Measuring mental well-being in Denmark: Validation of the original and short version of the Warwick-Edinburgh mental well-being scale (WEMWBS and SWEMWBS) and cross-cultural comparison across four European settings

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ABSTRACT

This study examined the psychometric properties of the Danish WEMWBS and its short version (SWEMWBS) in a Danish population sample, and compared scores in Denmark with scores representative of three other European settings. A total of 3,508 Danish men and women aged 16–95 filled out an electronic survey. Face validity was examined by cognitive interviews. Content validity was assessed by examining response distributions and construct validity by confirmatory factor analysis, measurement invariance, and relations to other or similar measures. Overall mental well-being scores were calculated, as well as stratified by sex and age. Support was found for the single-factor hypothesis, yielding good model fits for both versions of the scale. Both scales have high internal consistency. Correlations with mental health measures were largely in line with expectations. The highest mental well-being scores were reported for Catalonia, followed by Denmark, Iceland, and England. The (S)WEMWBS appear to be appropriate instruments to measure mental well-being in the Danish population. The present findings encourage the use of the scales, particularly SWEMWBS, in epidemiological, intervention and evaluation studies in research and practice. Cross-cultural comparisons like the one reported here may be essential to inform international mental health policy.

1. Introduction

Mental well-being is a concept regarded as encompassing dimensions of hedonic (positive feelings, affect, emotions) and eudemonic (positive functioning, mindset and relationships) well-being (Stewart-Brown, 2013). Over the past decade, interest in the concept of mental well-being has increased along with the recognition of its impact on public health (WHO, 2013). This has led to an increased interest among researchers, policymakers and service providers to improve knowledge about mental well-being measurement and application (Forsman et al., 2015; Huppert, 2014). In spite of mental well-being being closely connected to healthy life years and productivity, how to promote mental well-being has generally been under-researched, partly due to a lack of appropriate population-based measures (Huppert, 2014; Huppert and Whittington, 2003).

The Warwick-Edinburgh Mental Well-being Scale (WEMWBS) was developed in the United Kingdom (UK) to meet the need for a psychometrically robust measure that would enable monitoring of mental well-being in the general population and the evaluation of projects, programs and policies which aim to improve mental well-being (Stewart-Brown, 2015a,b; Tennant et al., 2007). Mental well-being is desirable in its own right and is also a modifiable determinant of

longevity and a protective factor against future disease (Chida and Steptoe, 2008; Siahpush et al., 2008). The scale covers both feeling and functioning aspects of mental well-being which it represents as the positive end of a continuum of mental health. Licenses to use WEMWBS are provided free on application.

The scale is now widely used in the UK and other parts of Europe, where it is considered an appropriate tool to measure mental well-being (Stewart-Brown, 2015a,b). The WEMWBS has been validated in various populations and among different subgroups including adolescents, clinical samples and ethnic minority samples (McKay and Andretta, 2017; Smith et al., 2017; Stewart-Brown, 2015a,b; Stewart-Brown et al., 2011; Trousselard et al., 2016). The scale has been translated into more than a 25 languages including Arabic, Urdu, Japanese and Chinese (Taggart, 2015), and validated in e.g. Norwegian, Swedish, Italian, Dutch, German, French and Spanish (Castellví et al., 2014; Forero et al., 2014; Haver et al., 2015; Smith et al., 2017; Taggart, 2015). Previous validation studies have found that the WEMWBS is considered easy to complete and that it provides a credible measure of mental well-being (Stewart-Brown, 2015a,b). The scale has also been found to be sensitive to the changes which occur in the context of a broad variety of well-being promotion initiatives (Stewart-Brown, 2015a,b).

Some validation studies suggest that item redundancy might be an issue for the WEMWBS leading to the development of the 7-item short WEMWBS (SWEMWBS) (Stewart-Brown et al., 2009). The SWEMWBS is preferred by some researchers in terms of its psychometric properties and convenience for monitoring mental well-being. However, the seven items in the SWEMWBS relate more to functioning than to feeling and therefore offer a slightly different perspective on mental well-being (Stewart-Brown, 2015a,b). When content coverage is an issue, such as in research projects where for example the project or intervention aims to help participants develop their understanding of the concept of mental well-being, gathering data on the full 14-item scale may therefore be preferred (Stewart-Brown et al., 2009).

