completed primary school education. However this effect is not present in model 2, which  
343 contains SWB+ predictors. This result shows that when comparing similar well-being levels,  
344 educational level does not correlate with the g facet. Also this effect occurs consistently over  
345 models 3 and 4 where those with higher and secondary education report lower g facet scores  
346 than primary educated participants, but only when broad ranging SWB+ and QoL factors are  
347 controlled. Age-band shows small correlations without controlling for QoL, but these vanish  
348 when including QoL in models 3 and 4. The variance in the g facet due to age is explained by  
349 QoL facets. As expected, both control variables on health (presence of illness; self-rated  
350 health) show consistent correlation with the g facet across all four models, although the effect  
351 is substantially reduced when SWB+ and/or QoL variables are taken into the models.

352 Thirteen QoL variables correlated positively and significantly with the g facet,  
353 irrespective of whether or not well-being variables were included. Furthermore, these  
354 variables are selected from across all six QoL domains, as predicted: energy & fatigue, sleep  
355 & rest (physical), self-esteem (psychological), dependence on medication & treatment  
356 (independence), personal relationships, practical social support, sex-life (social), perceived  
357 home environment, financial resources, access to health & social care, opportunities for  
358 recreation & leisure (environment), wholeness & integration, inner peace (spiritual). In the  
359 QoL model (model 3), physical safety & security and hope & optimism also positively  
360 correlated with the g facet, but cease to be significant predictors when combined with SWB+  
361 indicators in the final regression (model 4).

362 The picture for SWB+ indicators is different. While all four indicators are significant  
363 when run together in a separate model (model 2), only positive feelings showed a significant  
364 correlation with the g facet over and above QoL indicators, in the final model (model 4).  
365 Variance shared between other indicators of SWB+ (negative feelings, meaning in life,  
366 purpose in life) and the g facet appears to be explained by QoL indicators.

367 The random effects of the mixed model (Table 2; SD (Const) and SD (Residual)) show  
368 that relevant, but small cluster effects relating to cultural centre were present between 5% and  
369 9%, across models. Maximal Monte Carlo error (Table 2; MC error) was observed each time  
370 for the model intercept, and the next one in size was every time, only one tenth of the  
371 maximal value. This means that values for the four models were small, compared to  
372 estimated coefficients, indicating little variation across imputation runs. The maximal  
373 variance inflation factor (VIF) derived from an ordinary least squares model as an  
374 approximation for the (multi-)collinearity of the predictors, was also acceptable for all  
375 models. VIFs quantify collinearity of predictors; high collinearity can lead to loss of  
376 statistical power (Cohen, Cohen, West, et al., 2003). However as no high VIF coefficients  
377 were connected to any SWB+ variable, collinearity is an unlikely alternative explanation of  
378 lost significance for SWB+ variables in model 4.

#### 379 **4. Discussion**

380 A review of positions and open questions about the fields of QoL and SWB research led  
381 to an inquiry about whether both concepts are needed, and the degree to which they represent  
382 complementary perspectives. Consequently we examined the empirical relationship between  
383 the two subjective models using international survey data. As person-centred approaches are  
384 increasingly used for monitoring and evaluating service outcomes (State of Connecticut  
385 Department of Mental Health and Addiction Services, 2014), and informing global policy  
386 decisions (Stiglitz, Sen, & Fitoussi, 2009), this work seems timely.

387 Our findings show that both SWB+ and WHOQOL SRPB QoL facets contribute to  
388 the prediction of the g facet, and these range across every WHOQOL domain: energy, sleep  
389 (physical domain); positive feelings, self-esteem (psychological); dependence on medication  
390 & treatment (independence); personal relationships, social support, sex-life (social  
391 relationships); home environment, financial resources, health & social care, recreation &  
392 leisure (environment); wholeness, inner peace (spiritual). Several of these variables also  
393 played an important role in the descriptive network analysis of facets' interrelations, as well  
394 as representing two broad clusters of content identified in that analysis.

