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Age-stratified validation of the Functional Assessment of Chronic Illness Therapy-Spiritual Well-Being based on a large cohort of Danish cancer survivors

Age-stratified validation of the FACIT-Sp on Danish cancer survivors

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Keywords

Cancer; Oncology; FACIT-Sp; Well-being; Spirituality; Danish; Factor analysis

Abstract

Objective: Previous research indicate that the FACIT-Sp instrument is susceptible to bias when measuring spiritual well-being in older patients. Our first focus was to evaluate the 2-factor vs. the 3-factor model of the FACIT-Sp and our second focus was to explore how these models behave for different age groups.

Methods: We used a large national cohort of Danish cancer patients (N=3,439) which included a significant number of patients aged at least 70 years (N=1,033). Item-test correlations and factor analyses were conducted on complete cases (N=2,820). Additionally, a reliability analysis was performed using Cronbach's alpha and Guttman's lower-bound estimate.

Results: Factor analysis revealed a loading pattern for the oldest age group (70+) showing items on peace and meaning loading into a single factor, as originally proposed in the 2-factor model. The loading estimates for the patients younger than 70 matched the 3-factor model. Furthermore, item-test correlations changed as age increased. Based on Cronbach's alpha and Guttman's estimate of 0.83 and 0.89, respectively, total scores proved reliable. Items 4, 8 and 12 are discussed separately concerning their problematic influence on instrument validity in their current formulation.

Conclusion: Overall, the 3-factor model had a good fit; however, for the eldest patients a 2-factor solution proved even better. Interpretation of FACIT-Sp sub-scale scores of older cancer patients must therefore be done with caution.

Introduction

Understanding and supporting dimensions of spiritual well-being in cancer patients are important in cancer rehabilitation and palliative care (1, 2). Religious/spiritual (R/S) dimensions in cancer coping have been examined in both cross-sectional and longitudinal studies, (3) with findings pointing towards a positive effect on experienced meaning and reduced suffering despite methodological discrepancies. Despite methodological discrepancies, meta-analyses have found modest but positive effects on cancer patients' physical and mental health (4, 5).

Spiritual well-being is a subset of general well-being, and several instruments are available for clinical use. Among those instruments is the Functional Assessment of Chronic Illness Therapy-Spiritual well-being (FACIT-Sp), which is a validated 12-item questionnaire for adults with cancer and other chronic illnesses. The FACIT-Sp was originally proposed as a 2-factor model by Peterman in 2002 (6), covering two subscales: an 8-item "meaning/peace" component and a 4-item "faith" component (6). A revision of the scale structure resulting in a 3-factor model in 2008 by Canada (7) has since been widely accepted (8-11). The revision introduced a factor solution with the subscales "meaning", "peace", and the original "faith". The "meaning" factor captures cognitive dimensions of spiritual well-being, whereas the "peace" component includes a more affective component. The instrument has been translated and linguistically validated in many languages including Danish (12).

However, this questionnaire may perform differently in subpopulations, such as older people. A study of older patients admitted to a geriatric rehabilitation found that half of the patients expressed difficulties answering questions about meaning and purpose. Half of patients with a high total score but low scores on Item 5 (Sense of purpose) explained the latter due to their high age. The authors thus suspect FACIT-Sp might systematically underestimate spiritual well-being in older patients (13).

In this study we analyze the FACIT-Sp responses from a cohort of cancer survivors. We had two foci: first, to validate the 2-factor and 3-factor models of FACIT-Sp in this Danish sample; second, to explore if these models behaved differently across age groups.

Materials and methods

Subjects were participants in a large national survey of cancer rehabilitation among survivors 14 months after being diagnosed with cancer for the first time (N=3,459). This cohort included patients with a broad range of cancer types, stages, and prognosis, all diagnosed from 1 October 2007 to 30 September 2008. See Holm et al. for a detailed description of the cohort (14-16).

Patients were identified using the Danish Cancer Registry (17). Vital status and postal address were confirmed by linkage to the Civil Registration System (18), and a 171-item questionnaire including the FACIT-Sp-Danish was sent in a prepaid envelope (6, 19). Patients were asked to think back on the last week when scoring. Available responses were 'not at all', 'a little bit', 'somewhat', 'quite a bit' and 'very much'. All items were scored 0 to 4. Answers of items 4 and 8 were recoded reversely. A total score, ranging from 0 to 48, was calculated by adding all item scores. High scores indicated high spiritual well-being.

Questionnaire items are presented in Supplemental Table S1 including both the original English text and the Danish translation used in this study.