The (S)WEMWBS is a potentially promising scale for measuring mental well-being in Danish population studies. However, the (S)WEMWBS has not been validated in a Danish context. Validation of a scale in the national context in which it is meant to be used is important in order to ensure its appropriateness in the specific setting. If validity of the (S)WEMWBS) can be ensured in a Danish setting, it would be of immense value as it would: a) provide a tool suitable for measuring mental well-being in population-based samples - in which there is currently a high demand; b) enable mental health promotion practitioners to evaluate their programmes using a practical mental well-being measure; and c) to conduct research on the distributions and predictors of mental well-being in order to inform experts and stakeholders relevant to national and international public mental health policy.

1.1. Aim

The aim of this study is to examine the psychometric properties and validate the original and the short Warwick-Edinburgh Mental Well-Being Scale among a Danish population sample, as well as comparing mental well-being scores in Denmark with scores representative of three other European settings.

2. Methods

2.1. Study design

We used data from a national cross-sectional survey *The Danish Mental Health and Well-being Survey 2016* (Nielsen et al., 2017). The survey was carried out by Statistics Denmark. A random representative sample of Danish men and women aged 16 years and above was drawn from the Danish Civil Registration System. Statistics Denmark sent an electronic letter to the sampled individuals in October 2016 with information about the study and an invitation to participate. After a week a reminder letter was sent, and after yet another week a final reminder was sent.

2.2. Sampling

In total 5,050 men and 5,200 women were contacted. Out of them 1,656 men and 1,852 women responded to the web-based survey resulting in a response rate of 33% for men and 36% for women. In terms of non-response, 5,854 did not respond to the invitation to participate, 463 only partially completed the survey, 183 refused to participate, 3 could not participate due to language barriers, 213 could not participate due to privacy protection, and 26 could not participate due to medical conditions or disability.

2.3. Ethics

There is no formal agency for ethical approval of questionnaire-based survey studies in Denmark. The study complies with the Helsinki 2 declaration on ethics and is registered with the Danish Data Protection Authority, and confidentiality and privacy requirements were met. The participants' voluntary completion and return of the survey questionnaires constituted implied consent.

2.4. Measures

All measures included in this study were self-administered.

2.4.1

(S)WEMWBS: The WEMWBS is a 14-item scale with 5 response categories, with a total score ranging from 14–70. The SWEMWBS consists of 7 items with a total score ranging from 7–35 (see table 2). The items are all positively worded. Respondents are required to describe their experience of each statement over the past two weeks using a 5-point Likert scale ('none of the time', 'rarely', 'some of the time', 'often', 'all of the time'). The overall WEMWBS score is calculated by summing the scores for each item, with equal weights. A higher WEMWBS score therefore indicates a higher level of mental well-being (Tennant et al., 2007). The SWEMWBS is scored similarly by creating a sum score for all the items with final scores transformed to enhance scaling properties (available online) (Stewart-Brown, 2015a,b). Participants were asked to respond to the 14-item scale, of which the same responses were used for the 7-item scale, i.e. participants were not asked to respond to the seven same items twice.

The scale was translated into Danish in line with recommendations set forth by the World Health Organization for the translation and adaptation of scales, which includes 1) forward-translation, 2) expert panel back-translation, 3) pre-testing and cognitive interviewing, and 4) final version. The details of the translation methodology can be found elsewhere (WHO, 2018).

2.4.2. Other measures

Five additional measures were included in this study to assess relations to other variables. The measures were chosen to include similar concepts to the (S)WEMWBS and concepts expected to be associated with mental well-being. The measures included for analysis were:

2.4.2.1. **WHO-5** (Topp et al., 2015) covering overall well-being: 5 items given a score from 0–5, then added up and multiplied by 4, and scored into a continuous scale 0–100, with high scores indicating high levels of mental well-being.

2.4.2.2. **Self-rated health**: Single item for self-rated health which asks respondents to rate their overall health (physical as well as mental), five response categories from poor to excellent ranging from 1–5, higher scores indicate better self-rated health. The question is part of the

Danish national health and morbidity surveys (Christensen et al., 2014).

2.4.2.3. **Discomfort and pain**: Six items for symptoms of discomfort and pain within the past two weeks in; Shoulder or neck; Back or lower back; Arms, hands, legs, knees, hips or joints; Headache; Stomach-ache; Difficulties sleeping. Each item coded 0 = symptom not present, 1 = symptom present. Items added up to a scale ranging from 0–6, with higher scores indicating a higher number of symptoms. The questions are part of the Danish National Health and Morbidity surveys (Christensen et al., 2014).

