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ABSTRACT

Background

The accurate monitoring of population mental health requires repeated assessments using valid and reliable measures. The Warwick-Edinburgh Mental Well-being Scale (WEMWBS) and its short form (SWEMWBS) are widely used positive mental health (PMH) measures ([S]WEMWBS is used hereafter to refer to both). This study tested their validity among Canadian adults using representative health survey data.

Data and methods

Cross-sectional data from the 2024 Canadian Community Health Survey – Rapid Response on Sleep Quality and Positive Mental Health of adults (18 years and older) living in the provinces were used. The distributions of (S)WEMWBS responses and scores were examined. Confirmatory factor analysis (CFA) and bifactor exploratory structural equation modelling (ESEM) were conducted to assess factorial validity. Measurement invariance was tested across gender and age. Differences in (S)WEMWBS scores by gender, age, and other mental health indicators were examined. Cronbach's alphas were used to investigate internal consistency.

Results

(S)WEMWBS scores had relatively normal distributions, with no floor and minimal ceiling effects. A bifactor ESEM and bifactor CFA model for the WEMWBS and SWEMWBS, respectively, fit the data best, with indices suggesting that they were essentially unidimensional. Evidence was found for measurement invariance across gender and age. Older adults had higher (S)WEMWBS scores on average, as did men on the WEMWBS. The (S)WEMWBS had acceptable internal consistency and were associated with other mental health indicators.

Interpretation

The (S)WEMWBS appear to be valid and reliable PMH measures for Canadian adults. The (S)WEMWBS could be regularly included in health surveys to support the surveillance of population-level changes in PMH.

Keywords

Mental health, psychological well-being, emotions, surveys and questionnaires, validation study, factor analysis, adult, Canada.

AUTHORS

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What is already known on this subject?

- The 14-item Warwick-Edinburgh Mental Well-being Scale (WEMWBS) and its 7-item short form (SWEMWBS), together referred to as (S)WEMWBS, are positive mental health measures that have been used and validated in other countries.
- The (S)WEMWBS were included in the 2024 Canadian Community Health Survey – Rapid Response on Sleep Quality and Positive Mental Health. However, their psychometric properties had not been examined in that dataset before this analysis.

What does this study add?

- This study provides evidence for the factorial and criterion validity, measurement invariance, and internal consistency of the (S)WEMWBS among adults in Canada in early 2024.
- Mean (S)WEMWBS scores were highest among older adults, and mean WEMWBS scores were higher among men+ than women+ (the plus signs reflect the inclusion of non-binary individuals).
- Future research could examine differences on the (S)WEMWBS by additional sociodemographic characteristics, across countries, and over time.

Effective public health surveillance of population mental health requires the regular collection, analysis, interpretation, and dissemination of mental health data using validated measures to inform action.[1] In addition to mental ill-health, an essential feature in the measurement of population mental health is mental well-being or positive mental health (PMH).[2] PMH is a multifaceted construct that involves positive feelings (i.e., hedonia or emotional well-being) and positive functioning (i.e., eudaimonia or psychological and social well-being).[3] Many PMH measures have been developed, with some intended to measure a specific aspect of PMH (e.g., life satisfaction, which is an aspect of hedonic well-being)[4] and others designed as more comprehensive measures of overall PMH.[5] Examples of the latter include the Warwick-Edinburgh Mental Well-being Scale (WEMWBS) and its short form (SWEMWBS);[6,7] "(S)WEMWBS" will be used when referring to both hereafter. The (S)WEMWBS have received a lot of attention in other countries,[8] with the SWEMWBS even being recommended as an internationally harmonized measure of population PMH by the Organisation for Economic Co-operation and Development (OECD), primarily based on existing data collection practices.[2] However, the (S)WEMWBS have been included in population health surveys in Canada only recently,[9,10] and there are unanswered research questions surrounding their psychometric properties within Canada.

International research suggests that the (S)WEMWBS are sensitive to change[11-13] and associated with other constructs in an expected manner (e.g., negatively correlated with indicators of mental ill-health).[6,14-18] A recent meta-analysis provided evidence for the high internal consistency of both scales and the high test-retest reliability of the WEMWBS.[19] Moreover, (S)WEMWBS scores tend to be relatively normally distributed.[6,14-16,18,20] However, conclusions about the structure and dimensionality of the (S)WEMWBS have been mixed. Some validation studies have claimed support for a single-factor model,[6,16,17] but only after correlating item residuals based on modification indices, which can capitalize on chance and mask important latent constructs.[21] As certain (S)WEMWBS items appear to capture aspects of emotional (e.g., "I've been feeling relaxed"), psychological (e.g., "I've been dealing with problems well"), and social (e.g., "I've been feeling close to other people") well-being, alternative two- and three-factor models have also been examined, with varying success.[14,15,22,23] The most recent validation studies have often found the strongest support for bifactor models, where a general PMH factor capturing common variance across all items and one or more specific factors capturing common variance across a subset of items are modelled.[14,15,22,24]

Including the (S)WEMWBS in the 2024 Canadian Community Health Survey (CCHS) – Rapid Response on Sleep Quality and Positive Mental Health provided an opportunity to test the validity of these scales among adults in Canada.[9] Using these data, this study's objective was to determine the suitability of these measures for Canadian PMH surveillance and research by examining the distributions, factor structures, internal consistencies, and measurement invariance of the (S)WEMWBS, along with their associations with other mental health indicators and disparities across gender and age.

Methods

Data

Cross-sectional data collected by Statistics Canada from January to March 2024 for the CCHS – Rapid Response on Sleep Quality and Positive Mental Health were used.[9] The area frame of the Labour Force Survey was used as the sampling

frame to recruit adults aged 18 years or older from the 10 provinces. Excluded from recruitment were individuals living on reserves and other Indigenous settlements, full-time members of the Canadian Armed Forces, those who were institutionalized, and those living in two remote health regions in Quebec. Two-thirds of respondents completed the survey on their own using an online questionnaire, with the remainder completing the survey via a telephone or personal interview. The response rate was 40.0%; 77.0% of respondents agreed to share their data with other departments or agencies, such as the Public Health Agency of Canada. Proxy respondents did not complete the (S)WEMWBS and were excluded from this study (less than 1.0%), leaving a sample size of 6,637 individuals.