We described participants and analyzed missing values. We chose not to perform imputation and restricted all further analyses to complete cases. Besides item characteristics (mean, standard deviation, numbers and percentages of single answer categories), a discrimination index (DI) was calculated for each item. DIs were calculated as the difference of mean item score between the participants from the upper and lower third of the sum scores, respectively, divided by the estimated pooled standard deviation of the item (20). DI is thus a validity measure of a specific item, where higher values of the index indicate greater ability to discriminate between those who score lowest versus those who score highest on the total instrument. We inspected item-test correlations using Pearson coefficients for each item in relation to the rest score (i.e. the total score subtracted the value of the item currently assessed).

Instrument reliability was assessed using Cronbach's alpha and Guttman's lower-bound reliability estimate (21).

Age groups were defined as tertiles by dividing the sample population into three groups, 18-59 (N=1,142), 60-69 (N=1,264), and 70+ (N=1,033) years.

Overall structure was examined with exploratory factor analysis (varimax rotation). Estimates for both a 2-factor (6) and 3-factor (7) solution were examined, as well as estimates for the age groups. Uniqueness values were reported; they describe the part of variance for the variable that was not explained by the common factors. As sensitivity analysis, corresponding analyses based on polychoric correlations were performed.

Finally, confirmatory factor analysis (CFA) was performed on complete cases and separately for age groups. We used Stata's framework of structural equation models (*sem*). We compared model fit using the following goodness-of-fit indices: Satorra-Bentler χ^2 , root mean squared error of approximation (RMSEA), both Akaike and Bayesian information criteria (AIC, BIC), the Tucker-Lewis index (TLI), the comparative fit index (CFI) and the standardized root mean squared residual (SRMR). Cut-off for good fit were <0.08 for RMSEA, ≥ 0.95 for TLI, ≥ 0.9 for CFI, and SRMR < 0.08. The choice of indices was based on comparability with previous validation studies. Since the chosen models were not nested, direct comparison, e.g. by likelihood-ratio test, was not feasible.

Stata 16 was used for statistical analyses. P-values below 0.05 were considered statistically significant, and 95% confidence intervals (CI) are shown in parentheses.

Results

Among 4,947 eligible subjects, 3,439 returned the questionnaire (70%) (14). In total, 619 (18.0%) did not answer all items of the FACIT-Sp, including 323 (9.4%) who had 3 or more missing responses. Participant characteristics are presented in Table 1.

Item 2 (Reason for living) had the lowest missing rate (0.22%), all other missing rates were close to 1%. Missing values were distributed equally across age and gender, although 10 patients aged 70+ omitted item 7 (Harmony) which was more frequent than younger patients (respectively 4 and 2), χ^2 10.48, df=2, P=0.005. 2,820 (82.0%) participants completed all items (Supplemental table S2). Item 12 (Things will be okay) was responsible for 32.5% of all missing values.

Mean item scores and standard deviations are shown in Supplemental Table S2. The responses of items 1 to 8 were negatively skewed, while the responses of items 9 to 12 were positively skewed with lower mean

scores. Discrimination indices varied between 0.8 and 1.6, with the weakest scores belonging to items 2 (0.9), 4 (0.9) and 8 (0.8), indicating that these items have poorer ability to discriminate between participants with the highest versus lowest sum scores.

We performed item-test correlations, where item correlations were estimated in relation to the rest score and in relation to its relevant subscale (both 2-factor and 3-factor models were considered) (Supplemental material – Table S3). We generally found moderate to strong item-test correlations (between 0.4 and 0.8), although the two reversed items (4 and 8) as well as item 12 showed weaker correlations to the total rest score, 0.30 (0.26-0.33), 0.29 (0.25-0.32) and 0.39 (0.36-0.42), respectively. However, with values of 0.43 (0.40-0.46) and 0.42 (0.39-0.45), items 4 and 8 correlated moderately to the rest-score of the Meaning/Peace factor in the 2-factor model.

Cronbach's alpha was 0.83 for the total score and 0.79, 0.71, and 0.84 for the subscores peace, meaning, and faith, respectively. Guttman's lower bound reliability estimate for the total score was 0.89, and for the subscores 0.82, 0.70, and 0.87, respectively.

For the 2-factor model, we found that items generally had lower factor loadings on the meaning/peace factor (Factor 1) compared to the items loading on the faith factor (Factor 2). An exception was item 12 that did not load clearly on any of the factors. Correspondingly, uniqueness values were above 0.7 for items 3, 4, 8, and 12 (Table 2).

In the 3-factor model, we also observed uniqueness values above 0.7 for items 4 (reversed), 8 (reversed), and 12, but not item 3. Item 8 (reversed), considered part of the meaning factor, loaded more on the peace than meaning factor. Items 8 and 12 did not load clearly onto a single factor (Table 2).

