

Health-Related Hardiness

Age Cohorts	Older
Surveys	Survey 2
Derived Variable	HRDINS1
Definition	7-item, summed scale measuring Health-Related Hardiness Scale - score 1 (positive items)
Source Items (Index Numbers)	HRHS1, HRHS3, HRHS6, HRHS7, HRHS9, HRHS12 & HRHS13 (HRHS-001, -003, -006, -007, -009, -012 & -013)
Statistical Form	Continuous variable
Index Number	HRHS-016
Derived Variable	HRDINS2
Definition	7-item, summed scale measuring Health-Related Hardiness Scale - score 1 (negative items)
Source Items (Index Numbers)	HRHS2, HRHS4, HRHS5, HRHS8, HRHS10, HRHS11& HRHS14 (HRHS-002, -004, -005, -008, -010, -011& -014)
Statistical Form	Continuous variable
Index Number	HRHS-017
Prepared by	Nadine Smith
Endorsed	15 October 2003

Background

Health-related hardiness is conceptualised as a multifaceted construct, composed of three subordinate concepts: a sense of control over one's health (control dimension), a commitment to the maintenance of one's health (commitment dimension), and a tendency to prefer to take direct action in the face of challenges (challenge dimension). The "control" dimension of the health-related hardiness construct has been defined as a sense of mastery or self-confidence regarding the skills needed to appropriately appraise and interpret health¹. The "control" dimension of the health-related hardiness construct has been widely studied and is closely related to the concept of "health locus of control".

The Health-Related Hardiness Scale (HRHS)

Pollock and Duffy² developed the Health-Related Hardiness Scale (HRHS) to measure the effects of hardiness in people with diagnosed health problems (diabetes, hypertension, multiple sclerosis and rheumatoid arthritis). The factors of commitment/challenge and control were identified from positive and negative self-report items.

The development of the HRHS, in contrast to many other measures of hardiness, was undertaken with rigorous attention to psychometric testing, including assessment of item-to-concept content validity. Pollock and Duffy conceptualised hardiness as a multidimensional characteristic with aspects of control, commitment and challenge. This conceptualisation has received some empirical support through criterion-related validity studies and factor analytic studies.³ Some researchers have found different criterion relationships for the three components and small positive correlations

between components, suggesting these components are not highly related aspects of a single concept of hardiness, but rather three dimensions of the multidimensional concept of hardiness.⁴

Source items

The ALSWH surveys used only the 14 items from the control sub-scale of the HRHS.² The items and scoring are shown below.

Please indicate how much agree with each statement

HRHS1	a	I can avoid illness if I take care of myself ^a
HRHS2	b	Luck plays a big part in determining how soon I will recover from an illness ^b
HRHS3	c	I am in control of my health ^a
HRHS4	d	My good health is largely a matter of good fortune ^b
HRHS5	e	No matter what I do, if I am going to get sick, I will get sick ^b
HRHS6	f	The main thing which affects my health is what I do myself ^a
HRHS7	g	Setting goals for health is realistic ^a
HRHS8	h	Most things that affect my health happen to me by accident ^b
HRHS9	i	If I get sick, it is my own behaviour that determines how soon I will get well ^a
HRHS10	j	I will stay healthy if it's meant to be ^b
HRHS11	k	No matter what I do, I am likely to get sick ^b
HRHS12	l	If I take the right actions, I can stay healthy ^a
HRHS13	m	I can be as healthy as I want to be ^a
HRHS14	n	I have little influence over my health ^b

^a Positive item

^b Negative item

Positive Item Score	Negative Item Score	Response
1	6	Strongly disagree
2	5	Disagree
3	4	Slightly disagree
4	3	Slightly agree
5	2	Agree
6	1	Strongly agree

Scale Evaluation

Item Responses

The 14 items from the HRHS control sub-scale was included in the full version of Survey 2 of the Older cohort. Responses were distributed across the entire scale with a slight skewed left for most positively-phrased items (positive items) and slight skew right for most negatively-phrased items (negative items) (Table 1). Mean scores ranged from 3.7 to 4.5 for positive items and 2.2 to 4.1 for negative items. The percentage of missing data was moderate (2.5% to 8.5%) and 84% of women completed all 14 items.