Measures

Warwick-Edinburgh Mental Well-being Scale and Short Warwick-Edinburgh Mental Well-being Scale

Respondents were asked how often they experienced a variety of feelings and thoughts over the last two weeks using 14 statements.[6] Response options included "1: None of the time," "2: Rarely," "3: Some of the time," "4: Often," and "5: All of the time." Overall WEMWBS scores ranging from 14 to 70 were calculated by summing responses to the 14 items. WEMWBS scores were dichotomized into high (56 and higher) and non-high (lower than 56) categories. Overall SWEMWBS scores ranging from 7 to 35 were calculated by summing responses to the relevant seven items and then transforming the raw sums into metric scores.[7] SWEMWBS scores were also dichotomized into high (raw score = 28 or higher; metric score = 25.03 or higher) and non-high (metric score lower than 25.03) categories. There is no gold standard for identifying high levels of PMH based on the (S)WEMWBS.[25] In this study, the cut-off values for the high (S)WEMWBS categories were selected because they are the scores for someone who tended to answer "often" to the items, which happened to align with mode scores on the (S)WEMWBS (see Appendix Figure 1).

Other mental health indicators

Six other mental health indicators were examined in this study to determine their associations with the (S)WEMWBS.

Overall self-rated mental health (SRMH) was assessed by asking, "In general, how is your mental health?" Response options were "excellent," "very good," "good," "fair," and "poor." Single-item general mental health questions like this are common and have been recommended as a population mental health measure by the OECD because, in part, of their low response burden.[2,26] High SRMH was identified by responses of excellent or very good.[27,28]

An aspect of social well-being was assessed[29] by asking, "How would you describe your sense of belonging to your local community?" Response options were "very strong," "somewhat strong," "somewhat weak," and "very weak." High community belonging was identified by responses of very strong or somewhat strong.[27,28]

Life satisfaction was assessed by asking, "Using a scale of 0 to 10, where 0 means 'very dissatisfied' and 10 means 'very satisfied', how do you feel about your life as a whole right now?" Life satisfaction was kept as a numerical variable and not dichotomized.[27] High SRMH, high community belonging, and average life satisfaction are key PMH outcomes in the Positive Mental Health Surveillance Indicator Framework[27] and were expected to be associated with higher scores on the (S)WEMWBS.

Perceived stress was assessed by asking, "Thinking about the amount of stress in your life, how would you describe most of your days?" Response options were "not at all stressful," "not

Table 1
Descriptive statistics for items on the Warwick-Edinburgh Mental Well-being Scale, household population aged 18 years and older, Canada (excluding territories)

	Average response to item			Response options																
				(1) None of the time			(2) Rarely			(3) Some of the time			(4) Often			(5) All of the time				
Shortened		95% CI			95% CI			95% CI			95% CI			95% CI			95% CI			
item wording	Mean	from	to	%	from	to	%	from	to	%	from	to	%	from	to	%	from	to		
1. Optimistic[1]	3.61	3.57	3.65	3.4	2.7	4.0	9.8	8.4	11.1	30.5	28.7	32.3	35.5	33.6	37.4	20.9	19.3	22.4		
2. Useful[1]	3.80	3.76	3.85	2.8	2.0	3.6	5.7	4.6	6.7	24.8	23.0	26.6	41.6	39.6	43.6	25.1	23.3	26.8		
3. Relaxed[1]	3.46	3.42	3.50	2.2	1.6	2.8	11.5	10.1	12.8	38.5	36.3	40.6	34.1	32.3	36.0	13.7	12.5	15.0		
4. Interested in people	3.64	3.60	3.68	2.5	1.9	3.1	10.2	8.8	11.6	28.6	26.7	30.5	38.1	36.1	40.0	20.6	19.0	22.2		
5. Energy to spare	3.21	3.16	3.25	6.3	5.4	7.3	18.0	16.4	19.7	35.5	33.5	37.5	28.8	27.0	30.7	11.3	10.0	12.6		
6. Dealing with problems[1]	3.81	3.78	3.84	1.3	0.9	1.8	4.4	3.6	5.2	27.1	25.2	28.9	46.3	44.4	48.2	20.9	19.4	22.5		
7. Thinking clearly[1]	4.10	4.06	4.13	0.4	0.2	0.6	3.1	2.4	3.8	17.1	15.4	18.7	45.3	43.2	47.4	34.2	32.2	36.1		
8. Good about myself	3.81	3.77	3.85	1.8	1.2	2.4	6.3	5.2	7.4	24.9	23.1	26.6	42.8	40.9	44.8	24.2	22.4	26.0		
9. Close to people[1]	3.79	3.75	3.82	1.7	1.1	2.2	7.5	6.4	8.6	25.6	23.7	27.5	41.1	39.2	43.1	24.1	22.4	25.9		
10. Confident	3.79	3.75	3.83	2.0	1.4	2.6	7.3	6.1	8.4	24.8	23.1	26.5	41.8	39.8	43.7	24.2	22.4	26.0		
11. Make up own mind[1]	4.18	4.15	4.22	0.6	0.2	1.1	2.8	2.0	3.7	14.0	12.5	15.5	42.7	40.7	44.7	39.8	37.8	41.8		
12. Loved	4.13	4.09	4.17	1.1	0.7	1.6	3.5	2.8	4.2	17.3	15.5	19.1	37.1	35.2	38.9	41.0	38.9	43.0		
13. Interested in things	3.70	3.66	3.75	2.3	1.7	2.8	10.2	8.9	11.5	27.3	25.4	29.3	35.4	33.4	37.3	24.8	23.0	26.6		
14. Cheerful	3.72	3.69	3.76	1.8	1.2	2.4	6.8	5.8	7.8	28.8	27.0	30.6	42.7	40.8	44.6	20.0	18.4	21.6		

1. Item is used in the Short Warwick-Edinburgh Mental Well-being Scale.

Notes: CI = confidence interval. Results are weighted. The sample sizes for the mean estimates ranged from 6,522 to 6,546 because of missing responses.

