Appendix E
Description of the *RAND–12 Health Status Inventory*

The RAND–12 HSI, a 12-item version of the RAND–36 HSI, is reported in this appendix, including a discussion of the selection of the items, the methodology of the scoring, and an example. The RAND–12 HSI items by scale and composite are provided in Appendix G. The purpose of the RAND–12 HSI is to provide estimated scores on the Physical Health, Mental Health, and Global Health composites of the 36-item instrument. For this reason, separate norms tables and validity analyses are not provided. The intended use of the 12-item instrument is aggregate-level analysis, when summary reports are desired; its scores are not considered precise enough for individual-level analysis. Instructions for scoring responses are also provided on the RAND–12 HSI Hand-Scoring Worksheet. (RAND–12 HSI Question/Answer Sheets and Hand-Scoring Worksheets are available from The Psychological Corporation.)

Item Selection

The RAND–12 HSI contains at least one item from each of the eight scales of the RAND–36 HSI so that the abbreviated form adequately represents the wide range of relevant aspects of health status (Ware, Kosinski, & Keller, 1995, 1996). Table E.1 summarizes the correlations between the 12 items and the three RAND–36 HSI composite scores that they were selected to estimate.

Item Scoring Methodology

The scores derived from the RAND–12 HSI represent composite estimates of the corresponding RAND–36 HSI Physical Health, Mental Health, and Global Health composite scores. The items included in each composite are drawn from the items on the scales included in the corresponding RAND–36 HSI composites. Six items contribute to each of the Physical Health Composite and Mental Health Composite estimates, with all 12 items contributing to the Global Health Composite estimate. The three composite estimates are based on three regression equations for each of the seven normative groups (described in Chapter 2), for a total of 21 regression formulas. For each regression, the RAND–36 HSI

composite *T* score was the dependent variable, and the IRT-weighted item scores were the independent variables. Scoring methodology was developed to be as pragmatic as possible while maintaining the IRT weighting at the level of response option for each item. For this reason, the value for each item response in the prediction formula was the IRT weighting for the response option in the RAND–36 HSI for that item (see Appendix A, Tables A.1–A.8). Although these response-option IRT weights are based on scale composition that is not retained in the RAND–12 HSI, these weights retain the item-specific response-option weighting. The relative weights of item responses in the new formula are determined by the regression analyses.

Each of the 21 prediction formulas was developed on the data from 60% of each original normative sample and cross-validated on the data from the remaining 40% of each sample. The general formula for calculating an estimated composite *T* score is

Estimated Composite *T* Score = Intercept Value + Sum of Derived Item Scores

The derived score for each of the contributing items is the IRT weight for the response option multiplied by the item's parameter estimate. The specific formula for each of the three composites follows. Note that the item numbers are RAND–36 HSI item numbers. The IRT weights for the formulas are found in Appendix A, Table A.1–A.8. The norm-specific intercept values and the parameter estimates are provided in Tables E.2–E.4.

Estimated **Physical Health Composite** *T* Score =

Intercept Value (Table E.2)
+ (Item 1 IRT Weight) (Parameter Estimate)
+ (Item 4 IRT Weight) (Parameter Estimate)
+ (Item 6 IRT Weight) (Parameter Estimate)
+ (Item 14 IRT Weight) (Parameter Estimate)
+ (Item 15 IRT Weight) (Parameter Estimate)
+ (Item 22 IRT Weight) (Parameter Estimate)

Estimated **Mental Health Composite** *T* Score =

Intercept Value (Table E.3)
+ (Item 18 IRT Weight) (Parameter Estimate)
+ (Item 19 IRT Weight) (Parameter Estimate)
+ (Item 26 IRT Weight) (Parameter Estimate)
+ (Item 27 IRT Weight) (Parameter Estimate)
+ (Item 28 IRT Weight) (Parameter Estimate)
+ (Item 32 IRT Weight) (Parameter Estimate)