Goodness-of-fit indices of the CFA are reported in Supplemental table S4. Comparing the 3-factor model to the 2-factor model for the entire sample, the 3-factor model showed a slightly better fit on indices RMSEA (0.087 compared to 0.116), and AIC (85.910 compared to 86,826). Leaving out the 'problematic' items 4, 8, and 12 in a modified model (F3-Removed), we measured an even better fit (RMSEA 0.060 and AIC 60,675).

Age-stratified analyses

Analyzing item-test correlations by age group, we found that the two reversed items, 4 and 8, generally showed worse correlations with their subscales (Peace and Meaning, respectively) in the 3-factor model for higher ages. The correlation values of 0.48 (0.43-0.53) and 0.41 (0.36-0.46) for the young age group (18-59 years) decreased to 0.39 (0.34-0.44) and 0.33 (0.27-0.38) for the middle age group (60-69 years), and to 0.30 (0.23-0.36) and 0.26 (0.19-0.33) for the eldest. A reverse pattern was found in the item-test correlations of item 12 with its subscale (Faith), namely higher coefficients for higher age groups: 0.28 (0.22-0.34) for the youngest age group compared to 0.42 (0.35-0.47) for the eldest age group (Supplemental material – S5).

Factor loadings differed for the eldest age group (70+). The peace-related items (items 1, 6, and 7) loaded more on the meaning-factor for this age group. Items 2, 3, and 5 (which conceptually "belong" to the meaning factor) loaded slightly more on the peace factor for the younger group than for the eldest. Especially item 12 showed poor factor loadings, although the picture was a bit clearer for the oldest age group where the item loaded into the expected faith factor (loading 0.4). For the middle age group, item 8 loaded almost equally on the peace and meaning factor (Table 3). We also included a sensitivity analysis,

testing the above-mentioned factor analyses using polychoric correlations, and the results were very similar to our initial analysis (not shown).

Comparing the 2-factor and 3-factor models of the eldest participants in a CFA (i.e. models named 'F2-70+' and 'F3-70+' in the table) to the 2-factor and 3-factor models in the total population (i.e. 'F2' and 'F3'), we found equal model fit with respect to the RMSEA indices, 0.114 vs. 0.116 and 0.088 vs. 0.087. But the models proved more parsimonious, with AIC estimates of 23,791 vs. 86,826 and 23,578 vs. 85,910 (Supplemental table S5).

Discussion

This study investigated the psychometric properties of FACIT-Sp-Danish. We hypothesized that the instrument would perform differently for older patients compared to younger patients. Both the 2-factor and 3-factor model were fair representations of the data in the non-age-stratified sample, but when taking age into account, factor loadings behaved differently for the oldest age group. Loading estimates for the young and middle-aged groups matched the 3-factor model, while dimensions of peace and meaning seemed to melt together for the older patients, making the 2-factor model a better match for this age group.

Comparison with other studies

The initial selection of questions and validation of the scale by Peterman in 2002 (6) included 16.9% HIV patients. Historically, HIV patients have differed in several demographic characteristics compared to cancer patients (i.e. age, gender, sexuality, social isolation, feelings of guilt and/or shame). The existential challenges of HIV patients are likely to differ from those of cancer patients. Peterman (6) showed significantly lower scores for HIV patients than cancer patients on both the meaning/peace and the faith factor. One can speculate if factor composition had been different in the initial proposal by Peterman et al. (6) if it had been based exclusively on cancer patients like our study.

After Canada (7) proposed the 3-factor model in 2008 it has been confirmed in several cancer populations (8, 22-25). Generally, these studies lack cancer patients of high age. Mean age (SD) was reported by Jafari 46.8 (15.1), Lazenby 46.5 (13.7), Bai 59.6 (12.2), and Murphy 62.7 (11.9) (8, 22, 23, 25). Akturk (24) did not report the overall mean age, but age groups were reported of which the eldest (aged 62-79 years) only comprised 31 patients. However, none of these studies reported age stratified analysis of the loading estimates. Although Murphy (8) included many patients above 70 years, stratified analyses on age groups were not performed and challenges fitting the 3-factor model were mainly explained with reference to ethnic and racial differences in the sample (8). Without restricting to cancer cases, Monod (13) validated the FACIT-Sp on a sample of 208 65+ year-old geriatric patients and concluded that the instrument may underestimate spiritual well-being in elderly hospitalized patients.

Our sample included 747 patients aged at least 70 years who completed all 12 items of the instrument. The age-specific factor analysis showed different loading patterns for this age group as compared to the total sample and younger age groups. Items 1, 6, and 7, which are considered part of the peace factor, loaded markedly into the meaning factor. The pattern thus aligned more with the original 2-factor model (6). The concepts of meaning and peace may be experienced as more intertwined by the eldest whose existential concerns are likely to differ from the younger patients. Some age-related factors that could influence

attitudes toward existential concerns are shorter expected lifespan, frequency of losing friends and relatives, and concerns about offspring.