Source: Statistics Canada, 2024 Canadian Community Health Survey – Rapid Response on Sleep Quality and Positive Mental Health.

Table 2

One-, two-, and three-factor confirmatory factor analysis, and bifactor exploratory structural equation modelling of the Warwick-Edinburgh Mental Well-being Scale, household population aged 18 years and older, Canada (excluding territories)

		Two-factor CFA Model A[1]		Two-factor CFA Model B[2]		Three-factor CFA Model A[3]			Three-factor CFA Model B[4]			Bifactor ESEM[5]			
	One-factor CFA	Factor 1	Factor 2	Factor 1	Factor 2	Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3	General factor	Specific factor 1	Specific factor 2	Specific factor 3
Standardized factor loadings															
1. Optimistic	0.710	0.713	…	0.715	…	0.716	…	…	0.719	…	…	0.714	0.263	…	…
2. Useful	0.731	0.734	…	0.735	…	0.737	…	…	…	…	0.766	0.726	0.225	…	…
3. Relaxed	0.729	0.732	…	0.734	…	0.736	…	…	0.738	…	…	0.745	…	…	…
4. Interested in people	0.707	…	0.756	…	0.718	…	…	0.756	…	…	0.737	0.677	0.266	…	0.287
5. Energy to spare	0.687	0.690	…	0.691	…	0.693	…	…	0.695	…	…	0.708	…	…	…
6. Dealing with problems	0.770	0.772	…	…	0.783	…	0.830	…	…	0.798	…	0.747	…	0.286	…
7. Thinking clearly	0.814	0.817	…	…	0.828	…	0.876	…	…	0.844	…	0.774	…	0.481	…
8. Good about myself	0.906	0.908	…	0.911	…	0.913	…	…	0.914	…	…	0.913	…	…	…
9. Close to people	0.813	…	0.879	…	0.828	…	…	0.879	…	…	0.854	0.784	…	…	0.464
10. Confident	0.900	0.903	…	0.905	…	0.907	…	…	0.909	…	…	0.898	…	…	…
11. Make up own mind	0.742	0.745	…	…	0.753	…	0.792	…	…	0.766	…	0.694	…	0.390	…
12. Loved	0.722	…	0.774	0.728	…	…	…	0.775	…	…	0.755	0.696	…	…	0.345
13. Interested in things	0.754	0.758	…	…	0.767	0.762	…	…	…	0.785	…	0.754	…	…	…
14. Cheerful	0.876	0.880	…	0.882	…	0.883	…	…	0.886	…	…	0.890	…	…	…
Model fit															
SRMR	0.035	0.032	…	0.034	…	0.027	…	…	0.031	…	…	0.016	…	…	…
RMSEA	0.068	0.061	…	0.066	…	0.051	…	…	0.061	…	…	0.046	…	…	…
CFI	0.959	0.967	…	0.962	…	0.977	…	…	0.968	…	…	0.990	…	…	…

… not applicable

1. The correlation was 0.89 between factors.

2. The correlation was 0.96 between factors.

3. The correlations were 0.89 between factors 1 and 2, 0.90 between factors 1 and 3, and 0.81 between factors 2 and 3.

4. The correlations were 0.94 between factors 1 and 2, 0.92 between factors 1 and 3, and 0.89 between factors 2 and 3.

5. Standardized factor loadings with absolute values that are < 0.2 are not shown.

Notes: CFA = confirmatory factor analysis. CFI = comparative fit index. RMSEA = root mean square error of approximation. ESEM = exploratory structural equation modelling. SRMR = standardized root mean square residual. Results are weighted. Models used a robust weighted least squares mean and variance adjusted estimator. All factor loading values that are shown and factor correlations were statistically significant (p < 0.001). Model fit indices are listed under the first factor, but they concern the entire model. The sample size was 6,266 because of missing data on any of the Warwick-Edinburgh Mental Well-being Scale items.

Source: Statistics Canada, 2024 Canadian Community Health Survey – Rapid Response on Sleep Quality and Positive Mental Health.

very stressful," "a bit stressful," "quite a bit stressful," and "extremely stressful." High perceived stress was identified by responses of quite a bit stressful and extremely stressful.[30] This measure of global subjective stress[31] will be considered an indicator of mental ill-health, along with the following two measures.

Mood and anxiety disorder diagnoses were identified by asking respondents whether they have been diagnosed with a mood disorder (e.g., depression, bipolar disorder) or an anxiety disorder (e.g., generalized anxiety disorder, phobia), with "yes" and "no" as response options for each question. Mood and anxiety disorders are the two most common types of mental illness[32] and, along with high perceived stress, were expected to be associated with lower scores on the (S)WEMWBS.

Analysis

To understand how individuals are responding to the (S)WEMWBS, weighted means with 95% confidence intervals (CIs) were obtained for the overall scores and for each item, and weighted percentages with 95% CIs were obtained for each response option across each item. Histograms were obtained to visualize the distributions of overall scores. Weighted percentages with 95% CIs of high and non-high levels on the (S)WEMWBS were also obtained.

