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Comprehensively Measuring Health-Related Subjective Well-Being: Dimensionality Analysis for Improved Outcome Assessment in Health Economics

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ABSTRACT

Background: Allocation of inevitably limited financial resources for health care requires assessment of an intervention's effectiveness. Interventions likely affect quality of life (QOL) more broadly than is measurable with commonly used health-related QOL utility scales. In line with the World Health Organization's definition of health, a recent Delphi procedure showed that assessment needs to put more emphasis on mental and social dimensions. **Objective:** To identify the core dimensions of health-related subjective well-being (HR-SWB) for a new, more comprehensive outcome measure. **Methods:** We formulated items for each domain of an initial Delphi-based set of 21 domains of HR-SWB. We tested these items in a large sample (N = 1143) and used dimensionality analyses to find a smaller number of latent factors. **Results:** Exploratory factor analysis suggested a five-factor model, which explained 65% of the total variance. Factors related to physical independence, positive affect, negative affect, autonomy, and personal growth. Correlations

between the factors ranged from 0.19 to 0.59. A closer inspection of the factors revealed an overlap between the newly identified core dimensions of HR-SWB and the validation scales, but the dimensions of HR-SWB also seemed to reflect additional aspects. This shows that the dimensions of HR-SWB we identified go beyond the existing health-related QOL instruments. **Conclusions:** We identified a set of five key dimensions to be included in a new, comprehensive measure of HR-SWB that reliably captures these dimensions and fills in the gaps of the existent measures used in economic evaluations.

Keywords: factor analysis, quality of life.

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Introduction

The allocation of inevitably limited financial resources for health care and the evaluation of alternative treatments and interventions require assessment of the effects of treatments and interventions on health. According to the World Health Organization's (WHO's) definition of health, "Health is a state of complete positive physical, mental, and social well-being and not merely the absence of disease or infirmity" [1]. This definition was adopted at the International Health Conference held in New York in 1946 and signed on July 22, 1946, by the representatives of 61 states [2] and has not been amended since. The effectiveness of health interventions is often measured in terms of quality-adjusted life-years (QALYs) [3]. QALYs combine the quality and quantity of life into a one-dimensional outcome. QALYs are, however, currently derived from health measures that focus primarily on physical and mental functioning and not so much

on social well-being [4]. As a consequence, existing scales and corresponding QALYs may not provide a comprehensive picture of the effectiveness of an intervention for a patient's health as defined by the WHO. The overarching purpose of the present research was to design a new utility measure that better fits WHO's definition and that may serve as a basis for economic appraisal of health interventions. More specifically, we identified the core dimensions of health as defined by the WHO, that is, "a state of complete positive physical, mental and social well-being."

The Need for a More Comprehensive Outcome Assessment in Health Economics

In line with the WHO definition of health, a recent Delphi consensus procedure among five stakeholder groups (i.e., patients, family of patients, clinicians, scientists, and general public) showed that economic evaluations of health care

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interventions need to put more emphasis on mental and social dimensions [5]. Currently, QALYs are typically calculated on the basis of various health-related quality-of-life (QOL) measures, such as the EuroQol five-dimensional questionnaire (EQ-5D), the Health Utility Index (HUI), and the Short Form- Six Dimensions derived from Short-Form 36 Health Survey (SF-6D) [6]. Such measures provide scores on a predefined set of domains relevant to the QOL, such as mobility and pain. Nevertheless, an increasingly common critique is that these measures do not capture all the domains relevant to the QOL but capture only limitations in functioning [4,7]. For example, the EQ-5D domains are mobility, self-care, usual activities, pain/discomfort, and anxiety/depression, and sometimes a cognitive dimension is added. QALYs based on these EQ-5D domains miss some important aspects of the QOL. For example, although one may argue that domain 3 of the EQ-5D (usual activities) does seem to tap into social well-being, social well-being is not confined to only activities, but also entails aspects such as relationship quality and social support. Moreover, although domain 5 of the EQ-5D (anxiety/depression) taps into affective aspects of mental well-being, it is restricted to negative affect and does not take into account positive feelings such as happiness, satisfaction, confidence, and self-efficacy. Importantly, these positive affective states are not always inversely correlated to negative feelings, such as anxiety and depression, but can coexist and also exist independently [8].

Furthermore, current measures of health-related QOL focus mainly on determining the physical effects of treatments, which are mainly obtained with cure-related treatments. Therefore, these measurements do not optimally detect important effects of health interventions in other medical contexts such as end-of-life care [9,10], older people [11,12], mental care [13], public health [14], informal care [15,16], and in vitro fertilization [17]. To better gauge the effectiveness of health interventions, measures need to go beyond what is measurable by currently available health-related QOL assessment instruments.

For a comprehensive picture of the assessment of the effectiveness of health interventions on health, multiple terms that are used in the literature are relevant. In health economics, the QOL is a common term. Subjective well-being is a key concept in psychology, with an explicit focus on the mental and social domains of well-being, the two pillars of the WHO definition of health that seem to be under-represented in the currently available health utility measures [5]. Building on the traditional and relatively narrow way in which the QOL is conceptualized and measured in health economics, our aim was to enrich this approach by incorporating a broader perspective on the QOL, for which we will use the term health-related subjective well-being (HR-SWB). More specifically, in this article we focus on identifying the core dimensions of HR-SWB.