Factor Analysis

Factor analysis using principal components estimation was performed using responses from 7 679 Older women completing all 14 items. Inter-item correlations are shown in Table 2.

There were 3 factors with eigenvalues greater than one (Table 3) and they explained approximately 27%, 17% and 7% of the variance respectively. Two factors were suggested by parallel analysis and the MAP test.

Also, for the principal components solution (unrotated) loadings on the third factor were weak for all items (<0.5 ; Table 4). Factor loadings for the two-factor solution with varimax (orthogonal) and promax (oblique) rotations strongly suggest 2 factors. The correlation between factors for the promax rotation was very low ($-.05$).

All 7 positively phrased items loaded moderately (>0.5) onto factor 1 (referred to as “hardiness 1”) and weakly onto the other factor. All 7 negatively phrased items loaded moderately (>0.5 for all items except item “h”, 0.45 loading) onto factor 2 (referred to as “hardiness 2”) and weakly onto the other factor.

Table 1 Distribution (%) and mean (SD) of responses and percent missing for 14 HRHS control sub-scale (n = 9 501)

Please indicate how much agree with each statement	Percent					Mean (SD)	Number (percent) missing
	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Strongly agree		
Positive items							
a I can avoid illness if I take care of myself	2.4	8.3	5.7	19.2	50.8	13.7	4.5 (1.2) 241 (2.5)
c I am in control of my health	2.2	8.4	7.3	23.5	48.2	10.4	4.4 (1.2) 314 (3.3)
f The main thing which affects my health is what I do myself	5.6	18.5	6.7	17.8	43.5	8.0	4.0 (1.4) 569 (6.0)
g Setting goals for health is realistic	2.1	9.3	5.1	17.1	57.9	8.5	4.4 (1.2) 797 (8.4)
i If I get sick, it is my own behaviour that determines how soon I will get well	4.6	13.2	5.8	21.6	46.2	8.5	4.2 (1.3) 557 (5.9)
l If I take the right actions, I can stay healthy	1.5	6.9	6.6	25.8	50.2	9.0	4.4 (1.1) 507 (5.3)
m I can be as healthy as I want to be	4.9	20.5	15.5	24.4	28.8	5.9	3.7 (1.4) 708 (7.5)
Negative items							
b Luck plays a big part in determining how soon I will recover from an illness	19.3	43.3	7.3	12.7	14.0	3.4	2.7 (1.5) 530 (5.6)
d My good health is largely a matter of good fortune	11.5	29.2	8.5	17.0	29.1	4.7	3.4 (1.5) 589 (6.2)
e No matter what I do, if I am going to get sick, I will get sick	34.0	42.6	6.1	6.7	8.2	2.5	2.2 (1.3) 502 (5.3)
h Most things that affect my health happen to me by accident	11.9	39.9	9.4	12.5	22.3	4.0	3.1 (1.5) 700 (7.4)
j I will stay healthy if it's meant to be	5.3	15.7	5.7	14.3	49.8	9.1	4.1 (1.4) 588 (6.2)
k No matter what I do, I am likely to get sick	14.3	27.9	9.3	13.8	30.4	4.4	3.3 (1.6) 651 (6.9)
n I have little influence over my health	9.4	32.4	14.7	16.4	23.3	3.8	3.2 (1.4) 589 (6.2)

Table 2 Pearson Correlations for 14 HRHS Items, by item direction (n = 7 679)

	Positive Items						Negative Items						
	c	f	g	i	l	m	b	d	e	h	j	k	n
Positive Items													
a	0.55	0.39	0.31	0.36	0.53	0.49	0.10	0.11	-0.20	0.11	0.12	-0.11	-0.17
c		0.37	0.30	0.33	0.51	0.50	0.07	0.12	-0.20	0.08	0.13	-0.08	-0.17
f			0.35	0.38	0.40	0.38	0.08	0.12	-0.02	0.17	0.09	-0.04	-0.15
g				0.33	0.37	0.34	0.05	0.08	-0.08	0.15	0.09	-0.07	-0.16
i					0.42	0.39	0.11	0.13	-0.05	0.22	0.20	0.02	-0.12
l						0.61	0.07	0.11	-0.17	0.12	0.19	-0.08	-0.16
m							0.14	0.18	-0.13	0.17	0.21	-0.04	-0.13
Negative Items													
b								0.45	0.20	0.24	0.29	0.24	0.23
d									0.11	0.23	0.35	0.22	0.17
e										0.15	0.10	0.32	0.25
h											0.19	0.16	0.08
j												0.35	0.20
k													0.32