Confirmatory factor analysis (CFA) was conducted to judge the factorial validity of the (S)WEMWBS. One-factor models were tested, where items from each scale were loaded onto one factor representing PMH.[6,7,16,17] Additional models that had also been examined in previous studies were then tested.[14,15,22-24] For the WEMWBS, this included two-factor Model A with individual (i.e., hedonic and psychological well-being items) and social well-being factors;[14] two-factor Model B with hedonic and eudaimonic well-being factors;[23] three-factor Model A with hedonic, psychological, and social well-being factors;[14,22] and three-factor Model B, which was identical to the preceding model, except for two items loaded onto different factors.[15,22] Lastly, a bifactor exploratory structural equation model (ESEM) that included PMH as a general factor and hedonic, psychological, and social well-being as specific factors was tested.[22] Orthogonal target rotation was applied, such that all items were loaded onto the general factor, item loadings were freely estimated on specific factors according to the best-fitting three-factor model, and item cross-loadings on other specific factors were estimated but constrained to be as close to zero as possible.[33] For the SWEMWBS, additional CFA models that were tested included a two-factor model, where three items were loaded onto a psychological well-being factor and the remaining items were loaded onto another factor, and a bifactor model, where all items were loaded onto a general PMH factor and three items were also loaded onto a specific psychological well-being factor.[14] The correlations between item residuals were assumed to be zero in all models. The cut-off criteria from Hu and Bentler[34] were used to determine whether the model fit was adequate: comparative fit index (CFI) of 0.95 or higher,

standardized root mean square residual (SRMR) lower than 0.08, and root mean square error of approximation (RMSEA) lower than 0.06.

To establish the psychometric equivalence of the (S)WEMWBS across gender and age,[35] measurement invariance of the best fitting model for each was examined. Men+ and women+ were compared for gender (the plus signs reflect the inclusion of non-binary individuals who were distributed into the other gender categories by Statistics Canada for confidentiality reasons). In terms of age groups, young (18 to 34 years), middle-aged (35 to 64 years), and older (65 years and older) adults were compared. Configural invariance was tested by restricting the items to load onto the same factors for the different gender or age groups. The cut-off criteria from Hu and Bentler[34] were used to determine whether the model fit was adequate and configural invariance was achieved. Metric invariance was tested by examining whether the magnitude of each item's factor loading was equivalent across the different groups. Metric invariance was established if the fit of the metric invariance model was not substantially worse than the configural model (i.e., CFI change greater than -0.01, RMSEA change less than 0.015, and SRMR change less than 0.030).[36,37] Scalar invariance was tested by further restricting the item thresholds to be equivalent across the different groups, and strict invariance was tested by also restricting the residual variances to be equivalent across groups. Scalar or strict invariance was established if the fit of the model was not substantially worse than the metric or scalar invariance model, respectively (i.e., CFI change greater than -0.01, RMSEA change less than 0.015, and SRMR change less than 0.015).[36,37] Weighted mean estimates on the (S)WEMWBS with 95% CIs were obtained for each gender and age group and compared using *t*-tests and one-way analysis of variance tests, respectively. Weighted percentages with 95% CIs of high and non-high (S)WEMWBS levels were also obtained for each gender and age group and compared using chi-square tests.

To judge the criterion validity of the (S)WEMWBS, weighted mean estimates of the (S)WEMWBS with 95% CIs were obtained across the different levels of the dichotomized mental health indicators, and *t*-tests were conducted to identify statistically significant mean differences. Weighted percentages with 95% CIs of high and non-high (S)WEMWBS levels were also obtained across the levels of the dichotomized mental health indicators and compared using chi-square tests. Separate linear regression analyses were conducted using life satisfaction as the explanatory variable and (S)WEMWBS scores as the criterion variable. Weighted means with 95% CIs for life satisfaction were also compared across high and non-high (S)WEMWBS levels using *t*-tests.

Cronbach's alphas were obtained to assess the internal consistency of the (S)WEMWBS, with values of 0.70 or higher considered acceptable.[38]

The CFAs, bifactor ESEM, and measurement invariance tests were conducted using Mplus version 8.3 with the robust weighted least squares mean and variance adjusted estimator. Bifactor indices were obtained using Dueber's Microsoft Excel-based tool,[39] and the Mplus syntax for the measurement invariance tests was generated (and adapted) for the bifactor ESEM (and bifactor CFA) using De Beer and Morin's online tool.[40] All other analyses were conducted using SAS Enterprise Guide version 7.1. Sampling weights provided by Statistics Canada, which account for the complex survey design and adjust for non-response and non-sharing, were used to obtain representative results of the target population. Bootstrap weights provided by Statistics Canada were used for variance estimation when possible (i.e., in the SAS analyses, except when obtaining Cronbach's alphas).

Table 3
One-factor, two-factor, and bifactor confirmatory factor analysis of the Short Warwick-Edinburgh Mental Well-being Scale, household population aged 18 years and older, Canada (excluding territories)

	One-factor CFA model	Two-factor CFA model[1]		Bifactor CFA model	
		Factor 1	Factor 2	General factor	Specific factor
Standardized factor loadings					
1. Optimistic	0.715	0.731	…	0.731	…
2. Useful	0.743	0.762	…	0.762	…
3. Relaxed	0.703	0.727	…	0.728	…
6. Dealing with problems	0.801	…	0.827	0.759	0.242
7. Thinking clearly	0.853	…	0.878	0.766	0.537
9. Close to people	0.746	0.774	…	0.774	…
11. Make up own mind	0.771	…	0.787	0.679	0.389
Model fit					
SRMR	0.032	0.023	…	0.020	…
RMSEA	0.084	0.063	…	0.059	…
CFI	0.962	0.980	…	0.985	…

… not applicable

1. The correlation was 0.89 between factors.

Notes: CFA = confirmatory factor analysis. CFI = comparative fit index. RMSEA = root mean square error of approximation. SRMR = standardized root mean square residual. Results are weighted. Models used a robust weighted least squares mean and variance adjusted estimator. The factor correlation and all factor loadings are statistically significant ($p < 0.001$). Model fit indices are listed under the first factor, but they concern the entire model. The sample size was 6,390 because of missing data on any of the Short Warwick-Edinburgh Mental Well-being Scale items.

Source: Statistics Canada, 2024 Canadian Community Health Survey – Rapid Response on Sleep Quality and Positive Mental Health.