Identifying the core dimensions of HR-SWB is an essential step in the process of developing a new, more comprehensive outcome measure for effectiveness assessment of health care interventions suitable in all health care contexts. To have a good understanding of what stakeholders perceive as important for HR-SWB, we recently ran the aforementioned Delphi procedure. Building on the Delphi-based set of 21 domains of HR-SWB, our main objective in the research presented in this article was to investigate whether the variation on these domains can be summarized by means of a limited number of underlying HR-SWB factors. This way, we aimed to identify the core dimensions of HR-SWB. Importantly, such a set of core dimensions of HR-SWB can serve as a basis for a new, more comprehensive outcome measure, and hence contribute to improving the assessment of the effectiveness of health care interventions.

Methods

Overview

First, we constructed, pilot-tested, and adapted a draft questionnaire on the basis of the outcomes of our recent Delphi procedure [5]. We then assessed the dimensionality of the concept questionnaire and examined whether the information from the domains could be summarized using a limited number of factors. We finally determined the construct validity of the dimensions identified using the most frequently used generic health-related QOL utility measures and questions of QOL, well-being, and happiness (e.g., the EQ-5D and the Satisfaction with Life Scale [SWLS]). These dimensions can serve as a basis for a new, more comprehensive outcome measure.

Draft Questionnaire Construction

For each of the 21 Delphi-based selected domains (see Appendix A in Supplemental Materials found at <http://dx.doi.org/10.1016/j.jval.2015.11.010>), we formulated three questions on an average. We used multiple questions to allow for selecting those questions that best capture the meaning of each specific domain (e.g., by looking at the correlations with preselected existing scales). For the domain “self-esteem,” we chose to include one question because there was abundant evidence concerning the concrete operationalization of this construct; it is common practice to include one specific question [18]. The domains that covered participants’ satisfaction with daily activities, balance between obligations and leisure, and life roles were such concrete domains that we believed that it was not necessary to include multiple questions either. For the domain “autonomy,” we included four questions because this was a broad concept that included many aspects [19]. Two pairs of domains resulted in almost identical questions. Therefore, we chose to combine these domains: “being able to perform activities of daily living” and “independence,” and “purpose in life” and “meaningfulness.”

To keep uniformity, we chose to construct the questions in such a way that all could be answered using the same answering options. That is, all the questions were phrased as statements and respondents could indicate to what extent they agreed with these statements. We used a five-point Likert scale: 1, totally not; 2, a little; 3, to a moderate extent; 4, largely; and 5, totally. There is no consensus in the scientific literature on the choice of the number of answering options (e.g., choice between five-point and seven-point scale or choice between even or uneven numbers). There is also no consensus on the types of labels that should preferably be used (i.e., frequency indications or severity indications) [20]. We chose to use a five-point scale because we believed this would give participants enough variety, but not too much. The labels we chose indicated the extent/severity of things, which enabled respondents to express whether they were hindered in reaching the best level of HR-SWB. These labels are commonly used in QOL questionnaires.

The Delphi procedure showed that some of the physical domains (“vitality,” “mobility”) that are part of commonly used generic health-related QOL utility measures such as the EQ-5D and the SF-6D were perceived as relatively unimportant by stakeholders. We decided to also include questions based on the domains of the EQ-5D and the SF-6D that were not among our Delphi-based selection of HR-SWB domains, because the EQ-5D and the SF-6D are the most frequently used generic health-related QOL utility measures [6,21]. The final draft questionnaire consisted of 56 questions, covering the Delphi-based selection of domains and the added domains from the EQ-5D and the SF-6D (see Table 1).

Table 1 – Domains of the HR-SWB questionnaire.