Estimated **Global Health Composite** *T* Score =

Intercept Value (Table E.4)
+ (Item 1 IRT Weight) (Parameter Estimate)
+ (Item 4 IRT Weight) (Parameter Estimate)
+ (Item 6 IRT Weight) (Parameter Estimate)
+ (Item 14 IRT Weight) (Parameter Estimate)
+ (Item 15 IRT Weight) (Parameter Estimate)
+ (Item 18 IRT Weight) (Parameter Estimate)
+ (Item 19 IRT Weight) (Parameter Estimate)
+ (Item 22 IRT Weight) (Parameter Estimate)
+ (Item 26 IRT Weight) (Parameter Estimate)
+ (Item 27 IRT Weight) (Parameter Estimate)
+ (Item 28 IRT Weight) (Parameter Estimate)
+ (Item 32 IRT Weight) (Parameter Estimate)

Scoring Example

Following is an example demonstrating the calculation of the three RAND–12 HSI estimated composite *T* scores. The example is based on the responses of a 21-year-old female respondent and the intercept value and parameter estimates for the 18–24 Age Group.

Estimated Physical Health Composite *T* Score

Intercept Value = –19.0938

RAND–12 HSI Item	RAND–36 HSI Item	Response	IRT Weight		Parameter Estimate		Derived Item Score
1	1	3	46	x	.1108	=	5.0968
2	4	3	56	x	.1566	=	8.7696
3	6	3	72	x	.1605	=	11.5560
4	14	2	100	x	.1076	=	10.7600
5	15	2	74	x	.1877	=	13.8898
8	22	2	49	x	.3283	=	16.0867

Estimated *T* Score = –19.0938 + 66.1589
= 47.0651
= 47 (rounded to nearest whole number)

Actual *T* Score = 46

Estimated Mental Health Composite *T* Score

Intercept Value = 10.4916

RAND–12 HSI Item	RAND–36 HSI Item	Response	IRT Weight	x	Parameter Estimate	=	Derived Item Score
6	18	1	59	x	.0521	=	3.0739
7	19	1	13	x	.1044	=	1.3572
9	26	4	32	x	.1054	=	3.3728
10	27	5	13	x	.1268	=	1.6484
11	28	3	22	x	.1642	=	3.6124
12	32	2	38	x	.1170	=	4.4460

Estimated *T* Score = 10.4916 + 17.5107
= 28.0023
= 28 (rounded to nearest whole number)

Actual *T* Score = 29

Estimated Global Health Composite *T* Score

Intercept Value = –8.4989

RAND–12 HSI Item	RAND–36 HSI Item	Response	IRT Weight	x	Parameter Estimate	=	Derived Item Score
1	1	3	46	x	.0517	=	2.3782
2	4	3	56	x	.0428	=	2.3968
3	6	3	72	x	.1118	=	8.0496
4	14	2	100	x	.0300	=	3.0000
5	15	2	74	x	.0901	=	6.6674
6	18	1	59	x	.0303	=	1.7877
7	19	1	13	x	.0491	=	.6383
8	22	2	49	x	.1285	=	6.2965
9	26	4	32	x	.0723	=	2.3136
10	27	5	13	x	.0962	=	1.2506
11	28	3	22	x	.1296	=	2.8512
12	32	2	38	x	.0989	=	3.7582

Estimated *T* Score = –8.4989 + 41.3881
= 32.8892
= 33 (rounded to nearest whole number)

Actual *T* Score = 34

Note on Negative Regression Weightings

In multiple linear regression, the set of regression weights is chosen to maximize the variance of the dependent variables that can be explained by the set of independent variables (R^2). Unless all of the independent variables are uncorrelated, a simple relationship does not exist between regression weights and the correlation between the independent variable and dependent variable. Therefore, a negative regression weight in multiple regressions does not indicate anything about the relationship between the item score and the composite score. The relationship between any given item score and composite score is demonstrated by the correlation between the two scores (see Table E.1).

Cross-Validation

Cross-validation results correlating predicted composite *T* scores from the RAND–12 HSI with actual *T* scores on the RAND–36 HSI for the cross-validation sample of each normative group are presented in Table E.5. The cross-validated R^2 values are all adequate, with 19 of the 21 R^2 values $\geq .90$.