Results

Descriptive statistics

Table 1 shows descriptive statistics for the (S)WEMWBS items. The mean response for items ranged from 3.21 to 4.18, with "often" being the most common response option for most items. The distributions of total (S)WEMWBS scores were relatively normal (see Appendix Figure 1). Floor effects were absent, while small but nonserious ceiling effects were observed, with 4.1% of individuals having the maximum possible WEMWBS scores and 6.4% having the maximum possible SWEMWBS scores.[41,42] The average WEMWBS score was 52.85 (95% CI: 52.45 to 53.25), with 41.6% (95% CI: 39.5 to 43.7) classified as high. The average SWEMWBS score was 24.51 (95% CI: 24.33 to 24.70), with 45.8% (95% CI: 43.9 to 47.8) classified as high.

Factorial validity

The CFA and bifactor ESEM results for the WEMWBS are reported in Table 2. The one-factor and two-factor models and the three-factor Model B met two of the three cut-off criteria,[34] with the RMSEA being higher than 0.06 across all of them. The three-factor Model A met all three cut-off criteria,[34] indicating good fit. However, the three factors were strongly correlated with each other (correlation coefficients of 0.81 or higher), and there were almost two dozen potential cross-loadings with statistically significant modification indices (higher than 3.84), suggesting that there was potential overlap between factors or that some items may not be uniquely associated with a single factor. The bifactor ESEM had an even better fit. The general factor explained 86.6% of the common variance and had an omega hierarchical value of 0.94, which is well above the 0.80 cut-off used to identify when total scores can be viewed as essentially unidimensional.[43] The average relative parameter bias (i.e., the average difference between an item loading in the one-factor model and an item loading on the general factor divided by the general factor loading) was 2.6%, which can be considered acceptable, as it is below 10% to 15%.[44] The standardized factor loadings ranged from 0.677 to 0.913 on the general factor, -0.175 to 0.266 on the hedonic well-being specific factor, -0.089 to 0.481 on the psychological well-being specific factor, and -0.116 to 0.464 on the social well-being specific factor.

The CFA results for the SWEMWBS are reported in Table 3. Similar to the WEMWBS, the one-factor and two-factor models for the SWEMWBS met the cut-off criteria for the SRMR and CFI but not for the RMSEA, while the bifactor model met all three cut-off criteria.[34] The general factor explained 88.6% of the common variance and had an omega hierarchical value of 0.87. The average relative parameter bias was 6.0%. In sum, the results provide support for the essentially unidimensional structure of the (S)WEMWBS.

Table 4
Measurement invariance of bifactor models across gender and age group for the Warwick-Edinburgh Mental Well-being Scale and the Short Warwick-Edinburgh Mental Well-being Scale, household population aged 18 years and older, Canada (excluding territories)

	RMSEA	CFI	SRMR	ΔRMSEA	ΔCFI	ΔSRMR
WEMWBS						
Gender						
Configural	0.044	0.992	0.015	…	…	…
Metric	0.035	0.992	0.018	-0.009	0.000	0.003
Scalar	0.030	0.993	0.020	-0.005	0.001	0.002
Strict	0.028	0.993	0.021	-0.002	0.000	0.001
Age group						
Configural	0.058	0.989	0.015	…	…	…
Metric	0.037	0.993	0.019	-0.020	0.003	0.004
Scalar	0.035	0.992	0.022	-0.002	-0.001	0.003
Strict	0.033	0.991	0.024	-0.002	-0.001	0.002
SWEMWBS						
Gender						
Configural	0.056	0.986	0.023	…	…	…
Metric	0.047	0.987	0.024	-0.009	0.001	0.001
Scalar	0.039	0.986	0.025	-0.008	-0.001	0.001
Strict	0.037	0.986	0.026	-0.002	0.000	0.001
Age group						
Configural	0.055	0.991	0.021	…	…	…
Metric	0.045	0.991	0.022	-0.010	0.000	0.001
Scalar	0.047	0.984	0.027	0.002	-0.007	0.005
Strict	0.049	0.980	0.032	0.002	-0.004	0.005

… not applicable

Notes: CFI = comparative fit index. RMSEA = root mean square error of approximation. SRMR = standardized root mean square residual. SWEMWBS = Short Warwick-Edinburgh Mental Well-being Scale. WEMWBS = Warwick-Edinburgh Mental Well-being Scale. Results are weighted. Models used a robust weighted least squares mean and variance adjusted estimator. Because of missing data on items from each scale, the sample sizes were 6,266 for the WEMWBS and 6,390 for the SWEMWBS.
Source: Statistics Canada, 2024 Canadian Community Health Survey – Rapid Response on Sleep Quality and Positive Mental Health.

Table 5
Comparing responses to the Warwick-Edinburgh Mental Well-being Scale and the Short Warwick-Edinburgh Mental Well-being Scale by gender and age group, household population aged 18 years and older, Canada (excluding territories)

	Comparing (S)WEMWBS means				Comparing (S)WEMWBS distributions						
					Non-high			High			
		95% CI		t-test/ANOVA		95% CI			95% CI		χ2 test
	Mean	from	to	*p*	%	from	to	%	from	to	*p*
WEMWBS											
Gender[1]											
Men+	53.3	52.8	53.9	0.03	56.9	53.6	60.2	43.1	39.8	46.4	0.18
Women+	52.4	51.8	53.0	…	59.9	57.2	62.6	40.1	37.4	42.8	…
Age (years)											
18 to 34	51.0	50.1	51.9	< 0.001	65.6	61.0	70.2	34.4	29.8	39.0	< 0.001
35 to 64	52.7	52.1	53.2	…	59.9	56.9	62.9	40.1	37.1	43.1	…
65 and older	55.6	55.1	56.1	…	46.2	43.6	48.8	53.8	51.2	56.4	…
SWEMWBS											
Gender[1]											
Men+	24.7	24.4	25.0	0.07	54.3	51.3	57.2	45.7	42.8	48.7	0.94
Women+	24.3	24.1	24.6	…	54.1	51.4	56.8	45.9	43.2	48.6	…
Age (years)											
18 to 34	23.6	23.2	24.0	< 0.001	63.8	59.5	68.1	36.2	31.9	40.5	< 0.001
35 to 64	24.4	24.2	24.7	…	54.7	51.8	57.6	45.3	42.4	48.2	…
65 and older	25.8	25.6	26.1	…	41.2	38.7	43.7	58.8	56.3	61.3	…

… not applicable

1. Men+ includes men and some non-binary people; women+ includes women and some non-binary people.

Notes: CI = confidence interval. SWEMWBS = Short Warwick-Edinburgh Mental Well-being Scale. WEMWBS = Warwick-Edinburgh Mental Well-being Scale. (S)WEMWBS = the WEMWBS and the SWEMWBS. Results are weighted. Because of missing data on items from each scale, the sample sizes were 6,266 for the WEMWBS and 6,390 for the SWEMWBS.