Being able to perform activities of daily living that are important to you/Independence	
1	In the past week I was able to perform the daily activities that are important to me (think about physical care, household chores, work, study, and leisure).
2	In the past week I was able to take care of myself (think about things like eating, dressing, and washing).
3	In the past week I was able to <i>independently</i> perform the daily activities that are important to me. This means that I was not depending on other people to perform my daily activities, such as physical care, household chores, work, study, and leisure.
Mobility	
4	In the past week I was able to move around <i>indoors</i> .
5	In the past week I was able to move around <i>outdoors</i> (think about walking and possibilities to use transport like a wheelchair, bicycle, car, and train).
6	In the past week I had trouble walking.
Vitality	
7	In the past week I felt fit and energetic.
8	In the past week I had sleeping problems.
9	In the past week I had sufficient energy to do the things I find important.
Positive emotions	
10	In the past week I felt satisfied.
11	In the past week I felt joyful.
12	In the past week I felt happy.
Mental balance	
13	I live my life my own way.
14	I feel calm and in balance.
15	I feel mentally in balance.
Self-acceptation	
16	I like most aspects of my personality.
17	When I look at the story of my life, I am pleased with how things have turned out.
18	I acknowledge and accept the positive and negative aspects of myself.
Self-esteem	
19	I have self-esteem.
Autonomy	
20	I tend to be influenced by people with strong opinions.
21	I have confidence in my opinions, even if they are contrary to the general consensus.
22	I judge myself by what I think is important, not by the values of what others think is important.
23	I feel I am free to decide for myself how to live my life.
Optimism	
24	In uncertain times, I usually have optimistic expectations.
25	If something can go wrong in my life, it will.
26	I am optimistic about my future.
Personal growth	
27	I think it is important to have new experiences that challenge how I think about myself and the world.
28	For me, life has been a continuous process of learning, changing, and growth.
29	I see it as a positive challenge to grow and become a better person.
Feeling in control	
30	I determine how I live my life and not faith, chance, luck, my environment, or other people.
31	I feel helpless.
32	I have the feeling that I control my daily life.
Feeling competent and capable	
33	I have the feeling that I am capable to do the things that are important to me.
34	I have the feeling that I have sufficient knowledge and skills to perform my daily activities.
35	I have the feeling that I can achieve the goals that I set for myself.
Purpose in life/Meaningfulness	
36	I have beliefs and ideas that give my life a sense of direction.
37	I lead a meaningful life.
38	I have no real goal to live for.
Satisfaction with daily activities	
39	I am satisfied with my daily activities (think about work, hobbies, leisure time, study, and household chores).
Satisfaction with life roles	
40	I am satisfied with the roles that I fulfill in my life (think about role as partner, parent, child, employee, friend, etc.).
Acceptation of the situation	
41	I am able to take life as it comes.
42	I can accept that life sometimes gives me pain and grief.
43	I am capable to adjust to changes that occur in my life.
Enjoying the little things in life	
44	I enjoy all that I have and experience.

continued on next page

Table 1 – continued.

45	I am satisfied with the little things in life.
46	I enjoy all the little things in life.
Good social contacts	
47	I experience sufficient support of others.
48	I have warm and trusting relations with others.
49	I feel lonely.
Satisfaction with the balance between obligations and leisure	
50	I am satisfied with the balance between my obligations/tasks and leisure time (think about the balance between hobbies and work).
Domains based on the EQ-5D and the SF-6D	
51	In the past week I experienced bodily pain or other physical complaints.
52	In the past week I was bothered by emotional problems (such as feeling anxious or depressed).
53	In the past week I found it difficult to do my daily work because of my physical health (both at home and away from home).
54	In the past week my personal or emotional problems limited my daily activities.
55	In the past week my physical health limited my usual physical activities (such as walking or climbing stairs).
56	In the past week my physical health or emotional problems limited my usual social activities (such as visiting family and friends).

Notes. Respondents were asked to indicate to what extent they agreed with all the statements. A five-point Likert scale was used: 1, totally not; 2, a little; 3, to a moderate extent; 4, largely; and 5, totally. All the questions were presented in a random order. The questionnaire was developed in Dutch and tested in a Dutch population. The English items were carefully translated. They were, however, not tested on validity and reliability.

EQ-5D, EuroQol five-Dimensional questionnaire; HR-SWB, Health-Related Subjective Well-Being; SF-6D, Short Form- Six Dimensions (derived from Short Form 36 Health Survey).

Pretest of the Draft Questionnaire

Ten participants (seven women and three men; mean age 44 ± 10 years; recruited by means of an online call on Web sites of regional newspapers and on the Web site of a University Medical Center) pretested our draft questionnaire in a face-to-face interview with a researcher who was well informed about the way the questionnaire items were constructed. Six participants indicated being patients (i.e., people who had, at the moment of recruitment or in the previous year, an acute/chronic physical or mental disease, were terminally ill, or underwent fertility treatment), and four participants indicated not belonging to the group of patients. Participants were each offered €10 for participating in the pretest.

We used the “think aloud” technique [22,23]. Participants were asked to read all the questions aloud and to tell the researcher about all the thoughts that came to their mind. They were asked to signal all things they perceived to be unclear. Participants also indicated the ease of using the aforementioned five-point Likert scale. All participant comments concerned the general introduction of the questionnaire and the wording of the questions. None of the participants indicated having any problems with the answering scale, and neither with the number of answering options nor with the content of the labels. We acted upon all the suggestions and altered the general introduction and the wording of the items. Table 1 gives an overview of the domains and constituent items of our questionnaire after the pretest. We will refer to this questionnaire as the HR-SWB questionnaire.

Validation Scales

To determine how well the dimensions identified in the present study are able to comprehensively capture different facets of HR-SWB, we included nine validated questionnaires that also measured aspects of HR-SWB: the three-level EQ-5D [24], ICEpop CAPability measure for Older people (ICECAP-O) [25], World Health Organisation Quality of Life (WHOQOL_BREF) [26,27], Mental Health Continuum- Short Form (MHC-SF) [28], Flourishing Scale [29], Scale of Positive and Negative Experience (SPANE) [29], SWLS [30], a single-item 10-point Likert scale for life satisfaction (i.e., “Taking all together, how satisfied or unsatisfied are you nowadays with your life as a whole?”) [31,32], and a visual analog scale for happiness. This scale recorded the respondents’ self-rated

happiness in the past week, with end points labeled “perfectly happy” and “completely unhappy.” The visual analogue scale was posed directly after the HR-SWB questionnaire. The remaining validation scales were presented to the participants in a random order. Respondents were instructed that the questionnaire consisted of several scales on the QOL and well-being and that consequently some questions were almost identical. The beginning of each new questionnaire was clearly indicated.