2.4.2.4. **The Perceived Stress Scale** (PSS) (Cohen et al., 1983) covering perceived stress and coping: 10 items each given a score from 0–4. Positive items reversed, and added up into a scale ranging from 0–40, with higher scores indicating higher levels of perceived stress.

2.4.2.5. **The Patient Health Questionnaire for Depression and Anxiety (**PHQ-4**)**: Data on poor mental health was collected using the PHQ-4 which asks participants about their experience of core depressive and anxiety symptoms over the past two weeks as specified by DSM-IV (Kroenke et al., 2009). There are 4 items for depression/anxiety, each item is given a score from 0–3, then scored into continuous scale 0–12, with higher scores indicating high level of depression/anxiety.

Other variables included in the present study were: sex, age, education, and employment.

2.4.3. Steps of validation and statistical procedures

Validation of the scales examined: 1) the face validity, 2) construct validity assessing goodness of fit and measurement invariance through confirmatory factor analysis, as well as relations to other or similar measures, 3) content validity including distribution of responses and potential floor and ceiling effects, 4) assessment of internal consistency. Quantitative analyses were completed using the statistical package R (R. 2018), and the Lavaan package for structural equation modelling (Rosseel, 2012).

2.4.3.1. Face validity. Cognitive interviewing techniques were used to examine the face validity of the scale (i.e. do people understand the questions in the way they were intended) and how participants process and respond to the scale. Eleven face-to-face interviews were conducted with six men and five women aged 20–77 years. Participants were selected striving for a variation on age, sex and education, attributes known to be associated with mental health and health literacy (Bo et al., 2014; Christensen et al., 2017). Interview data was analysed using the Framework Approach based on the four stages (*comprehension, retrieval, judgement,* and *response*) of Tourangeau et al.'s model for survey response (Tourangeau et al., 2000).

2.4.3.2. Construct validity. Confirmatory factor analysis (CFA) based unweighted least squares means and variance adjusted (ULSMV) was performed to assess goodness of fit and measurement invariance for a single-factor model of both the Danish WEMWBS and SWEMWBS. To enhance cross-validity of the analyses, two independent subsets were randomly created for assessing global fit ($n = 1150$) and measurement invariance ($n = 2358$). As recommended by Hoyle and Panter (1995), several fit indices were used including the Root Mean Square Error of Approximation (RMSEA), the Comparative Fit Index (CFI), and the Tucker-Lewis Index (TLI). Values greater than 0.95 for the CFI and TLI were considered to reflect good model fit. A RMSEA value of 0.06 or less is considered to indicate a good fit, although values up to 0.08 were considered acceptable (Hu and Bentler, 1999; Jöreskog and Sörbom, 1993). Measurement invariance was evaluated across sex (women vs. men) and age groups (16–54 years of age vs. 55+) performing a Likelihood-Ratio Test (LRT).

Criterion validity was assessed by calculating correlations between the WEMWBS scores and the SWEMWBS scores. Convergent validity was assessed by calculating correlations between the (S)WEMWBS and WHO-5. Discriminant validity was assessed by calculating correlations between the (S)WEMWBS and Self-rated health (SRH), education, symptoms of discomfort and pain, PSS, and PHQ-4. We hypothesized that the (S)WEMWBS scores would show a strong positive correlation with the positively phrased measure of general well-being (WHO-5) (Tennant et al., 2007), moderate positive association with SRH (McKay and Andretta, 2017), and moderate negative associations with scales measuring the negative aspects of physical or mental health status (symptoms of discomfort and pain, PSS and PHQ-4) (McKay and Andretta, 2017) (based on Cohen's rule of thumb, i.e. small: $r = 0.1$; moderate = 0.3; large = 0.5, Cohen et al., 2003).

Based on the findings of recent Danish health and morbidity studies, we hypothesized that men would score higher than women on the (S)WEMWBS and that the scales would show a positive association with education (Christensen et al., 2014, 2017). The latter association was hypothesized to be mild to moderate based on recent studies suggesting that mental well-being is less sensitive to socioeconomic patterning compared to poor mental health (Nielsen et al., 2016). Differences in scores across sex and education were assessed using linear regression analysis.