Source: Statistics Canada, 2024 Canadian Community Health Survey – Rapid Response on Sleep Quality and Positive Mental Health.

Measurement invariance and group differences

Measurement invariance tests of the bifactor (S)WEMWBS models by gender and age group are reported in Table 4. All model fit indices in the configural invariance models of the (S)WEMWBS met cut-off criteria.[34] Restricting the factor loadings to be equal in the metric invariance models did not result in worse model fit across gender or age group.[36,37] Moreover, when thresholds and residual variances were restricted to be equal in the scalar and strict invariance models, respectively, the changes in model fit did not exceed the cut-offs used to identify substantially worse fit.[36,37]

Given the results, mean (S)WEMWBS scores were compared by gender and age (see Table 5). Significant gender differences were found only for mean WEMWBS scores, with men+ scoring significantly higher than women+ on average. Age differences were consistently observed across the (S)WEMWBS, with older adults having the highest mean scores, followed by middle-aged adults, then young adults. A majority of older adults were classified as having high (S)WEMWBS scores, whereas just over one-third of young adults were.

Criterion validity

Differences on the (S)WEMWBS by the dichotomized mental health indicators are reported in Table 6. As expected, mean (S)WEMWBS scores were significantly higher among individuals who had high (versus non-high) SRMH, strong (versus weak) community belonging, and non-high (versus high) levels of perceived stress, along with those who reported the absence (versus presence) of a mood disorder diagnosis and the absence (versus presence) of an anxiety disorder diagnosis. These individuals were also more likely to be classified as having high (S)WEMWBS scores.

Significant positive associations between the (S)WEMWBS and life satisfaction were found (see Table 7). A one-unit increase in life satisfaction was associated with a 3.14-unit increase on the WEMWBS and a 1.37-unit increase on the SWEMWBS. Moreover, differences in mean life satisfaction ratings significantly varied across high and non-high (S)WEMWBS scores.

Internal consistency

The internal consistencies of the WEMWBS (Cronbach's alpha = 0.94) and the SWEMWBS (Cronbach's alpha = 0.87) were acceptable.[38]

Discussion

This study validates various aspects of the (S)WEMWBS in a representative sample of adults in Canada. The (S)WEMWBS had relatively normal distributions, with the proportion of respondents at the lowest and highest scores at reasonable levels.[41,42] This can help analyses involving (S)WEMWBS scores meet normality assumptions that underlie some statistical tests and allow for increases or decreases in population PMH to be reflected on these scales. Consistent with meta-analytic findings,[19] the (S)WEMWBS had acceptable internal consistencies, suggesting little item-specific variance.[45]

Similar to recent studies,[14,15,22,24] the factor structures of the (S)WEMWBS with the greatest support in this study were the

bifactor models. The bifactor indices consistently suggested that the (S)WEMWBS can be considered essentially unidimensional, with the general PMH factor explaining most of the common variance. These results provide justification for the use of overall (S)WEMWBS scores as broad indicators of PMH among adults in Canada.

As found in some but not all previous studies,[15,16,18,20] the (S)WEMWBS had measurement invariance across age and gender, allowing for comparisons by these sociodemographic factors.[35] Older adults scored highest on the (S)WEMWBS, while younger adults scored lowest. This pattern has been found with other PMH outcomes among Canadian adults[27,46] and could be attributable to aging or cohort effects.[47] A gender difference in mean scores was found on the WEMWBS but not the SWEMWBS, with men+ scoring higher than women+ on average on the WEMWBS. Similar observations were made in England[48] and could be attributable to the SWEMWBS having a greater portion of psychological well-being items than the WEMWBS.[7] Indeed, previous Canadian research found that sex was not a significant predictor of psychological well-being.[46]

High ratings on the single-item PMH measures (i.e., life satisfaction, SRMH, and community belonging) were associated with higher average (S)WEMWBS scores, while the indicators of mental ill-health (i.e., perceived stress and mood or anxiety disorder diagnosis) were associated with lower scores. These results provide evidence for the criterion validity of the (S)WEMWBS and are in line with previous research.[6,14-18] The amount of variance explained by life satisfaction and the proportion of individuals with high SRMH and strong community belonging in the non-high (S)WEMWBS group (or vice versa) suggest that the (S)WEMWBS are not redundant with existing single-item PMH measures. The prevalence of individuals with high (S)WEMWBS scores was less than half among those who reported the presence (versus absence) of a mood or anxiety disorder diagnosis or high (versus non-high) perceived stress. However, a minority of these individuals were in the high (S)WEMWBS group, supporting the dual continuum model of mental health, which conceptualizes PMH and mental ill-health as being negatively related but distinct.[2]

Table 6
Comparing responses to the Warwick-Edinburgh Mental Well-being Scale and the Short Warwick-Edinburgh Mental Well-being Scale by other mental health indicators, household population aged 18 years and older, Canada (excluding territories)