Demographic Questions

After completing the HR-SWB questionnaire and the validation scales, participants were asked to answer some demographic questions and questions about their mental and physical health.

Participants

A group of 1143 participants (56.6% women; mean age 47.43 ± 12.53 years; education levels: low = 30.6%, medium = 43.6%, high = 25.8%) completed the questionnaire that we developed and the additional existing QOL, well-being, and happiness measures. The sample’s demographic characteristics were fairly similar to that of the Dutch population (50.5% women; mean age of people older than 18 years: 48.88 ± 18.48 years; education levels: low = 33.7%, medium = 39.0%, high = 27.4%). In general, the proportion of people with chronic diseases was higher than that in the general Dutch population, but people with migraine, anxiousness, and Parkinson disease were somewhat under-represented (for the exact numbers, see Appendix B in Supplemental Materials found at <http://dx.doi.org/10.1016/j.jval.2015.11.010>). Participants were recruited by a market research agency, and they received points in exchange for their participation (after they had earned a certain minimum number of points by completing online studies, they were given a gift coupon) or by means of online calls and calls in local Dutch newspapers (N = 108). They could win one of five gift coupons of €20. All the participants completed the questionnaire online. Participants were allowed to complete the questionnaire with breaks.

Dimensionality Analysis

To examine the dimensionality of the data collected with the HR-SWB questionnaire, we fitted a series of factor models to the matrix of polychoric correlations. Polychoric correlations may

be better suited than Pearson correlations for analyzing the dimensionality of Likert scale items because the responses should be treated as ordinal data [33]. We started with a one-factor model and then added one factor at a time. In each step, all the items were allowed to load on all the factors in the model, meaning that no a priori restrictions were imposed on the factorial structure. Factors were added until a model was found that 1) showed adequate fit in terms of the Bentler’s Comparative Fit Index/Tucker-Lewis Index (CFI/TLI > 0.98), the root mean square error of approximation (RMSEA < 0.08), and the standardized root mean square residual (SRMR < 0.08); 2) explained a reasonable amount of variance (i.e., at least 50%); and 3) had an interpretable simple structure (i.e., each factor has a clear pattern of large and small factor loadings, and each item loads strongly on only one factor). In addition, we used parallel analysis [34] to determine the ideal number of factors. In parallel analysis, factors are retained if they are able to explain a larger amount of variance than would be expected by chance alone. All the analyses were done with MPLUS5.0 [35] using weighted least-squares estimation and the *psych* package in the R v3.2 statistical programming language [36,37].

Validation with Other QOL Measures

To clarify the meaning of the QOL dimensions extracted from the factor analyses, we examined the association between the dimensions that emerged from our dimensionality analysis (exploratory factor analysis [EFA]) and the domain scores from the validation scales. These associations showed the extent to which the existing QOL scales reflected the extracted dimensions that underlay our HR-SWB questionnaire and thus the domains identified by the stakeholders from the Delphi procedure.

To examine the association between the latent factors in the HR-SWB factors and the validation measures, we fitted a series of confirmatory factor models. A confirmatory factor analysis tests whether a data set can be adequately described by a specific factor analytic model. The point of departure was the factor model that was found in the EFA (see Table 3), but with all loadings smaller than 0.3 fixed to zero. This confirmatory factor model expressed the factorial structure in the EFA. This was the basic model in our validation analysis and will be referred to as the HR-SWB model. Because most items loaded on one dimension only, the basic model had a factorial composition that was close to a simple structure. Then, for each validation measure, we fitted a confirmatory model that was composed of the HR-SWB model and the validation measure, where the domain score(s) for that validation measure could load on all factors. The standardized loadings for the validation measure showed how the validation measure fitted the HR-SWB factor model, and to what extent the factors from the HR-SWB model overlapped with the validation measures.

Results

Dimensionality Analysis

First, several tests showed that the data were well factorable. Inspection of the matrix of Pearson correlations showed that, except for one item, all the items had a correlation of at least 0.4 with at least one of the other items. The exception was item 20, “I tend to be influenced by people with a strong opinion,” for which the maximum correlation was 0.29. The Kaiser-Meyer-Olkin measure of sampling adequacy was high (0.978), the Bartlett test for sphericity was significant, $\chi^2 (1540) = 41703.05, P < 0.001$, and the item-specific measures of sampling adequacy were all higher than 0.91. Finally, the item communalities were above 0.3, except for item 20 (which had a communality of 0.275).