2.4.3.3. Content validity. The distribution of responses highlighted the frequency of popular responses and any floor and ceiling effects. Total scores were examined for floor and ceiling effects. Instruments exhibit floor or ceiling effects if more than 15% of participants record the lowest or highest score (McHorney and Tarlov, 1995).

2.4.3.4. Internal consistency. Cronbach's α and McDonald's ω were calculated as reliability indices of the total scores. Internal consistency estimates of > 0.70 were sought (Bagozzi and Yi, 2012).

2.4.3.5. Cross-cultural comparison of mental well-being scores. Total (S)WEMWBS scores were computed with weights applied to generate nationally representative estimates. The Danish mental well-being scores were reported along with scores based on data representative of three other European settings, specifically Iceland, England, UK, and Catalonia, Spain. Overall scores were reported as well as scores stratified by age and sex. Information regarding survey and sampling in Iceland, England, and Catalonia is provided in Appendix 1.

3. Results

3.1. Participant characteristics

319 (9.1%) were 16–25 years old, 735 (21.0%) were 26–44 years old, 1,437 (41.0%) were 45–64 years old, and 1,017 (28.9%) were 65–95. The mean age was 52.1 years. Among participants 2,528 (72.0%) were either married or living with a partner. 1,919 (54.7%) were employed, and 1,220 (34.8%) were educated beyond youth education (For more information on the demographic distribution see Table 1).

3.2. Face validity

Participants found the scales easy to complete with no major problems in terms of understanding. All items are shown in Table 2. Item b) *I have been feeling useful* and item l) *I have been feeling loved* evoked a few comments on the ambiguity caused by the context sensitiveness of the questions (i.e. have I been feeling useful or loved *at work, in school, in my family* or *as a citizen*?). The concepts of feeling *useful* and *loved* were understood consistently among participants. The wording used for item n) (*cheerful* in Danish translated into *fornøjet*) was considered *outdated* or *quirky*. Nevertheless, participants felt able to provide an answer. The

Table 1
Characteristics of the study sample.

Characteristic	Category	n	%	Response rate (%)*
Total number of respondents (N)		3,508	100	34
Sex	Female	1,852	52.8	36
	Male	1,656	47.2	33
Age (years)	16–25	319	9.1	20
	26–34	282	8	21
	35–44	453	12.9	28
	45–54	667	19	38
	55–64	770	21.9	50
	65+	1,017	29	43
Education	Primary or unknown	831	23.7	24
	Youth education	1,457	41.5	36
	Short-cycle higher education	170	4.8	42
	Medium-cycle higher education	627	17.9	47
	Long cycle higher education	423	12.1	44
Employment status	Employed	1,919	54.7	38
	Not employed or unknown	1,589	45.3	31
Living arrangements	Single	980	28	26
	Married or with partner	2,528	72	39

* Response rate in relation to the invited survey sample.

Table 2
Items included in the (S)WEMWBS questionnaire.*

a) I've been feeling optimistic about the future.	Jeg har følt mig optimistisk i forhold til fremtiden
b) I've been feeling useful.	Jeg har følt mig nyttig
c) I've been feeling relaxed.	Jeg har følt mig afslappet
d) I've been feeling interested in other people.	Jeg har været interesseret i andre mennesker
e) I've had energy to spare.	Jeg har haft overskud af energi
f) I've been dealing with problems well.	Jeg har klaret problemer godt
g) I've been thinking clearly.	Jeg har tænkt klart
h) I've been feeling good about myself.	Jeg har haft det godt med mig selv
i) I've been feeling close to other people.	Jeg har følt mig tæt på andre mennesker
j) I've been feeling confident.	Jeg har følt mig selvsikker
k) I've been able to make up my own mind about things.	Jeg har været i stand til at danne min egen mening om ting
l) I've been feeling loved.	Jeg har følt mig elsket
m) I've been interested in new things.	Jeg har været interesseret i nye ting
n) I've been feeling cheerful.	Jeg har følt mig fornøjet

* Answers options were: "none of the time (på intet tidspunkt)", "rarely (sjældent)", "some of the time (noget af tiden)", "often (ofte)", "all of the time (hele tiden)". Bold items included in the short form SWEMWBS.

recall time-scale of the previous two weeks was considered appropriate. Some participants mentioned not using the outermost answer categories, because they considered it unrealistic to feel a certain way *all of the time*.