395 Our new, improved and streamlined model of *Life Quality and Well-being (LQW)*  
396 therefore integrates 14 facets of subjective QoL (including g facet) drawn from both  
397 theoretical formulations. Furthermore we confirm that these facets were derived from six  
398 internationally important QoL domains, so offering a holistic model that potentially  
399 incorporates SWB+ and offering more comprehensive conceptual coverage than the limited  
400 psychological and spiritual components of SWB+. This work also streamlines the 33 facets  
401 assessed by the WHOQOL SRPB. We report the first step in evolving a novel, integrated  
402 model of life quality and well-being (LQW). This result is important as the sample contained  
403 11 diverse cultures from most inhabited world regions; hence this model approaches  
404 'universal' status.

405 Model results consistently show that subjective health is important to QoL, and also  
406 SWB+ where, although investigated, health has not officially been a component. Subjective  
407 health is a predictor in all four regression models, and the network model shows that health-  
408 related variables are closely linked to physical QoL facets on medication, activity and  
409 mobility. We conclude that the new LQW model should routinely include a 'subjective health'  
410 assessment, not just to accommodate theoretical credibility, but also to sensitively adjust  
411 scores to health status. This should be done irrespective of whether an assessment is intended

412 for health use, or other purposes/populations (Camfield & Skevington, 2008). Similarly we  
413 note the need to assess educational level which acts as a literacy indicator, and a proxy for  
414 poverty, commensurate with other approaches on socio-economic factors.

415 The regression and network models confirm that positive affect/feelings are a  
416 mainstay of both SWB+, and subjective QoL. In network analyses, positive feelings were  
417 centrally located, and when assessed in relation to all SWB+ and QoL variables in the final  
418 regression model, positive feelings was the only predictive component from four in SWB+,  
419 underscoring its central importance in LQW. This result was not unexpected as happiness is  
420 routinely assessed in measures and models of well-being, and of QoL within health (e.g.  
421 Veenhoven, 2010). It is noteworthy that positive feelings in the WHOQOL combines  
422 contentment with happiness, indicating more enduring properties than the ephemeral qualities  
423 suggested by mood.

424 In the SWB+ model alone (model 2), all four variables showed significant predictive  
425 values. Positive and negative feelings endorsed a sound hedonic component, and meaning  
426 and purpose in life evidenced eudaimonia, strongly supporting SWB+ *per se*. However,  
427 neither eudaimonic variable or negative feelings subsequently contributed to predicting the  
428 g facet in the final LQW model. Instead two unpredicted spiritual qualities of  
429 wholeness/integration, and inner peace emerged as significant. These should be tested further  
430 as potential components of eudaimonia within SWB+; also in other populations.

431 All three facets of the social relationships domain were included in the LQW model,  
432 illustrating the core importance of 'quality ties to others' (Veenhoven, 2010). Among these,  
433 the most important predictor in the final model was personal relations, chiming with  
434 interpersonal elements in PWB. As PWB predicts SWB configurations (Ryff & Singer,

435 1998), and may be 'universal' (Veenhoven, 2010), new research is warranted to scrutinise  
436 relations between the WHOQOL social domain and PWB.

437         Conceptual convergence between the two models was observed between recent  
438 definitions of SWB and QoL, as defined by WHO, revealing common ground. Our findings  
439 point to a streamlined, unified but multi-dimensional concept, comprised of a subset of the  
440 original facets. When reassessed, these facets should represent a foundation for building one  
441 single instrument. The findings also show model overlap, and that some components of both  
442 concepts have greater predictive value than others. The empirical research underpinning this  
443 newly integrated concept has potential to simplify measurement choice for policy-makers in  
444 health, and other applied fields. A trans-disciplinary international collaboration is needed to  
445 seek consensus on a single unifying definition, from which new policy and measurement  
446 initiatives could flow. Guidance for this work is provided by the LQW model research. Fresh  
447 cross-cultural data will be necessary to confirm the LQW model, and provide full  
448 psychometric testing of any associated measure.

449         Another implication is that where QoL and well-being need to be measured, an  
450 approach combining at least these 14 facets, promises to be more comprehensive, and also  
451 theoretically grounded. Pending validation, any such instrument would reduce the twin  
452 burdens of administering and completing two or more measures. Organisations (e.g. The  
453 Organisation for Economic Co-operation & Development) and governments planning well-  
454 being surveys should reconsider whether using SWB+ provides sufficient information to  
455 draw confident conclusions about life quality and wellbeing. This is especially important  
456 when the costs of gathering large scale survey data are considered (e.g. Gibbons et al., 2016;  
457 Stochl et al., 2016).