Table E.1. Correlations Between RAND–12 HSI and RAND–36 HSI Item Scores for the Seven Normative Groups

Item Number		RAND-36 HSI Composites																					
		Physical Health Composite							Mental Health Composite							Global Health Composite						
R–12	R–36[a]	18–24	25–44	45–64	≥65	Overall	Female	Male	18–24	25–44	45–64	≥65	Overall	Female	Male	18–24	25–44	45–64	≥65	Overall	Female	Male
1	1	.69	.73	.77	.72	.74	.73	.74	.51	.55	.57	.53	.52	.48	.57	.65	.70	.73	.67	.69	.68	.70
2	4	.52	.68	.72	.73	.70	.69	.71	.16**	.32	.49	.51	.33	.30	.36	.33	.52	.64	.66	.55	.53	.56
3	6	.63	.54	.71	.65	.66	.65	.68	.32	.35	.46	.41	.32	.25	.40	.49	.47	.63	.55	.52	.47	.56
4	14	.69	.69	.74	.75	.73	.71	.74	.40	.43	.57	.58	.47	.41	.52	.57	.59	.70	.71	.65	.62	.68
5	15	.58	.74	.84	.79	.77	.76	.78	.22****	.43	.54	.58	.42	.30	.55	.40	.62	.73	.73	.64	.57	.71
8	22	.75	.79	.84	.82	.81	.83	.80	.47	.54	.55	.61	.53	.49	.57	.65	.71	.74	.76	.73	.73	.73
6	18	.40	.36	.31	.40	.30	.18***	.46	.61	.64	.56	.53	.59	.60	.60	.58	.57	.49	.51	.52	.47	.58
7	19	.41	.28	.37	.39	.32	.25	.41	.63	.56	.61	.50	.54	.53	.55	.60	.49	.55	.48	.49	.46	.53
9	26	.25******	.41	.41	.37	.33	.30	.36	.63	.72	.77	.66	.73	.75	.70	.53	.65	.66	.57	.61	.63	.61
10	27	.44	.54	.56	.60	.53	.48	.57	.72	.68	.77	.73	.70	.72	.68	.67	.69	.74	.72	.70	.70	.69
11	28	.42	.33	.44	.31	.29	.30	.29	.71	.67	.80	.59	.66	.67	.66	.66	.57	.70	.50	.55	.58	.54
12	32	.36	.43	.68	.49	.50	.48	.52	.55	.67	.77	.71	.71	.71	.69	.53	.63	.80	.66	.69	.70	.67

Note. 18–24, n = 200; 25–44, n = 200; 45–64, n = 200; ≥65, n = 200; Overall, n = 500; Female, n = 255; Male, n = 245. Items above the bold line are included in the Physical Health Composite estimate. Items below the bold line are included in the Mental Health Composite estimate.

[a]The RAND–36 HSI item numbers are listed so that IRT-weight ranges for each item can be found in Appendix A, Tables A.1–A.8.

*All correlations are significant at $p < .0001$, unless otherwise indicated.

**$p < .0224$. ***$p < .0033$. ****$p < .0021$. *****$p < .0003$.

Table E.2. Intercept Values and Parameter Estimates for Predicting Physical Health Composite *T* Scores From the RAND–12 HSI

		Aged-Based Sample				Age-Stratified Sample		
		18–24	25–44	45–64	≥65	Overall	Female	Male
Intercept		-19.0938	-11.0710	10.5244	9.1548	2.8864	–.4386	2.7032
Item Number								
R–12	**R–36[a]**							
1	1	.1108	.0896	.0943	.0923	.0967	.1071	.0928
2	4	.1566	.2342	.0489	.1143	.0799	.1215	.0748
3	6	.1605	.1602	.1146	.0876	.1306	.1144	.1231
4	14	.1076	.1107	.0763	.0822	.0911	.1425	.0713
5	15	.1877	.1482	.1172	.1010	.1331	.0919	.1773
8	22	.3283	.2160	.2005	.2597	.2151	.2121	.2206

Note. Normative groups represent 60% of the original standardization samples. The IRT weight is multiplied by the parameter estimate for the selected normative group.