Second, several indices, the parallel analysis, and the inspection of factor loadings showed that a model with five factors best describes the data. A comparison of the fit indices, eigenvalues, and explained variances across the seven models (see Table 2) showed that the one-factor model clearly explains a substantial amount of variance (45.1%). Increasing the number of factors resulted in a substantial increase in explained variance and improved model fit. The fit indices first reached acceptable levels in the model with four factors (CFI = 0.988, TLI = 0.986, RMSEA = 0.078, and SRMR = 0.033). The fifth, sixth, and seventh added factor had eigenvalues larger than 1 (explaining 2.5%, 2.1%, and 1.7% more variance, respectively), and so these models were also considered. A parallel analysis (using 100 samples) suggested retaining either five components (in principal-components analysis) or seven factors (in principal axis factoring). There is no consensus as to whether components (principal-components analysis) or factors (principal axis factoring, communalities estimated with the first factor) should be used for factor extraction [38]. As the previous analyses pointed to a four- to seven-factor model, we inspected their factor loadings and selected the model with the fewest factors but with the best interpretable factor solution. In particular, we selected the factor model in which the number and the size of cross-loadings were the smallest (i.e., a solution that is closest to a simple structure) and in which there were at least three items for each factor that loaded on that factor and which had no cross-loadings on the other factors. According to these criteria, the five-factor model yielded the best interpretable factors, and therefore this solution was used in further analyses (Table 3).

The final five-factor model explained 64.1% of the total variance. Correlations between the factors ranged from 0.193 (F1 to F5) to 0.589 (F4 to F5; see Table 4), and so the factors are sufficiently distinct. Table 3 presents the standardized loadings. The factors can be labeled as *physical independence* (e.g., “my health limited my usual physical activities”), *positive affect/happiness* (e.g., “In the past week I felt joyful”), *negative affect/feeling lost*

Table 2 – Model fit and variance explained for a series of exploratory factor analyses.

Number of factors	CFI	TLI	RMSEA	Eigenvalue of the added factor	Total variance explained by the added factor (%)	Cumulative variance explained (%)
1	0.927	0.924	0.183	25.253	45.09	45.09
2	0.974	0.972	0.111	5.232	9.34	54.43
3	0.984	0.982	0.088	2.367	4.23	58.66
4	0.988	0.986	0.078	1.628	2.91	61.57
5	0.991	0.989	0.069	1.424	2.54	64.11
6	0.993	0.992	0.060	1.166	2.08	66.19
7	0.995	0.993	0.054	0.965	1.72	67.91

CFI, comparative fit index; TLI, Tucker-Lewis Index; RMSEA, root mean square error of approximation.

Table 3 – Standardized weights of the exploratory five-factor model using polychoric correlations and oblimin rotated factors.

Domain	Item	F1	F2	F3	F4	F5
Independence	1	0.690				
	2	0.675				
	3	0.789				
Mobility	4	0.668	−0.376			
	5	0.760				
	6	0.800				
Vitality	7	0.415	0.548			
	8			0.369		
	9	0.479	0.399			
Positive emotion	10		0.427	0.353		
	11		0.501	0.369		
	12		0.478	0.430		
Mental balance	13				0.730	
	14		0.347		0.416	
	15			0.314	0.416	
Self-acceptation	16				0.595	
	17			0.350		
	18				0.602	
Self-esteem	19				0.574	
Autonomy	20				0.554	−0.348
	21				0.738	
	22				0.845	
	23				0.579	
Optimism	24				0.358	0.313
	25			0.460		
	26					0.308
Personal growth	27					0.683
	28					0.703
	29					0.719
Feeling in control	30				0.695	
	31			0.612		
	32				0.449	
Capable	33				0.380	
	34				0.481	
	35				0.406	
Meaningfulness	36					0.426
	37			0.377		0.348
	38			0.582		
Satisfaction with daily activities	39		0.325		0.383	
Satisfaction with life roles	40			0.396		
Acceptance	41				0.519	
	42				0.396	
	43				0.475	
Enjoy things in life	44				0.421	
	45			0.325	0.480	
	46			0.350	0.459	0.303
Good social contacts	47			0.496		
	48			0.464		0.413
	49			0.772		
Balance between obligations and leisure EQ-5D/SF-6D	50				0.483	
	51	0.678				
	52			0.581		
	53	0.795				
	54	0.497		0.401		
	55	0.900				
	56	0.693				

Notes. Only standardized factor loadings larger than 0.3 are tabulated. For items that load strongly on only one factor, loadings greater than 0.4 in absolute value are printed in boldface. F1 = physical independence; F2 = positive affect/happiness; F3 = negative affect/feeling lost and lonely; F4 = autonomy; F5 = personal growth. All negatively framed items were recoded so that higher scores reflect better well-being. EQ-5D, EuroQol five-dimensional questionnaire; SF-6D, six-dimensional health state short form (derived from short-form 36 health survey).

Table 4 – Correlations between the factors from the exploratory five-factor model (oblimin rotation).

	F1	F2	F3	F4	F5
F1		0.24	0.378	0.306	0.193
F2			0.402	0.319	0.209
F3				0.548	0.347
F4					0.589
F5					

Note. F1 = physical independence; F2 = positive affect/happiness; F3 = negative affect/feeling lost and lonely; F4 = autonomy; F5 = personal growth.

and lonely (e.g., “I feel lonely”), autonomy (e.g., “I live my life my own way”), and personal growth (e.g., “For me, life has been a continuous process of learning, changing, and growth”).