3.3. Construct validity

We conducted a CFA on the long and short versions of the WEMWBS scale. We obtained good model fit for both the WEMWBS (χ^2 (77) = 1037.7, CFI = 0.998; TLI = 0.986; RMSEA = 0.063) and the SWEMWBS (χ^2 (14) = 227.8, CFI = 0.990; TLI = 0.984; RMSEA = 0.065). Table 3 illustrates all model fit results.

Strong measurement invariance (see table 4) was sustainable for both sex and age groups on both scales. Difference in factor mean was significant across age groups, with a lower latent score for the younger population (-0.193, $z = -4.28$, $p < 0.001$) but there were no significant differences between men and women (0.049, $z = 1.06$,

$p = 0.29$). This latent trend is consistent with observed scores.

As can be seen from Table 5, the correlation between the original and short form showed that 92% of the variation in the WEMWBS is explained by the 7 items in the SWEMWBS. In terms of convergent validity, as expected, the (S)WEMWBS correlated positively and more strongly with the WHO-5 than with other measures. In terms of discriminant validity, there was a strong negative correlation with the PHQ-4 and the PSS, a positive moderate correlation with self-rated health, and a negative moderate correlation with symptoms of discomfort and pain. Finally, there was a statistically significant but weak correlation between (S)WEMWBS and education.

3.4. Content validity

In histograms, the WEMWBS and SWEMWBS total scores appeared to be normally distributed (figures not shown). Neither floor nor ceiling effects were observed for the scales (results not shown).

3.5. Internal consistency

Both the WEMWBS and the SWEMWBS showed high internal consistency in the total sample (WEMWBS: $\alpha = 0.94$, $\omega = 0.92$; SWEMWBS: $\alpha = 0.88$, $\omega = 0.85$). The internal consistency of the (S)WEMWBS scales can be seen in Table 5.

3.6. Cross-cultural comparison of mental well-being scores

Table 6 shows the (S)WEMWBS scores in Denmark, as well as in Iceland, England, UK, and Catalonia, Spain. Mean (SD) scores for the total scales in Denmark were 52.2 (8.7) for the WEMWBS, and 26.4 (4.31) for the SWEMWBS. The difference between WEMWBS scores in relation to sex were significant, with men scoring slightly higher than women (men: $M = 52.6$, SD = 8.7; women: $M = 51.9$, SD = 8.7, $p = 0.047$). No sex differences in mental well-being was found on the SWEMWBS scale (men: $M = 24.3$, SD = 3.81; women: $M = 24.1$, SD = 3.93, $p = 0.164$).

The highest overall mental well-being scores were reported for Catalonia, followed by Denmark, Iceland, and England. Differences between geographical locations exceeded estimates of minimally important differences for WEMWBS in Catalonia (Maheswaran et al., 2012), and between England and both Iceland and Denmark for SWEMWBS (Shah, Cader, Andrews, Wikijsera, and Stewart-Brown, Under review). Consistently, men reported slightly higher mental well-being scores than women in all four countries/regions. In terms of age differences, scores rose with age in northern settings, but fell with age in Catalonia.

4. Discussion

To our knowledge this is the first study to analyse the validity of the (S)WEMWBS in Denmark. This study included a large sample size with representatives from all social groups above the age of 16. Some limitations deserve mentioning. The response rate was 34% and while this is not unusual for web based surveys (Christensen et al., 2016), selection bias cannot be ruled out. Regarding the comparison of well-being scores with other European data, there were some minor discrepancies particularly in terms of the year of the survey, the age groups, and the lowest age for participation in each survey. Also, since this study set out to validate (S)WEMWBS in the Danish context, we did not test for measurement invariance across all four European settings. These limitations should be kept in mind when interpreting the results.

In line with previous findings, our study showed that the (S)WEMWBS were considered easy to complete and to provide a credible measure of mental well-being (Stewart-Brown, 2015a,b). The original WEMWBS scale was developed as an instrument for assessment in the general population fitting a one-factor model. The factor analysis

Table 3
CFA Global goodness-of-fit indices.