[a]The RAND–36 HSI item numbers are listed so that IRT-weight ranges for each item can be found in Appendix A, Tables A.1–A.8.

Table E.3. Intercept Values and Parameter Estimates for Predicting Mental Health Composite *T* Scores From the RAND–12 HSI

		Aged-Based Sample				Age-Stratified Sample		
		18–24	25–44	45–64	≥65	Overall	Female	Male
Intercept		10.4916	7.5204	7.8641	4.5878	5.0185	5.6996	1.9757
Item Number								
R–12	**R–36[a]**							
6	18	.0521	.0741	.0978	.0308	.0939	.1105	.1241
7	19	.1044	.1407	.0454	.1050	.1112	.0898	.0862
9	26	.1054	.1097	.0951	.1133	.1026	.1158	.1040
10	27	.1268	.1104	.0992	.1529	.1125	.1102	.1440
11	28	.1642	.1633	.1507	.1672	.1621	.1600	.1529
12	32	.1170	.1206	.1478	.1547	.1326	.1214	.1233

Note. Normative groups represent 60% of the original standardization samples. The IRT weight is multiplied by the parameter estimate for the selected normative group.

[a]The RAND–36 HSI item numbers are listed so that IRT-weight ranges for each item can be found in Appendix A, Tables A.1–A.8.

Table E.4. Intercept Values and Parameter Estimates for Predicting Global Health Composite *T* Scores From the RAND–12 HSI

		Aged-Based Sample				Age-Stratified Sample		
		18–24	25–44	45–64	≥65	Overall	Female	Male
Intercept		–8.4989	–7.6688	5.2822	2.1652	–3.1424	–3.5430	–1.7177
Item Number								
R–12	R–36[a]							
1	1	.0517	.0512	.0650	.0547	.0581	.0541	.0423
2	4	.0428	.1178	–.0031	.0357	.0057	.0725	–.0063
3	6	.1118	.0709	.0628	.0480	.0714	.0518	.0742
4	14	.0300	.0642	.0518	.0558	.0598	.0821	.0501
5	15	.0901	.0700	.0581	.0580	.0812	.0227	.0882
6	18	.0303	.0476	.0675	–.0015	.0524	.0623	.0468
7	19	.0491	.0869	–.0159	.0621	.0701	.0505	.0688
8	22	.1285	.1264	.1027	.1393	.1169	.1263	.1132
9	26	.0723	.0737	.0745	.0751	.0701	.0792	.0687
10	27	.0962	.0619	.0445	.0764	.0626	.0688	.0860
11	28	.1296	.0860	.0855	.0978	.0928	.1037	.0959
12	32	.0989	.0709	.0837	.0951	.0869	.0738	.0778

Note. Normative groups represent 60% of the original standardization samples. The IRT weight is multiplied by the parameter estimate for the selected normative group.

[a]The RAND–36 HSI item numbers are listed so that IRT-weight ranges for each item can be found in Appendix A, Tables A.1–A.8.

Table E.5. Cross-Validation Results Predicting RAND–36 HSI Composite *T* Scores From the RAND–12 HSI

		Aged-Based Sample				Age-Stratified Sample		
Composite		18–24 (*n* = 80)	25–44 (*n* = 80)	45–64 (*n* = 80)	≥65 (*n* = 80)	Overall (*n* = 200)	Female (*n* = 102)	Male (*n* = 98)
Physical Health	R^2	.91	.88	.93	.92	.94	.92	.94
	$S_{y\cdot x}$	3.00	3.46	2.65	2.83	2.45	2.83	2.45
Mental Health	R^2	.92	.92	.95	.87	.92	.93	.93
	$S_{y\cdot x}$	2.83	2.83	2.24	3.61	2.83	2.65	2.65
Global Health	R^2	.94	.93	.95	.94	.95	.94	.95
	$S_{y\cdot x}$	2.45	2.65	2.24	2.45	2.24	2.45	2.24

Note. Cross-validation samples are based on 40% of the original standardization sample. R^2 = the squared correlation between actual score and predicted score. $S_{y\cdot x}$ = the Standard Error of Multiple Estimate: $S_{y\cdot x} = S_y\sqrt{1 - R^2}$.