Validation with Other QOL Measures

The five-factor model was fairly strongly related to our validation scales and can explain a substantial amount of variance in these scales. Table 5 presents how well validation scales loaded on each of the factors that were extracted using the EFA. The first factor was most strongly related to the physical subscale of the WHOQOL and to the mobility, self-care, usual activities, pain, and utility scores of the EQ-5D. The second factor was mostly related to emotional and psychological well-being on the MHC-SF, and positive experiences in the last 4 weeks on the SPANE. The third factor was very strongly related to the social and psychological subscales of the WHOQOL and to many other subscales such as the SWLS and the Flourishing Scale. The fourth factor had a moderately strong relation with psychological and emotional

well-being on the MHC-SF and with the pain/discomfort score of the EQ-5D, but did not relate strongly to other scales. Finally, the fifth factor was moderately strongly associated with psychological and social well-being on the MHC-SF. Overall, the factors explained between 44% and 75% of the variance in the validation scales (Table 5, rightmost column). Together, the factors can explain about 45% of the variance for the EQ-5D Dutch tariff score.

Discussion

On the basis of the dimensionality analyses in a large sample, the present study identified five core domains of HR-SWB: physical independence, positive affect/happiness, negative affect/feeling lost and lonely, autonomy, and personal growth. These core domains partially overlapped with domains from the commonly used health-related QOL measures, but also diverged from these. To measure well-being comprehensively, (cost-)effectiveness analyses need to take into account these other dimensions (such as positive affect/happiness, autonomy, and personal growth) as well.

For validation purposes, we investigated associations of the identified core dimensions of HR-SWB with related, existing measures. Results show that overall there is a reasonable overlap of the newly identified core dimensions of HR-SWB with the validation scales, but the identified core dimensions of HR-SWB also seem to reflect other aspects of well-being. In other words, convergent validation is high, but the existing QOL measures do not indeed seem to fully capture the Delphi-based identified core dimensions of HR-SWB. That is, to comprehensively measure HR-SWB as it is perceived by stakeholder groups (patients, family of patients, clinicians, scientists, and the general public), these validation results underscore that measures need to go beyond health-related QOL and include other, that is, mental and social, domains.

Table 5 – Standardized loading factors of the other domains on the five main domains from the HR-SWB.

Scale	Domain	Standardized loadings (β) on SWB dimensions					R ^{2*}
		F1	F2	F3	F4	F5	
ICECAP-O	Quality of life	0.031 (ns)	0.216	0.582	−0.232	0.189	0.527
WHOQOL	Physical	0.488	0.328	0.129	−0.090 (ns)	0.097	0.650
	Psychological	−0.050	0.100	0.686	0.041 (ns)	0.119	0.750
	Social	−0.095	0.048 (ns)	0.822	−0.164	0.138	0.586
	Environment	0.292	−0.104	0.454	0.033 (ns)	0.139	0.490
MHC-SF	Emotional well-being	−0.061	0.387	0.455	−0.164	0.217	0.626
	Psychological well-being	−0.082	0.195	0.391	−0.042 (ns)	0.373	0.612
	Social well-being	−0.164	0.354	0.266	−0.303	0.493	0.436
Flourishing Scale	Positive human functioning	0.005 (ns)	−0.041 (ns)	0.625	−0.022 (ns)	0.351	0.699
SPANE	Positive experiences	−0.049	0.441	0.445	−0.085 (ns)	0.123	0.706
	Negative experiences	0.031 (ns)	−0.172	−0.682	0.008 (ns)	0.081	0.583
SWLS	Global satisfaction with one’s life	−0.009 (ns)	0.232	0.702	−0.151	0.103	0.712
EQ-5D	EQ-5D Dutch tariff	0.502	0.350	0.100 (ns)	−0.241	0.017	0.446
	Mobility	−0.565	−0.124 (ns)	0.007 (ns)	0.310	−0.049 (ns)	0.264
	Self-care	−0.472	−0.081 (ns)	0.187	0.083ns	−0.070 (ns)	0.167
	Usual activities	−0.505	−0.346	0.129 (ns)	0.210	−0.156	0.348
	Pain/discomfort	−0.587	−0.315	0.060 (ns)	0.342	−0.054 (ns)	0.344
	Anxiety/depression	0.050 (ns)	−0.318	−0.418	−0.048 (ns)	0.104	0.440

Note. F1 = physical independence; F2 = positive affect/happiness; F3 = negative affect/feeling lost and lonely; F4 = autonomy; F5 = personal growth.

ICECAP-O, ICEpop CAPability measure for Older people; WHOQOL, World Health Organisation Quality of Life; MHC-SF, Mental Health Continuum- Short Form; SPANE, Scale of Positive and Negative Experience; EQ-5D, EuroQol five-dimensional questionnaire; HR-SWB, health-related subjective well-being; ns = nonsignificant at the 5% level (two-tailed test); SWLS, Satisfaction with Life Scale.

*The amount of variance in the scale explained by the five factors.

One limitation of the present study is that we did not rely on a patient sample but on a general sample of the Dutch population. Nevertheless, even though the future use of the HR-SWB-5D will mainly be in patient populations, we do not believe this would be problematic because most chronic diseases were well represented in our sample (see Appendix B in Supplemental Materials). Moreover, we were interested in our scale's factor structure and correlations between our scale and other validated scales. Finally, the present study was based on a sample of the general Dutch population because we aimed to create a generally applicable measure of subjective well-being.