The age relation of the loading patterns may be a result of age differences, historical cohorts, or a combination. If a result of age, the scale behavior of the younger age groups is expected to change when they grow old. If a result of differences between cohorts, then the currently young generation cannot be expected to converge towards the views on religion/spirituality currently held by the 70+ population. Experiences both prior to and during the New Age movement that evolved through the 1960-70's may have influenced the development of a personal spirituality that could have persisted throughout life. In this study we are not able to analyze for historical effects: i.e., whether the differences are caused by time-related cultural and linguistic differences such as chronolects.

Overall, there is both good agreement with Peterman's (6) findings with respect to the 2-factor model across all age groups and with Canada's (7) findings with respect to the 3-factor model, even though Canada (7) used a different rotation method (promax instead of varimax).

Problematic items

The reverse-worded items (RWI) 4 and 8 showed low loadings in the factor analysis and high degrees of uniqueness (above 0.7), which could indicate that they measure something different from the remaining items. RWI have a long history within psychometry. RWI help researchers detect if respondents have read and understood specific items by including both reverse and non-reverse items, making it possible to detect if respondents uncritically agree or disagree with all questions (i.e. acquiescence response bias) (26). Over the last decades the use of RWI has been criticized for compromising unidimensionality and scale validity (27-29). Given that other validation studies have also had difficulties validating these reversed items in the FACIT-Sp, we raise our concerns about the current formulation of these items and their added value to the scale.

Item 12 (Things will be okay) showed to be omitted to a higher degree than the other items. Simply, as the last item of a scale it may be more susceptible to skipping than the others due to respondent fatigue. Based on the total data set, item 12 did not load into any specific factor. However, following age stratification we found increasing loading into the Faith component by age, with a maximum value of 0.4 of the oldest group. Our item-test correlation tests further confirmed this finding. Unspecific loadings of item 12 is in line with a study by Bai (25) showing loading into the Peace factor (0.56) and not into the Faith factor (0.09) (30). Furthermore, based on poor item loadings, Murphy (8) suggested replacing item 12 with an item from another scale, the American Cancer Society's Study of Cancer Survivors-II (ACS SCS-II): "*My faith or spirituality has helped me through my cancer experience*" (8). For the Danish context, we agree that this alternative item 12 could prove more reliable and lift the face validity of the instrument.

Study Limitations

Holm (14) addressed a potential selection bias in the cohort but concluded that the influence was negligible and found the cohort representable for Danish cancer patients alive 14 months after diagnosis.

No gender differences were observed, but age differed between complete versus incomplete cases. Regardless of age and gender, participants skeptical of religiosity and spirituality may have been more likely

to leave out one or more of these questions. However, we were not able to test for the potential influence of attitudes toward R/S on incompleteness.

Restricting several of our analyses to participants with complete answers of the FACIT-Sp may have introduced non-response bias. There is no consensus on how to manage missing values when validating this scale and details about handling of missing values and/or the magnitude of imputation models are often missing in validation studies, although exceptions exist (8).

Not all validation studies reported clearly how the scale values were calculated, and thus comparisons between studies must be made with caution.

Clinical Implications

In conclusion, we find the 3-factor model most suitable for young and middle-aged cancer patients, and found evidence suggesting that a 2-factor model might be the most appropriate for elderly patients.

For clinical use, 3-factor scores separating peace and meaning should be interpreted with caution for elderly patients, and we recommend that total sum-scores are always reported.

Future validation studies should take into consideration the items 4, 8, and 12 as potentially problematic items of the scale, and we highly recommend inclusion of age-stratified analyses.

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Conflict of interests

None.

Ethics

This project follows EU data protection rules (GDPR) and the Helsinki Declaration. University of Southern Denmark approved data processing activities (reg.nr 10.043). Participants were informed about their anonymity and right to withdraw at any time. Submitting the questionnaire equaled written consent. According to the Regional Scientific Ethics Committee, the Biomedical Research Ethics Committee System Act does not apply to this project.

Data Availability Statement

Data from the Danish Cancer Registry and the Civil Registration System are available from the Danish National Health and Medicines Authority (<http://www.sst.dk>) for researchers who meet the criteria.

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Tables

Table 1: Clinical and sociodemographic characteristics of the original study population, incomplete cases, and complete cases.