458 As the literature reveals unresolved conceptual problems with configuring the SWB  
459 model (Busseri & Sadava, 2011), we cannot exclude the possibility that a different  
460 configuration of components might better explain our model. There may also be important  
461 dimensions beyond these theoretical frameworks, and available WHOQOL facets that  
462 warrant testing, and inclusion. However network analysis corroborates the centrality of the  
463 g facet among other WHOQOL facets, and therefore choosing any other facet as the criterion  
464 would have effectively reduced validity.

465 Another important observation is that unlike previous approaches, our analysis did not  
466 address QoL from a purely operational perspective (Hyland, 1992). Instead the analyses were  
467 driven by an inclusive, broad QoL definition (The WHOQOL Group (1994), with an  
468 established empirical and theoretical track record. From this perspective, it is arguable that  
469 our results indicate a theoretical construct that influences responses to a substantial  
470 proportion of the WHOQOL facets. This perspective could guide further investigations into  
471 how health, and more broadly personality (e.g. Trompenaars, van Heck, Hodlment et al,  
472 2007), and situational aspects (e.g. Kellert, 2009), influence QoL.

473 Another limitation is that we used WHOQOL SRPB facets, not item-level analysis.  
474 This is especially noteworthy as our dependent variable contains life satisfaction, which in  
475 some models is conceptualised within well-being (Busseri & Sadava, 2011). The analysis  
476 focused on the WHOQOL SRPB as a validated instrument, and interrelationships between its  
477 facets as used in surveys and clinical practice worldwide. Future investigations into the LQW  
478 model should revisit the analysis, and potentially develop item content to identify an optimal  
479 set of indicators to operationalize the LQW model (see construct validity citations on  
480 WHOQOL SRPB in Methods).

481 Our statistical approach represents an advance in analysing clustered cross-cultural  
482 WHOQOL data, and progresses knowledge about what is important to global SWB and QoL.  
483 However moderate levels of missing data were necessarily addressed with multiple  
484 imputation, and the analysis followed the WHOQOL consortium approach of using the  
485 instrument as a conceptually validated instrument for measuring across cultural contexts (see  
486 also Gibbons, Skevington & the WHOQOL Group (2017); Theuns et al., (2010)). Despite  
487 such limitations, the findings offer insights into a rare cultural range of subjective data.

488 The primary research strength was access to cross-cultural WHOQOL SRPB data  
489 collected contemporaneously in 11 countries world-wide that enables some generalisation of  
490 results, and tentative global conclusions. Despite its length, the WHOQOL SRPB is suitable  
491 to use in this context as scores are reliable across a profile of facets, and cover key  
492 components of the LQW model. A shorter version of the WHOQOL SRPB - the WHOQOL  
493 SRPB BREF (Skevington, Gunson, & O'Connell, 2012) - is available, containing 34 items  
494 that retain the same conceptual breadth as the long-form. This short-form could be used in the  
495 interim, to ease administrative burden until a streamlined version potentially containing 14  
496 facets is standardised in line with the LQW model. Once fresh cross-cultural data has  
497 interrogated the global performance of the *Life Quality and Well-being* model, this tailor-  
498 made instrument could provide subjective information useful to national and international  
499 policy-makers.

500

501

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- 652

653 **Table 1:** Conceptual framework of subjective quality of life for WHOQOL SRPB domains  
 654 and facets (adapted from The WHOQOL SRPB Group, 2006).

### General Overall Quality of Life and Health

Physical Health	Psychological	Independence	Social Relationships	Environment	Spiritual, Religious & Personal Beliefs
Pain & Discomfort	<i>Positive Feelings</i>	Mobility	Personal Relations	Physical Safety & Security	<i>Purpose in life**</i>
Energy & Fatigue	Thinking, Learning, Memory & Concentration (Cognitions)	Activities of Daily Living	Practical Social Support	Home Environment	Spiritual Connection*
Sleep & Rest	Self-esteem	Dependence on Medication & Treatment	Sex-life	Financial Resources	<i>Meaning in Life*</i>
	Body Image & Attractiveness	Working Capacity		Health & Social Care	Awe & Wonder*
	<i>Negative Feelings</i>			Information & Skills	Wholeness & Integration*
				Recreation & Leisure	Spiritual Strength*
				Physical Environment	Inner Peace*
				Transport	Hope &