Future research must build on the current findings to construct a new scale, the HR-SWB-5D (five domains), by specifying one or two questions for each of the five core dimensions. Subsequently, the reliability, validity, and responsiveness of the new scale have to be assessed. To be useful as an instrument for cost-effectiveness studies in health economics, it is necessary to derive a utility score (a so-called tariff) for each possible health state of the HR-SWB-5D on a scale ranging from 0 to 1, generally defined as death and perfect health, respectively [39–42]. We argue that these efforts would improve the validity of economic evaluations, and, in the long run, enable allocation of inevitably limited financial resources for health care interventions to be better aligned with stakeholders' perceptions of intervention effectiveness.

Our intention was that the HR-SWB-5D would be able to also detect important effects of health interventions in situations that are more care-related than cure-related. Scrutinizing disease-specific questionnaires in care situations, such as end-of-life care, informal care, in vitro fertilization, and chronic diseases, shows that a considerable number of these questions are related to mental and social domains: control of life, pride and self-respect, meaningful and valuable life (Quality of dying and death questionnaire [43], Quality Care Questionnaire-End of Life [44]), life goal, jealousy/resentment, hope/despair (FertiQol [45]), fulfillment, mental health problems, support (CarerQol [15], Carer Experience Scale [46]), and relationships with other people, social activities, personal development, and fulfillment (Flanagan Quality of Life Scale [47]). Future research in which the final HR-SWB-5D will be administered in these care situations should reveal whether the mental and social domains of the HR-SWB-5D are able to reflect the effects of health interventions in care settings.

Conclusions

We identified a set of five key dimensions of HR-SWB to be included in a new, comprehensive measure of HR-SWB that reliably captures these dimensions and fills in the gaps of the existing measures used in economic evaluations. These efforts were intended to stimulate the use of a more comprehensive, standardized methodology in future effectiveness assessments of health care interventions.

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Supplemental Materials

Supplemental material accompanying this article can be found in the online version as a hyperlink at <http://dx.doi.org/10.1016/j.jval.2015.11.010> or, if a hard copy of article, at www.valueinhealthjournal.com/issues (select volume, issue, and article).

REFERENCES

- [1] World Health Organization. Basic Documents. Constitution of the World Health Organization. Geneva: World Health Organization, 1948.
- [2] World Health Organization. Official Records of the World Health Organization No. 2: Proceedings and Final Acts of the International Health Conference. Geneva: World Health Organization, 1948.
- [3] Gold MR, Siegel JE, Russel LB, et al. Cost-Effectiveness in Health and Medicine. New York, NY: Oxford University Press, 1996.
- [4] Pietersma S, van den Akker-van Marle ME, de Vries M. Generic quality of life utility measures in health care research: conceptual issues highlighted for the most commonly used utility measures. *Int J Wellbeing* 2013;3:173–81.
- [5] Pietersma S, de Vries M, van den Akker-van Marle ME. Domains of quality of life: results of a three-stage Delphi consensus procedure among patients, family of patients, clinicians, scientists and the general public. *Qual Life Res* 2014;23:1543–56.
- [6] Räsänen P, Roine E, Sintonen H, et al. Use of quality-adjusted life years for the estimation of effectiveness of health care: a systematic literature review. *Int J Technol Assess Health Care* 2006;22:235–41.
- [7] Dolan P. How does NICE value health? *BMJ* 2009;339:371–3.
- [8] Watson D, Clark LA, Tellegen A. Development and validation of brief measures of positive and negative affect: the PANAS scales. *J Pers Soc Psychol* 1988;54:1063–70.
- [9] Singer PA, Martin DK, Kelner M. Quality end-of-life care: patients' perspectives. *JAMA* 1999;281:163–8.
- [10] Van den Hout WB, Van der Linden YM, Steenland E, et al. Single- versus multiple-fraction radiotherapy in patients with painful bone metastases: cost-utility analysis based on a randomized trial. *J Natl Cancer Inst* 2003;95:222–9.
- [11] Donaldson C, Atkinson A, Bond J, Wright K. Should QALYs be programme-specific? *J Health Econ* 1988;7:239–57.
- [12] Hickey A, Barker M, McGee H, O'Boyle C. Measuring health-related quality of life in older patient populations: a review of current approaches. *Pharmacoeconomics* 2005;23:971–93.
- [13] Chisholm D, Healey A, Knapp M. QALYs and mental healthcare. *Soc Psychiatry Psychiatr Epidemiol* 1997;32:68–75.
- [14] Chalkidou K, Culyer A, Naidoo B, Littlejohns P. Cost-effective public health guidance: asking questions from the decision-maker's viewpoint. *Health Econ* 2008;17:441–8.
- [15] Brouwer WBF, Van Exel NJA, Van Gorp B, Redekop WK. The CarerQol instrument: a new instrument to measure care-related quality of life of informal caregivers for use in economic evaluations. *Qual Life Res* 2006;15:1005–21.
- [16] Van den Berg B, Brouwer W, van Exel J, Koopmanschap M. Economic valuation of informal care: the contingent valuation method applied to informal caregiving. *Health Econ* 2005;14:169–83.
- [17] Ryan M. Using conjoint analysis to take account of patient preferences and go beyond health outcomes: an application to in vitro fertilization. *Soc Sci Med* 1999;48:535–46.
- [18] Robins RW, Hendin HM, Trzesniewski KH. Measuring global self-esteem: construct validation of a single-item measure and the Rosenberg Self-Esteem Scale. *Pers Soc Psychol Bull* 2001;27:151–61.
- [19] Ryan RM, Deci EL. Self-regulation and the problem of human autonomy: does psychology need choice, self-determination, and will? *J Pers* 2006;74:1557–86.
- [20] Norman GR, Streiner DL. *Biostatistics: The Bare Essentials*. Hamilton, Ontario, Canada: BC Decker, 2008.
- [21] Coons SJ, Rao S, Keininger DL, Hays RD. A comparative review of generic quality-of-life instruments. *Pharmacoeconomics* 2000;17:13–5.
- [22] Willis GB, Royston P, Bercini D. The use of verbal report methods in the development and testing of survey questionnaires. *Appl Cog Psychol* 1991;5:251–67.
- [23] Willis GB, Schechter S. Evaluation of cognitive interviewing techniques: do the results generalize to the field? *Bull Methodol Sociol* 1997;55:40–66.
- [24] Brooks R. EuroQol: the current state of play. *Health Policy* 1996;37:53–72.
- [25] Grewal I, Lewis J, Flynn T, et al. Developing attributes for a generic quality of life measure for older people: preferences or capabilities? *Soc Sci Med* 2006;62:1891–901.
- [26] De Vries J, Van Heck GL. *De Nederlandse Versie van de WHOQOL-100 [The Dutch version of the WHOQOL-100]*. Tilburg: Tilburg University, 1995.
- [27] WHOQOL Group. Development of the World Health Organization WHOQOL-BREF quality of life assessment. *Psychol Med* 1998;28:551–8.
- [28] Lamers SMA, Westerhof GJ, Bohlmeijer ET, et al. Evaluating the psychometric properties of the Mental Health Continuum-Short Form (MHC-SF). *J Clin Psychol* 2011;67:99–110.
- [29] Diener E, Wirtz D, Tov W, et al. New measures of well-being: flourishing and positive and negative feelings. *Soc Indic Res* 2010;39:247–66.
- [30] Diener E, Emmons RA, Larsen RJ, Griffin S. The Satisfaction with Life Scale. *J Pers Assess* 1985;49:71–5.