	Study population	Incomplete cases	Complete cases
	3,439 (100.0)	619 (100.0)	2,820 (100.0)
Gender			
Male	1,466 (42.6)	251 (40.5)	1,215 (43.1)
Female	1,973 (57.4)	368 (59.5)	1,605 (56.9)
Age group (years)			
18-59	1142 (33.2)	146 (23.6)	996 (35.3)
60-69	1264 (36.8)	187 (30.2)	1077 (38.2)
70+	1033 (30.0)	286 (46.2)	747 (26.5)
Cancer diagnosis			
Breast	976 (28.4)	170 (27.5)	806 (28.6)
Prostate	501 (14.6)	91 (14.7)	410 (14.5)
Colo-rectal	522 (15.2)	88 (14.2)	434 (15.4)
Gynecological	230 (6.7)	41 (6.6)	189 (6.7)
Malignant melanoma	233 (6.8)	44 (7.1)	189 (6.7)
Lung	188 (5.5)	41 (6.6)	147 (5.2)
Lymphoma	104 (3.0)	14 (2.3)	90 (3.2)
Head and neck	125 (3.6)	21 (3.4)	104 (3.7)
Others	560 (16.3)	109 (17.6)	451 (16.0)
Civil status			
Married	1,787 (52.0)	296 (47.8)	1,491 (52.9)
Cohabitant	202 (5.9)	30 (4.8)	172 (6.1)
Single (not previously married or cohabitant)	85 (2.5)	10 (1.6)	75 (2.7)
Single (divorced, separated or previous cohabitant)	251 (7.3)	30 (4.8)	221 (7.8)
Single (widow or widower)	305 (8.9)	64 (10.3)	241 (8.5)
Unanswered	809 (23.5)	189 (30.5)	620 (22.0)
Income			
Under DKK 100.000	107 (3.1)	34 (5.5)	73 (2.6)
DKK 100.000 - 249.000	854 (24.8)	148 (23.9)	706 (25.0)
DKK 250.000 - 449.000	757 (22.0)	97 (15.7)	660 (23.4)
DKK 450.000 - 700.000	468 (13.6)	58 (9.4)	410 (14.5)
Over DKK 700.000 kr.	239 (6.9)	34 (5.5)	205 (7.3)
Unanswered	1,014 (29.5)	248 (40.1)	766 (27.2)

Table 2 - Factor loadings and uniqueness values from exploratory factor analysis (varimax rotation), two factors and three factors, based on complete cases (N=2,820). Loading values above .4 in bold.

Item	2-factor model			3-factor model			
	Meaning/Peace	Faith	Uniqueness	Meaning	Peace	Faith	Uniqueness
1:Peaceful	0.65	0.23	0.52	0.20	0.65	0.22	0.48
2:Reason for living	0.58	0.04	0.67	0.65	0.25	0.05	0.51
3:Productive life	0.54	0.05	0.71	0.48	0.32	0.06	0.66
4:Trouble feeling peace of mind*	0.47	-0.04	0.78	0.06	0.53	-0.06	0.71
5:Sense of purpose	0.67	0.13	0.53	0.65	0.37	0.14	0.43
6:Comfort	0.71	0.20	0.46	0.28	0.67	0.19	0.44
7:Harmony	0.79	0.21	0.33	0.25	0.79	0.19	0.27
8:Lack of meaning and purpose*	0.46	-0.05	0.78	0.25	0.39	-0.05	0.78
9:Comfort in belief	0.11	0.95	0.09	0.04	0.12	0.94	0.09
10:Strength in belief	0.12	0.95	0.08	0.05	0.11	0.95	0.08
11:Strength by illness	0.06	0.77	0.40	0.06	0.04	0.77	0.40
12:Things will be okay	0.25	0.35	0.82	0.03	0.28	0.34	0.80

* Reversed.

Table 3 – Results of exploratory factor analysis (varimax rotation), restricted to three factors. Factor loadings values are shown for three age groups. Factor loadings above .4 in bold.

Item	Factor 1 (Meaning)			Factor 2 (Peace)			Factor 3 (Faith)		
	18-	60-	70+	18-	60-	70+	18-	60-	70+
1:Peaceful	0.16	0.26	0.50	0.67	0.61	0.49	0.16	0.18	0.27
2:Reason for living	0.64	0.67	0.70	0.23	0.26	0.06	0.09	0.07	0.06
3:Productive life	0.41	0.59	0.59	0.37	0.25	0.07	0.01	0.07	0.07
4:Trouble feeling peace of mind*	0.19	0.06	0.13	0.55	0.51	0.51	-0.08	-0.02	-0.07
5:Sense of purpose	0.66	0.62	0.73	0.36	0.40	0.11	0.12	0.14	0.21
6:Comfort	0.22	0.24	0.57	0.70	0.71	0.40	0.14	0.19	0.27
7:Harmony	0.20	0.23	0.60	0.82	0.82	0.50	0.12	0.20	0.26
8:Lack of meaning and purpose*	0.38	0.24	0.22	0.40	0.38	0.35	-0.05	-0.03	-0.06
9:Comfort in belief	0.03	0.04	0.12	0.08	0.12	0.07	0.95	0.95	0.93
10:Strength in belief	0.04	0.05	0.12	0.10	0.12	0.06	0.95	0.96	0.93
11:Strength by illness	0.06	0.08	0.10	-0.00	0.05	0.00	0.78	0.76	0.76
12:Things will be okay	0.01	0.03	0.20	0.29	0.24	0.24	0.27	0.29	0.40