	$SB\chi^2$	χ^2/df	CFI	TLI	WRMR	SRMR	RMSEA [90%CI]
WEMWBS	1037.68(77)	13.48	0.988	0.986	1.564	0.056	0.063 [0.059, 0.066]
SWEMWBS	227.82(14)	16.27	0.990	0.984	1.201	0.047	0.065 [0.058, 0.072]

WEMWBS, The Warwick–Edinburgh Mental Well-being Scale; SWEMWBS, The Short Warwick–Edinburgh Mental Well-being Scale; $SB\chi2$, Satorra–Bentler scaled chi-square; df, degrees of freedom; CFI, comparative fit index; TLI, Tucker–Lewis index; RMSEA, root mean square error of approximation; WRMR, weighted root-mean-square residual; SRMR, standardized root-mean-square residual.

Table 4
Likelihood-ratio test (χ^2 difference test) for sex and age measurement invariance.

	$SB\chi^2$	χ^2/df	CFI	TLI	WRMR	SRMR	RMSEA [90%CI]	$Pr(>\chi^2)$
WEMWBS (sex)								
Configural	1733.37(153)	11.33	0.990	0.988	1.952	0.053	0.059 [0.057, 0.062]	NA
Loadings (Weak)	744.95(208)	3.58	0.984	0.986	2.772	0.056	0.064 [0.059, 0.069]	0.18
Intercepts (Scalar)	1372.36(167)	8.22	0.989	0.988	2.046	0.056	0.059 [0.056, 0.061]	0.10
Means heterogeneity	666.71(209)	3.19	0.984	0.986	2.836	0.056	0.064 [0.059, 0.07]	0.13
WEMWBS (age)								
Configural	2149.23(153)	14.05	0.989	0.986	2.196	0.055	0.062 [0.06, 0.064]	NA
Loadings (Weak)	763.34(208)	3.67	0.985	0.986	2.887	0.056	0.062 [0.057, 0.067]	0.46
Intercepts (Scalar)	1609.48(167)	9.64	0.989	0.988	2.236	0.056	0.059 [0.057, 0.062]	0.14
Means heterogeneity	838.58(209)	4.01	0.979	0.982	3.295	0.057	0.072 [0.067, 0.077]	0.00
SWEMWBS (sex)								
Configural	334.32(27)	12.38	0.992	0.987	1.426	0.043	0.059 [0.054, 0.065]	NA
Loadings (Weak)	168.09(54)	3.11	0.981	0.985	2.532	0.046	0.064 [0.053, 0.075]	0.21
Intercepts (Scalar)	309.50(34)	9.1	0.991	0.989	1.518	0.046	0.055 [0.05, 0.061]	0.30
Means heterogeneity	151.62(55)	2.76	0.982	0.986	2.555	0.046	0.062 [0.05, 0.074]	0.49
SWEMWBS (age)								
Configural	44.43(27)	16.31	0.990	0.985	1.667	0.046	0.064 [0.059, 0.07]	NA
Loadings (Weak)	221.11(54)	4.09	0.973	0.979	3.108	0.048	0.076 [0.066, 0.087]	0.17
Intercepts (Scalar)	406.70(34)	11.96	0.989	0.987	1.762	0.048	0.060 [0.055, 0.065]	0.10
Means heterogeneity	292.74(55)	5.32	0.956	0.966	3.801	0.048	0.096 [0.085, 0.107]	0.00

WEMWBS, The Warwick–Edinburgh Mental Well-being Scale; SWEMWBS, The Short Warwick-Edinburgh Mental Well-being Scale; $SB\chi^2$, Satorra-Bentler scaled chi-square; df, degrees of freedom; CFI, comparative fit index; TLI, Tucker–Lewis index, RMSEA, root mean square error of approximation; WRMR, Weighted root-mean-square residual; SRMR, standardized root-mean-square residual.

Table 5
Internal consistency estimates and relations to other or similar measures.

	α	ω	WEMWBS	SWEMWBS	WHO-5	Self-rated health	Education	PHQ-4	PSS	Symptoms of discomfort and pain
- WEMWBS	0.94	0.92	-							
- SWEMWBS	0.88	0.85	0.96*	–						
- WHO-5	0.92	0.89	0.75*	0.70*	–					
- Self-rated health	–	–	0.48*	0.46*	0.48*	–				
- Education	–	–	0.07*	0.09*	0.02	0.13*	–			
- PHQ-4	0.88	0.80	− 0.61*	− 0.58*	− 0.69*	− 0.40*	− 0.12*	–		
- PSS	0.89	0.82	− 0.66*	− 0.65*	− 0.70*	− 0.41*	− 0.10*	0.70*	–	
- Symptoms of discomfort and pain	0.77	0.67	− 0.37*	− 0.36*	− 0.43*	− 0.48*	− 0.11*	0.36*	0.41*	–

WEMWBS, The Warwick-Edinburgh Mental Well-being Scale; SWEMWBS, The Short Warwick-Edinburgh Mental Well-being Scale.