- [31] Veenhoven R. Overall satisfaction with life. In: Glatzer W, ed. *The Global Handbook of Wellbeing*. New York, NY: Springer, 2012.
- [32] Veenhoven R. Welbevinden in Nederland [Wellbeing in the Netherlands]. *Speling* 2011;63:8–12.
- [33] Holgado-Tello FP, Chacón-MoscOSO S, Barbero-García I, Vila-Abad E. Polychoric versus Pearson correlations in exploratory and confirmatory factor analysis of ordinal variables. *Qual Quant* 2010;44:153–66.
- [34] Horn JL. A rationale and test for the number of factors in factor analysis. *Psychometrika* 1965;30:179–85.
- [35] Muthén LK, Muthén BO *Mplus: Statistical Analysis with Latent Variables: User's Guide (Version 3)*. Los Angeles, CA: Muthén & Muthén.
- [36] R Core Team. *R: A Language and Environment for Statistical Computing [Software]*. Vienna, Austria: R Foundation for Statistical Computing, 2014.
- [37] Revelle W. *Psych: Procedures for Personality and Psychological Research [Software]*. Evanston, IL: Northwestern University, 2014.
- [38] Pett MA, Lackey NR, Sullivan JJ. *Making sense of factor analysis: the use of factor analysis for instrument development in health care research*. Thousand Oaks, CA: Sage, 2003.
- [39] Dolan P. Modeling valuations for EuroQol health states. *Med Care* 1997;35:1095–108.
- [40] Shaw JW, Johnson JA, Coons SJ. US valuation of the EQ-5D health states: development and testing of the D1 valuation model. *Med Care* 2005;43:203–20.
- [41] Craig BM, Pickard AS, Stolk E, Brazier JE. US valuation of the SF-6D. *Med Decis Making* 2013;33:793–803.
- [42] Brazier J, Roberts J, Deverill M. The estimation of a preference-based measure of health from the SF-36. *J Health Econ* 2002;21:271–92.
- [43] Curtis JR, Patrick DL, Engelberg RA, et al. A measure of the quality of dying and death: initial validation using after-death interviews with family members. *J Pain Symptom Manage* 2002;24:17–31.
- [44] Yun YH, Kim SH, Lee KM, et al. Patient-reported assessment of quality care at end of life: development and validation of Quality Care Questionnaire-End of Life (QCQ-EOL). *Eur J Cancer* 2006;42:2310–7.
- [45] Boivin J, Takefman J, Braverman A. The fertility quality of life (FertiQoL) tool: development and general psychometric properties. *Hum Reprod* 2011;26:2084–91.
- [46] Goranitis I, Coast J, Al-Janabi H. An investigation into the construct validity of the Carer Experience Scale (CES). *Qual Life Res* 2014;23:1743–52.
- [47] Burckhardt CS, Anderson KL. The Quality of Life Scale (QOLS): reliability, validity, and utilization. *Health Qual Life Outcomes* 2003;1:60.