* Reversed.

Supplemental material

Table S1: Contents of the 'Functional Assessment of Chronic Illness Therapy-Spiritual Well-Being' instrument. English and Danish versions.

Item	English	Danish	Factor**
1	I feel peaceful	Jeg føler mig fredfyldt	Peace
2	I have a reason for living	Jeg har grund til at leve	Meaning
3	My life has been productive	Jeg har haft et produktivt liv	Meaning
4*	I have trouble feeling peace of mind	Jeg har svært ved at føle fred i sindet	Peace
5	I feel a sense of purpose in my life	Jeg føler en mening med livet	Meaning
6	I am able to reach down deep into myself for comfort	Jeg er i stand til at finde trøst dybt inde i mig selv	Peace
7	I feel a sense of harmony within myself	Jeg har følelse af indre harmoni	Peace
8*	My life lacks meaning and purpose	Mit liv savner mening og formål	Meaning
9	I find comfort in my faith or spiritual beliefs	Jeg finder trøst i min tro eller i mine åndelige overbevisninger	Faith
10	I find strength in my faith or spiritual beliefs	Jeg finder styrke i min tro eller i mine åndelige overbevisninger	Faith
11	My illness has strengthened my faith or spiritual beliefs	Min sygdom har styrket min tro eller mine åndelige overbevisninger	Faith
12	I know whatever happens with my illness, things will be okay	Jeg ved, at ligegyldigt hvad der sker med min sygdom, så vil alt være ok	Faith

* Reversed items. ** Based on the 3 factors proposed by Canada et al (2008).

Table S2. Item response analysis, mean scores and response characteristics. Missings are based on 3,116 participants, whereas other columns are based on complete cases (N=2,820). Discrimination index (DI) is calculated as the difference of mean item score of the third of participants who score highest and lowest, divided by the estimated pooled standard deviation of the item.

Item	Missing N (%)	Mean (SD)	Category of response N (%)					DI
			0	1	2	3	4	
1:Peaceful	34 (1.1)	2.4 (1.1)	184 (6.5)	394 (14.0)	871 (30.9)	823 (29.2)	548 (19.4)	1.6
2:Reason for living	7 (0.2)	3.7 (0.7)	19 (0.7)	35 (1.2)	140 (5.0)	437 (15.5)	2189 (77.6)	0.9
3:Productive life	17 (0.5)	3.4 (0.9)	31 (1.1)	75 (2.7)	285 (10.1)	683 (24.2)	1746 (61.9)	1.0
4:Trouble feeling peace of mind*	23 (0.7)	3.2 (1.1)	83 (2.9)	186 (6.6)	418 (14.8)	669 (23.7)	1464 (51.9)	0.9
5:Sense of purpose	14 (0.4)	3.4 (0.9)	47 (1.7)	89 (3.2)	290 (10.3)	636 (22.6)	1758 (62.3)	1.3
6:Comfort	22 (0.7)	2.6 (1.1)	137 (4.9)	303 (10.7)	716 (25.4)	937 (33.2)	727 (25.8)	1.5
7:Harmony	16 (0.5)	2.6 (1.1)	152 (5.4)	318 (11.3)	780 (27.7)	900 (31.9)	670 (23.8)	1.6
8:Lack of meaning and purpose*	12 (0.4)	3.5 (1.0)	71 (2.5)	104 (3.7)	205 (7.3)	384 (13.6)	2056 (72.9)	0.8
9:Comfort in belief	33 (1.1)	1.4 (1.4)	1099 (39.0)	575 (20.4)	422 (15.0)	344 (12.2)	380 (13.5)	1.6
10:Strength in belief	32 (1.0)	1.4 (1.4)	1123 (39.8)	553 (19.6)	424 (15.0)	358 (12.7)	362 (12.8)	1.6
11:Strength by illness	21 (0.7)	1.0 (1.3)	1466 (52.0)	507 (18.0)	345 (12.2)	267 (9.5)	235 (8.3)	1.3
12:Things will be okay	111 (3.6)	1.6 (1.5)	1034 (36.7)	292 (10.4)	661 (23.4)	390 (13.8)	443 (15.7)	1.2
Total			5,446 (16.1)	3,431 (10.1)	5,557 (16.2)	6,828 (20.2)	12,578 (37.2)	

* Reversed.