Optimism\*

Faith\*

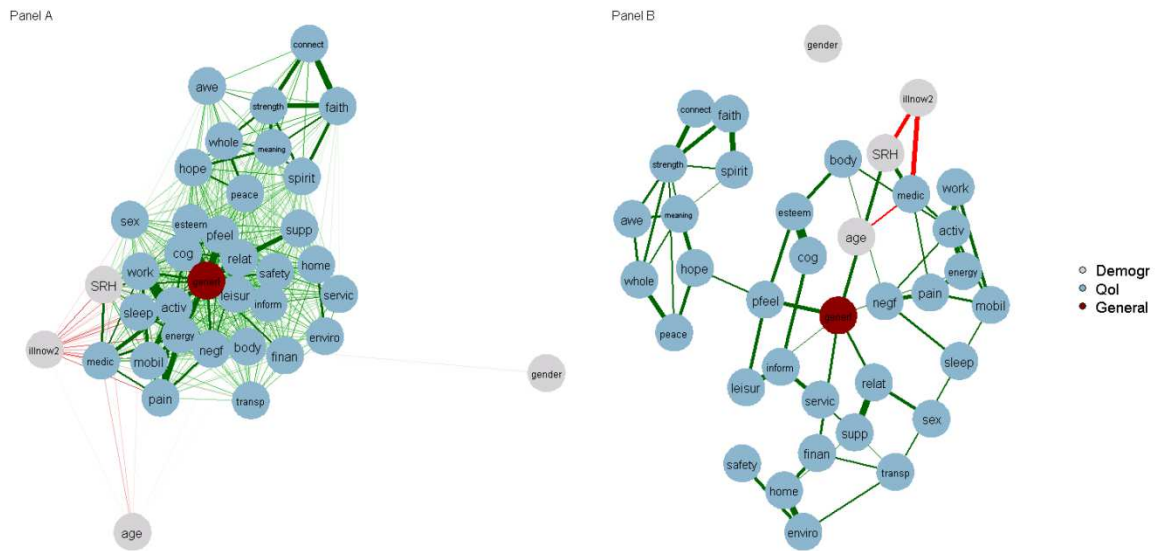
655 Key: \*New SRPB facets; \*\*formerly called 'Spirituality'; *Italics* indicate SWB+ model

656 components

657

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658 **Figure 1.** Network plots presenting the correlational relationships between QoL and control  
 659 variables. Panel A shows the observed correlations and Panel B partial correlations (after  
 660 LASSO regularization); circles represent facets; red lines indicate negative and green lines  
 661 positive correlations; correlations  $r < |.10|$  not shown; for abbreviations of facets see table 2



662

663

664 **Table 2:** Results of mixed-effect regression models predicting general QoL and WB based on 20  
 665 imputed data sets (with abbreviations for facets in brackets, see figure 1)

	Model 1	Model 2	Model 3	Model 4
	only demographic	demographic + SWB+	demographic + QoL	All
Gender	-.14 (.10)	0.00 (0.08)	-.02 (.07)	-.04 (.07)
Marital status	.17 (.11)	-0.05 (0.08)	-.13 (.08)	-.14 (.07)
Secondary education <sup>b</sup>	.19 (.16)	-0.14 (0.12)	-.26* (.11)	-.27* (.11)
Univ./ Post-graduate <sup>b</sup>	.54** (.17)	0.04 (0.13)	-.25* (.11)	-.27* (.11)
Age-band (age)	.02*** (.004)	0.008* (0.003)	.002 (.003)	.004 (.003)
Currently ill? (illnow2)	-.53*** (.11)	-0.39*** (0.09)	-.16* (.08)	-.16* (.08)
Health status rating (SRH)	1.64*** (.07)	.83*** (0.05)	.53*** (.05)	.49*** (.05)
Pain & discomfort (pain)			-.004 (.01)	.00 (.01)
Energy & fatigue (energy)			.11*** (.02)	.10*** (.02)
Sleep & rest (sleep)			.03** (.01)	.03* (.01)