* Statistically significant ($p < 0.05$).

conducted in our study showed that a single factor adequately confirmed item relationships with good model fit for both scales. SWEMWBS explained a substantial amount of the variance in WEMWBS and may therefore be preferred. As shown by the measurement invariance tests, the (S)WEMWBS could be used to compare parameter estimates over sex and age. Age was shown to be a source of population heterogeneity, which should be taken into account if (S)WEBWBS are used specifically for the purpose of comparing individual differences (rather than population differences) in scores between people belonging to different age groups.

Reliability estimates displayed high internal consistency for both the original and the short scale. The (S)WEMWBS did not show a ceiling effect in our sample, indicating that the scales have the potential for detecting overall improvement in mental well-being in the population. The results from the convergent and discriminant validity tests suggest that the (S)WEMWBS share common features with the WHO-5, and are inversely related to the PSS and the PHQ-4, in line with the original validation study (Tennant et al., 2007).

The (S)WEMWBS have proved very popular both in their country of origin and internationally (Shah, Steiner, Petrou, Johnson, and Stewart-Brown, in press) because they have enabled studies of risk and protective factors for mental well-being as well as intervention evaluation. Cognitive interviews with the general public confirm that the range of items in these measures offers a recognisable picture of a previously unfamiliar concept (Stewart-Brown, 2013). This is likely an important component of the scale's popularity in supporting research and evaluation in subtle ways that are hard to measure. The scales have proved responsive to change in evaluation studies (Maheswaran et al., 2012; Shah et al., Under review) and also in RCTs (Shah et al., in press). Studies of risk and protective factors suggest, surprisingly, that mental well-being is much less strongly associated with socio-demographic factors and health related lifestyles than mental illness (Ng Fat et al.,

Table 6
Cross-cultural comparison of mental well-being scores representative of four European settings.

	Category	n	WEMWBS	SWEMWBS[a]
Denmark 2016	Overall	3,508	52.2	26.4
	Females	1,852	51.9	24.1
	Males	1,656	52.6	24.3
	16–25	319	51.2	25.8
	26–44	735	51.7	26.1
	45–64	1,437	51.8	26.1
	65 +	1,017	54.3	27.4
Iceland 2017	Overall	6,344	NA	25.4
	Females	3,463	NA	25.3
	Males	2,881	NA	25.5
	18–25	197	NA	23.6
	26–44	1,231	NA	24.6
	45–64	2,438	NA	26.0
	65 +	2,478	NA	26.8
England, UK 2016	Overall	7,071	49.8	22.9
	Females	3977	49.5	22.8
	Males	3094	50.1	23.0
	16–25	631	48.9	22.4
	26–44	2171	49.6	22.7
	45–64	2431	49.3	22.7
	65 +	1838	50.9	23.5
Catalonia, Spain 2016	Overall	3,691	58.1	NA
	Females	1,862	57.6	NA
	Males	1,829	58.7	NA
	15–44	1,640	59.2	NA
	45–64	1,160	57.9	NA
	65–74	376	57.1	NA
	75 +	396	54.1	NA

WEMWBS, The Warwick–Edinburgh Mental Well-being Scale (range 14–70); SWEMWBS, The Short Warwick–Edinburgh Mental Well-being Scale (range 7–35); NA, not available.

[a] The conversion table was used for the calculation of SWEMWBS scores.

2017; Stewart-Brown et al., 2015; Stranges et al., 2014). Studies on adolescents, using other measures of mental well-being, have confirmed that this is also likely to be true in Denmark (Nielsen et al., 2016). This study now makes it possible to investigate distributions of mental well-being in the Danish population.