	Comparing (S)WEMWBS means				Comparing (S)WEMWBS distributions						
					Non-high			High			
		95% CI		t-test		95% CI			95% CI		χ2 test
	Mean	from	to	*p*	%	from	to	%	from	to	*p*
WEMWBS											
Self-rated mental health											
High	57.51	57.08	57.94	< 0.001	39.0	36.3	41.8	61.0	58.2	63.7	< 0.001
Non-high	47.28	46.72	47.85	...	81.6	79.1	84.0	18.4	16.0	20.9	...
Community belonging											
Strong	55.63	55.20	56.07	< 0.001	46.7	44.1	49.2	53.3	50.8	55.9	< 0.001
Weak	48.68	48.01	49.35	...	76.0	72.8	79.1	24.0	20.9	27.2	...
Perceived stress											
High	47.20	46.20	48.20	< 0.001	79.7	75.9	83.5	20.3	16.5	24.1	< 0.001
Non-high	54.40	54.00	54.80	...	52.5	50.2	54.8	47.5	45.2	49.8	...
Mood disorder diagnosis											
Yes	44.21	43.01	45.42	< 0.001	85.9	81.7	90.2	14.1	9.8	18.3	< 0.001
No	54.13	53.74	54.52	...	54.3	52.1	56.5	45.7	43.5	47.9	...
Anxiety disorder diagnosis											
Yes	46.10	45.08	47.12	< 0.001	81.9	78.0	85.7	18.1	14.3	22.0	< 0.001
No	54.23	53.82	54.64	...	53.6	51.4	55.9	46.4	44.1	48.6	...
SWEMWBS											
Self-rated mental health											
High	26.57	26.34	26.81	< 0.001	33.7	30.9	36.5	66.3	63.5	69.1	< 0.001
Non-high	22.06	21.83	22.28	...	78.6	76.2	81.0	21.4	19.0	23.8	...
Community belonging											
Strong	25.74	25.52	25.97	< 0.001	42.0	39.6	44.4	58.0	55.6	60.4	< 0.001
Weak	22.68	22.41	22.94	...	72.3	69.4	75.3	27.7	24.7	30.6	...
Perceived stress											
High	22.05	21.65	22.44	< 0.001	77.1	73.3	80.8	22.9	19.2	26.7	< 0.001
Non-high	25.19	24.99	25.39	...	47.8	45.7	50.0	52.2	50.0	54.3	...
Mood disorder diagnosis											
Yes	21.02	20.58	21.46	< 0.001	84.0	80.0	88.0	16.0	12.0	20.0	< 0.001
No	25.03	24.84	25.22	...	49.7	47.6	51.8	50.3	48.2	52.4	...
Anxiety disorder diagnosis											
Yes	21.62	21.22	22.01	< 0.001	80.5	76.8	84.2	19.5	15.8	23.2	< 0.001
No	25.10	24.91	25.30	...	48.8	46.6	51.0	51.2	49.0	53.4	...

... not applicable

Notes: CI = confidence interval. SWEMWBS = Short Warwick-Edinburgh Mental Well-being Scale. WEMWBS = Warwick-Edinburgh Mental Well-being Scale. (S)WEMWBS = the WEMWBS and the SWEMWBS. Results are weighted. Because of missing data on (S)WEMWBS items and varying rates of missing responses on the other mental health indicators, the sample sizes ranged from 6,244 to 6,259 for the WEMWBS analyses and from 6,365 to 6,382 for the SWEMWBS analyses.

Source: Statistics Canada, 2024 Canadian Community Health Survey – Rapid Response on Sleep Quality and Positive Mental Health.

Table 7
Linear regression analyses and *t* -tests involving life satisfaction and the Warwick-Edinburgh Mental Well-being Scale and the Short Warwick-Edinburgh Mental Well-being Scale, houshold population aged 18 years and older, Canada (excluding territories)

	Predicting (S)WEMWBS scores (Unadjusted regression)				Comparing mean life satisfaction by (S)WEMWBS level						
					Non-high			High			
		95% CI				95% CI			95% CI		t-test
	b	from	to	R^2	Mean	from	to	Mean	from	to	*p*
WEMWBS											
Life satisfaction	3.14	2.95	3.33	0.38	6.66	6.57	6.76	8.39	8.30	8.48	< 0.001
SWEMWBS											
Life satisfaction	1.37	1.29	1.45	0.32	6.55	6.45	6.65	8.35	8.28	8.43	< 0.001

Notes: *b* = unstandardized regression coefficient. CI = confidence interval. R^2 = coefficient of determination. SWEMWBS = Short Warwick-Edinburgh Mental Well-being Scale. WEMWBS = Warwick-Edinburgh Mental Well-being Scale. (S)WEMWBS = the WEMWBS and the SWEMWBS. Results are weighted. Because of missing responses to the life satisfaction question and any of the items from each scale, the sample sizes were 6,264 for the WEMWBS analyses and 6,388 for the SWEMWBS analyses.
Source: Statistics Canada, 2024 Canadian Community Health Survey – Rapid Response on Sleep Quality and Positive Mental Health.