Cognitions (cog)	-.01	-.02
	(.02)	(.02)
Self-esteem (esteem)	.13***	.09***
	.02	(.02)
Body Image	-.001	.003
& appearance (body)	(.01)	(.01)
Mobility (mobility)	.005	.003
	(.01)	(.01)
Activities of	.01	.01
daily living (activ)	(.02)	(.02)
Dependence on	.04**	.04***
medication/treatment	(.01)	(.01)
(medic)		
Working capacity	.02	.02
(work)		
	(.01)	(.01)
Personal relationships	.18***	.15***
(relat)		
	(.02)	(.02)
Practical social	.04*	.03*
Support (supp)	(.01)	(.01)
Sex-life (sexx)	.05***	.04***
	(.01)	(.01)
Physical safety &	.03*	.02
Security (safety)	(.02)	(.02)
Home environment	.06***	.05***
(home)		
	(.02)	(.02)
Financial resources	.11***	.11***
(finan)		

	(.01)	(.01)
Health & social care (servic)	.09***	.09***
	(.02)	(.02)
Information & skills (inform)	.01	.01
	(.02)	(.02)
Recreation & leisure (leisur)	.11***	.07***
	(.02)	(.02)
Physical environment (enviro)	-.02	-.02
	(.02)	(.02)
Transport (transp)	.01	.01
	(.01)	(.01)
Spiritual connection (connect)	.01	.01
	(.01)	(.01)
Awe & wonder (awe)	-.02	-.02
	(.01)	(.01)
Wholeness & Integration (whole)	.04*	.03*
	(.02)	(.01)
Inner strength (strength)	-.01	-.02
	(.01)	(.01)
Inner peace (peace)	.04**	.03*
	(.01)	(.01)
Hope & optimism (hope)	.04*	.01
	(.01)	(.01)

Faith (faith)			.003		-.01
			(.01)		(.01)
Positive feelings (pfeel)		.43***			.18***
			(.02)		(.02)
Negative feelings (negf)		.19***			.02
			(.01)		(.01)
Purpose in life (‘Spirituality’) (spirit)		.05**			.01
			(.01)		(.01)
Meaning in life (meaning)		.07***			.03
			(.02)		(.02)
Constant	9.05***	1.96***	-2.21***		-2.16***
	(.39)	(.33)	(.36)		(.36)
SD(Constant) <sup>a</sup>	.73	.39	.37		.38
	(.16)	(.09)	(.09)		(.09)
SD(Residual) <sup>a</sup>	2.43	1.89	1.62		1.59
	(.03)	(.03)	(.02)		(.02)
$R^2$	.29	.59	.69		.70
AIC	11733	10470	9747		9648
BIC	11791	10551	9969		9893
Evidence weight (AIC/BIC)	--	0 / 0	0 / 0		1 / 1
LR-Test	--	$\chi^2_{\text{Mod2-Mod1}} = 1277.23$ (df=4; p < .001)	$\chi^2_{\text{Mod3-Mod1}} = 2045.44$ (df=28; p < .001)		$\chi^2_{\text{Mod4-Mod2}} = 873.50$ (df=28; p < .001)
					$\chi^2_{\text{Mod4-Mod3}} = 105.29$ (df=4; p < .001)



max(VIF)	2.39 (Education)	2.40 (Education)	3.43 (Activities)	3.51 (Activities)
max(MC error)	.01	.007	.006	.006

666 *Note.* \*\*\*  $p < 0.001$ , \*\*  $p < 0.01$ , \*  $p < 0.05$ ; standard errors in parentheses; VIF variance inflation factor based on  
667 simple linear regressions; LR-Test Likelihood Ratio Test for model comparison;  $R^2$ , AIC, BIC, and VIF all  
668 based on randomly selected imputed data sets; <sup>a</sup>no asterisks provided since standard error based assessment of  
669 the relevance of variance components is not recommended; <sup>b</sup>Primary education as reference category

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## Highlights

- How subjective wellbeing (SWB) relates to quality of life (QoL) is obscure.
- Cross-cultural WHOQOL SRPB data enabled a global evaluation of concepts.
- Network analysis corroborates the central importance of general QoL and SWB+.
- A QoL model with 13 facets explains more general variance than SWB+ alone.
- An integrated Life Quality and Wellbeing model and its measure are supported.