Finally, this study provided comparative mental well-being scores across four European settings, suggesting that population norms for mental well-being are higher in Catalonia compared to Denmark, Iceland, and England. This is in contrast to the World Happiness Reports that have consistently ranked the Nordic countries highest on well-being (assessed by the Cantril ladder) (World Happiness Report, 2017) and the European Social Survey (ESS) where Denmark ranked highest (assessed by hedonic and eudemonic measures separately), followed by Iceland, the UK, and finally Spain (ESS, 2015). The World Happiness Reports evaluate participants' views of 'the best possible life for them' which elicits views on hedonic wellbeing or life satisfaction. It has recently been shown that in spite of the Nordic countries ranking highest in the World Happiness Reports, significant struggling or suffering minorities have been masked by these results (Andreasson and Birkjær, 2018), suggesting that measures of life satisfaction are insufficient as indicators of national happiness. This may in part explain the differences in ratings between our study and those reported in the World Happiness Reports. The ESS evaluates both hedonic and eudemonic wellbeing, finding a high correlation between the two, but with greater between-country variation in hedonic wellbeing as compared to eudemonic wellbeing. The (S)WEMWBS combine hedonic and eudemonic wellbeing in one overall score, possibly accounting for the differences in our findings compared to the findings reported in the ESS. It may also be considered that the relatively high mental wellbeing scores found for Catalonia compared to those

reported in the aforementioned studies may be related to within-country variation, i.e. other studies reported on Spain as a whole rather than Catalonia in isolation. Catalonia is a region quite distinct from the rest of Spain, with considerable differences in ethnicity, cultural values and economic conditions, and it is possible that these differences may explain our findings rather than the properties of the different measures. That said, we were not able to identify any other studies indicating that mental wellbeing is considerably higher in Catalonia than in the rest of Spain. Finally, due to the different sources of survey data, we could not test for measurement invariance across the four settings, and we cannot rule out that this could also have had implications for the findings. Thus, explanations for the reasons behind the differences in ratings between our study and the aforementioned reports remain speculative.

Different measures capture different constructs. It is important to understand the differences between them and their underlying mechanisms in relation to these different measures in order to guide policy and practice most appropriately. Comparison of mental well-being scores across different European settings offer valuable insights that might otherwise have remained unknown, as well as allowing research into risk and protective factors that vary between countries. Such research is strongly needed to inform international mental health policy, and scales that are valid across cultures and languages are essential to support this research. Finally, multicultural validity testing is warranted to examine how (S)WEMWBS functions across different cultural settings.

4.1. Conclusion

The (S)WEMWBS are shown to be valid and appropriate instruments to measure mental well-being in the Danish population. The present findings encourage the use of these measures in epidemiological, intervention and evaluation studies, where they are likely to be valuable for research as well as practice. While the WEMWBS scale may be used, the short version explains a substantial amount of the original scale, and may be preferred for the sake of practicality. The highest mental well-being scores were reported for Catalonia, followed by Denmark, Iceland, and England. Our findings offer insights into distributions of mental well-being on a global level that would otherwise likely remain unknown. Future cross-national investigations are therefore strongly warranted, as they may be essential to inform international mental health policy.

Conflict of interest

The Authors declare that there is no conflict of interest.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2018.12.003.

Appendix

Data sources, designs, and samples.

Iceland

Data on wellbeing using the Short Warwick-Edinburgh Mental Well-Being Scale (SWEMWBS) were extracted from the survey Health and Wellbeing of Icelanders 2017, which was conducted in October 2017. Health and Wellbeing of Icelanders 2017 is a national questionnaire survey among 9887 randomly selected Icelanders, 18 years and older of which 6.776 (68,5%) participated and 6.344 (64,2%) completed SWEMWBS.

England, UK

Data on well-being using the Warwick-Edinburgh Mental Well-Being Scale (WEMWBS) were extracted from the Health Survey England 2016 (HSE). HSE 2016 survey sampled one dwelling unit from 9558 addresses randomly selected from 531 postcode sectors to provide a representative sample of adults (> 16 years) living in private households. All consenting adults living in the sample dwelling units were interviewed. 8011 adults were interviewed, 55% of those approached. Of these 7071 (88.3%) completed WEMWBS.

Catalonia, Spain

The Spanish version of the WEMWBS was administered to a representative sample of non-institutionalized general population 15 years or older in Catalonia, a northeastern region of Spain with about 7.5 million inhabitants, as part of the 2016 Catalan Health Interview Survey (CHIS) Waves 12 and 13. The sample was selected using a stratified multistage random sampling design. Computer-assisted personal interviews (CAPI) were carried out by trained interviewers at the respondents' households from January 2016 to February 2017.

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