Table S3. Estimated item-test correlation coefficients (r , Pearson) with 95% confidence intervals (CI), where the item was removed from the scale in question.

Item	Total scale (95% CI)	Faith	Meaning	Peace	Meaning/Peace
	r (95% CI)	r (95% CI)	r (95% CI)	r (95% CI)	r (95% CI)
1:Peaceful	0.6 (0.6-0.6)			0.6 (0.6-0.7)	0.6 (0.6-0.6)
2:Reason for living	0.4 (0.4-0.4)		0.6 (0.6-0.6)		0.5 (0.5-0.5)
3:Productive life	0.4 (0.4-0.4)		0.5 (0.4-0.5)		0.5 (0.5-0.5)
4:Trouble feeling peace of mind*	0.3 (0.3-0.3)			0.4 (0.4-0.4)	0.4 (0.4-0.5)
5:Sense of purpose	0.5 (0.5-0.5)		0.6 (0.6-0.6)		0.6 (0.6-0.6)
6:Comfort	0.6 (0.6-0.6)			0.6 (0.6-0.7)	0.6 (0.6-0.7)
7:Harmony	0.7 (0.6-0.7)			0.8 (0.8-0.8)	0.7 (0.7-0.8)
8:Lack of meaning and purpose*	0.3 (0.3-0.3)		0.3 (0.3-0.4)		0.4 (0.4-0.4)
9:Comfort in belief	0.6 (0.6-0.6)	0.8 (0.8-0.8)			
10:Strength in belief	0.6 (0.6-0.6)	0.8 (0.8-0.8)			
11:Strength by illness	0.5 (0.4-0.5)	0.7 (0.7-0.7)			
12:Things will be okay	0.4 (0.4-0.4)	0.3 (0.3-0.4)			

* Reversed items.

Table S4 – Goodness-of-fit indices based on confirmatory factor analysis (structural equation models) for both the 2-factor (F2) and 3-factor (F3) analysis. For comparison, a 3-factor model was estimated, where items 4, 8 and 12 were removed (F3-removed). Separate models were estimated for the 70+ population (N=747), F2-70+ and F3, 70+.

Model	SB scaled Chi2 (df)	RMSEA (90% CI)	AIC	BIC	TLI_SB	CFI_SB	SRMR
F2	1859 (53)*	.116 (.112-.120)	86826	87046	.859	.887	.082
F3	1055 (51)*	.087 (.083-.091)	85910	86142	.918	.937	.070
F3-Removed	263	.060 (.054-.067)	60675	60853	.975	.983	.033
F2-70+	534 (53)*	.114 (.105-.122)	23791	23962	.862	.889	.084
F3-70+	335 (51)*	.088 (.080-.097)	23578	23758	.915	.934	.075

* P-value <.0001

Table S5. Item-test correlations, by age group. Estimated item-test correlation coefficients (r , Pearson) with 95% confidence intervals (CI), where the item score was removed.