Strengths and limitations

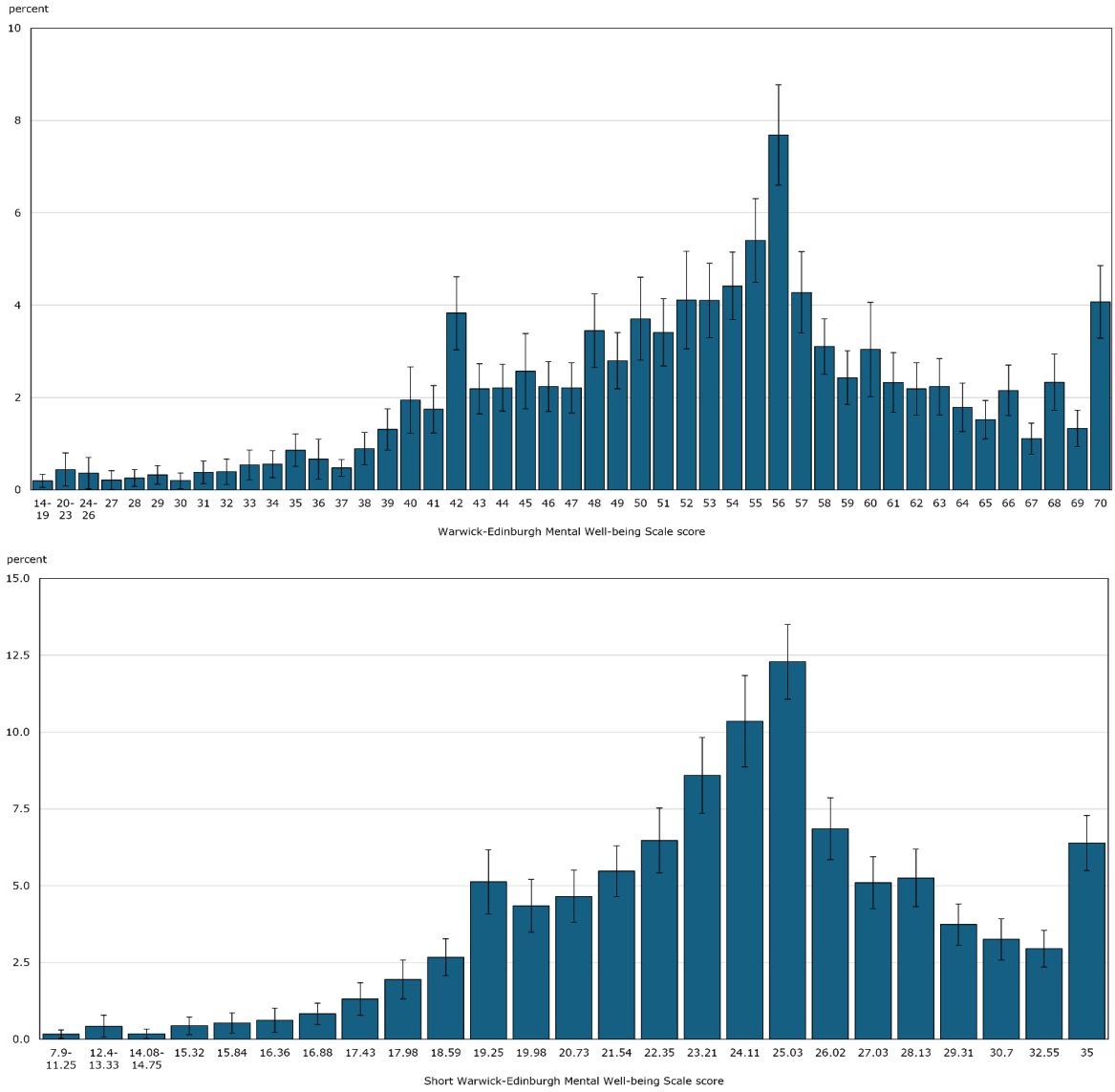
This study increases understanding of the psychometric properties of the (S)WEMWBS among adults in Canada using data from a representative population health survey, providing greater confidence in their use for national PMH surveillance and research. Numerous models were tested from the literature, with no post hoc data-driven changes to the models based on modification indices.[21] Some additional models were explored but not reported on because of error or warning messages in Mplus regarding inestimable standard errors or non-positive definite covariance matrices. Untested models with different item loadings are also theoretically plausible (e.g., feeling good about oneself is arguably an indicator of self-acceptance, which is traditionally thought to be part of psychological well-being).[3] While the (S)WEMWBS were described as relatively comprehensive measures of overall PMH, they exclude some aspects of PMH, such as broader elements of social well-being that reflect functioning in society rather than only in interpersonal relationships.[15,29] Other approaches and cut-offs for categorizing (S)WEMWBS levels could have been used.[2,48,49] The cross-sectional data limit inferences about causality and prevent the examination of test-retest reliability and predictive validity. The self-reported nature of the data could have led to biases. The response and share rates were relatively low. While the sampling weights used in analyses attempt to adjust for non-response and non-sharing, they could still have affected the results. Because of data access limitations, measurement invariance could not be tested for those who agreed versus those who disagreed with Statistics Canada sharing their data. The validity of the (S)WEMWBS for those who were excluded from the CCHS (e.g., youth, full-time members of the Canadian Armed Forces) could be investigated in other studies.

Conclusion

The (S)WEMWBS appear to be valid and reliable measures of PMH for adults in Canada. The (S)WEMWBS could be integrated into existing frameworks that guide surveillance, such as the Positive Mental Health Surveillance Indicator Framework,[27] and regularly included in health surveys to allow for the monitoring of population-level changes over time. With increasing international attention[2] and evidence of cross-cultural validity,[22] the (S)WEMWBS provide opportunities for cross-country comparisons that could complement those based on other indicators (e.g., life evaluation and positive emotions in the World Happiness Report).[50] While mean WEMWBS scores in Canada appear to be higher than in the United Kingdom, lower than in Catalonia (Spain), and similar to those in Denmark and Germany,[15,22] the Canadian data are more recent; therefore, cross-country comparisons should be interpreted with caution until more temporally comparable data are obtained. Future research could examine measurement invariance and differences on the (S)WEMWBS by additional sociodemographic characteristics that have shown disparities on other PMH outcomes.[27]

Appendix Figure 1

Distributions of scores from the Warwick-Edinburgh Mental Well-being Scale and the Short Warwick-Edinburgh Mental Well-being Scale, household population aged 18 years and older, Canada (excluding territories)



Notes: SWEMWBS = Short Warwick-Edinburgh Mental Well-being Scale. WEMWBS = Warwick-Edinburgh Mental Well-being Scale. Results are weighted. Because of missing data on any of the items on each scale, the sample sizes were 6,266 for the WEMWBS and 6,390 for the SWEMWBS. Whiskers on each bar are 95% confidence intervals. For this figure only, the lowest scores on the WEMWBS and the SWEMWBS were coded into groups, as the individual scores were not releasable.

Source: Statistics Canada, 2024 Canadian Community Health Survey – Rapid Response on Sleep Quality and Positive Mental Health.

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