Group: 18-59						
Item	Estimated item-scale correlation (95% CI): Pearson	Spearman (95% CI)	Faith*	Meaning*	Peace*	Meaning/Peace
1:Peaceful	0.58 (0.53-0.62)	0.58 (0.54-0.62)			0.63 (0.59-0.67)	0.61 (0.57-0.65)
2:Reason for living	0.42 (0.37-0.47)	0.40 (0.35-0.46)		0.56 (0.51-0.60)		0.48 (0.43-0.53)
3:Productive life	0.37 (0.32-0.42)	0.37 (0.31-0.42)		0.44 (0.39-0.49)		0.48 (0.43-0.52)
4:Trouble feeling peace of mind**	0.35 (0.29-0.40)	0.37 (0.31-0.42)			0.48 (0.43-0.53)	0.51 (0.46-0.55)
5:Sense of purpose	0.52 (0.48-0.57)	0.50 (0.45-0.54)		0.60 (0.56-0.64)		0.59 (0.55-0.63)
6:Comfort	0.58 (0.54-0.62)	0.58 (0.54-0.62)			0.63 (0.60-0.67)	0.64 (0.60-0.68)
7:Harmony	0.64 (0.60-0.67)	0.63 (0.59-0.66)			0.77 (0.75-0.80)	0.74 (0.71-0.76)
8:Lack of meaning and purpose**	0.35 (0.30-0.40)	0.40 (0.34-0.45)		0.41 (0.36-0.46)		0.49 (0.44-0.54)
9:Comfort in belief	0.50 (0.46-0.55)	0.48 (0.43-0.53)	0.81 (0.79-0.83)			
10:Strength in belief	0.53 (0.48-0.57)	0.50 (0.45-0.55)	0.83 (0.81-0.85)			
11:Strength by illness	0.41 (0.36-0.46)	0.37 (0.31-0.42)	0.72 (0.69-0.75)			
12:Things will be okay	0.35 (0.29-0.40)	0.33 (0.27-0.38)	0.28 (0.22-0.34)			
Group: 60-69						
Item	Estimated item-scale correlation (95% CI): Pearson	Spearman (95% CI)	Faith*	Meaning*	Peace*	Meaning/Peace
1:Peaceful	0.56 (0.52-0.60)	0.54 (0.50-0.58)			0.62 (0.58-0.65)	0.61 (0.57-0.64)
2:Reason for living	0.42 (0.37-0.47)	0.38 (0.33-0.43)		0.62 (0.58-0.65)		0.53 (0.48-0.57)
3:Productive life	0.38 (0.32-0.43)	0.33 (0.28-0.38)		0.50 (0.45-0.54)		0.46 (0.42-0.51)
4:Trouble feeling peace of mind**	0.30 (0.24-0.35)	0.32 (0.26-0.37)			0.39 (0.34-0.44)	0.42 (0.37-0.46)
5:Sense of purpose	0.53 (0.49-0.58)	0.50 (0.46-0.55)		0.60 (0.56-0.64)		0.62 (0.58-0.65)
6:Comfort	0.59 (0.55-0.63)	0.57 (0.53-0.61)			0.65 (0.61-0.68)	0.65 (0.61-0.68)
7:Harmony	0.67 (0.63-0.70)	0.64 (0.60-0.67)			0.78 (0.75-0.80)	0.74 (0.72-0.77)
8:Lack of meaning and purpose**	0.29 (0.23-0.34)	0.34 (0.29-0.40)		0.33 (0.27-0.38)		0.41 (0.36-0.46)
9:Comfort in belief	0.58 (0.54-0.62)	0.57 (0.53-0.61)	0.81 (0.79-0.83)			
10:Strength in belief	0.59 (0.55-0.63)	0.58 (0.54-0.62)	0.83 (0.81-0.85)			
11:Strength by illness	0.49 (0.45-0.54)	0.46 (0.42-0.51)	0.72 (0.69-0.75)			
12:Things will be okay	0.33 (0.28-0.38)	0.33 (0.27-0.38)	0.30 (0.25-0.35)			

Group: 70+						
Item	Estimated item-scale correlation (95% CI): Pearson	Spearman (95% CI)	Faith*	Meaning*	Peace*	Meaning/Peace
1:Peaceful	0.64 (0.60-0.68)	0.62 (0.58-0.67)			0.65 (0.60-0.69)	0.65 (0.61-0.69)
2:Reason for living	0.44 (0.38-0.50)	0.37 (0.31-0.43)		0.60 (0.56-0.65)		0.56 (0.51-0.61)
3:Productive life	0.39 (0.33-0.45)	0.35 (0.28-0.41)		0.48 (0.42-0.53)		0.48 (0.43-0.54)
4:Trouble feeling peace of mind**	0.20 (0.13-0.27)	0.25 (0.19-0.32)			0.30 (0.23-0.36)	0.32 (0.25-0.38)
5:Sense of purpose	0.58 (0.53-0.62)	0.56 (0.51-0.61)		0.59 (0.54-0.63)		0.62 (0.58-0.66)
6:Comfort	0.61 (0.56-0.65)	0.60 (0.55-0.64)			0.63 (0.59-0.68)	0.64 (0.59-0.68)
7:Harmony	0.66 (0.62-0.70)	0.65 (0.60-0.69)			0.73 (0.70-0.76)	0.72 (0.68-0.75)
8:Lack of meaning and purpose**	0.22 (0.15-0.28)	0.29 (0.22-0.36)		0.26 (0.19-0.33)		0.33 (0.27-0.40)
9:Comfort in belief	0.63 (0.58-0.67)	0.62 (0.58-0.66)	0.83 (0.81-0.85)			
10:Strength in belief	0.62 (0.58-0.67)	0.61 (0.57-0.66)	0.83 (0.80-0.85)			
11:Strength by illness	0.51 (0.46-0.56)	0.48 (0.42-0.54)	0.73 (0.69-0.76)			
12:Things will be okay	0.47 (0.41-0.52)	0.46 (0.40-0.52)	0.42 (0.35-0.47)			

* Estimated item-scale correlations (Pearson). ** Item scores reversed.