Table 3 Results of factor analysis (n = 7 979)

Factor	Eigenvalue	Difference	Proportion	Simulated Eigenvalue ^a		Average ^b Squared Correlation
				Mean	95 th Percentile	
1	3.79	1.37	0.27	1.07	1.09	0.03
2	2.41	1.39	0.17	1.06	1.07	0.02
3	1.02	0.13	0.07	1.04	1.05	0.03
4	0.90	0.11	0.06	1.03	1.04	0.04
5	0.78	0.05	0.06	1.02	1.03	0.05
6	0.74	0.05	0.05	1.01	1.02	0.07
7	0.69	0.05	0.05	1.00	1.01	0.10
8	0.64	0.03	0.05	1.00	1.00	0.13
9	0.61	0.04	0.04	0.99	0.99	0.19
10	0.57	0.05	0.04	0.98	0.98	0.27
11	0.52	0.00	0.04	0.97	0.98	0.40
12	0.52	0.07	0.04	0.96	0.97	0.52
13	0.44	0.06	0.03	0.95	0.95	1.00
14	0.38		0.03	0.93	0.94	

^a Parallel Analysis; ^b Velicer's MAP test

Table 4 Factor loadings from rotated and un-rotated analyses (n = 7 979)

Item	Un-Rotated			Varimax		Promax	
	Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 1	Factor 2
Hardiness 1							
a	0.73	0.15	-0.17	0.75	0.04	0.75	0.06
c	0.72	0.14	-0.23	0.73	0.04	0.73	0.06
f	0.64	0.04	0.32	0.63	-0.06	0.63	-0.04
g	0.57	0.08	0.33	0.58	0.00	0.58	0.01
i	0.64	-0.05	0.26	0.62	-0.15	0.62	-0.13
l	0.78	0.11	-0.10	0.79	0.00	0.79	0.02
m	0.76	0.02	-0.12	0.76	-0.09	0.76	-0.07
Hardiness 2							
b	-0.23	0.64	0.15	-0.13	0.66	-0.11	0.66
d	-0.29	0.60	0.25	-0.20	0.63	-0.18	0.63
e	0.19	0.53	-0.48	0.27	0.50	0.28	0.51
h	-0.30	0.41	-0.46	-0.23	0.45	-0.22	0.44
j	-0.31	0.58	0.28	-0.22	0.61	-0.21	0.61
k	0.05	0.67	-0.02	0.15	0.66	0.17	0.66
n	0.22	0.58	0.17	0.30	0.55	0.32	0.56

Internal reliability

Cronbach's alphas for the items loading most strongly on "hardiness 1" factor are fairly high 0.83 (Table 5). Cronbach's alphas for the items loading most strongly on "hardiness 2" factor are moderate but acceptable 0.68. High internal reliability was maintained when individual items were deleted from both factors. Item-to-total correlations were moderate and almost all exceeded 0.5 for items loading highly on the "hardiness 1" factor. Whilst, item-to-total correlations were lower for items loading highly on the "hardiness 2" factor and ranged from 0.28 to 0.47.

As most of the ALSWH evaluation procedure criteria were met, the 14 HRHS control sub-scale items in the Older cohort data from Survey 2 were determined to comprise 2 factors.

Derived Variables*Scores and Missing items*

Summed scores were calculated as the total of item scores for "hardiness 1" and "hardiness 2". Mean substitution for up to two missing values was allowed. The distribution of missing items for these 2 scores is shown in Table 6.

Factor scores were calculated for women with complete data for all 14 items; two scores were calculated for the varimax rotation and two for the promax rotation. Scores were calculated as the total of item scores, weighted by the standardised scoring coefficients from the factor analysis (Table 7).

Table 5 Correlation with item-total and Cronbach's alpha for standardised variables with deletion of individual items and communality estimates

Deleted item/item	Correlation with total	Cronbach's Alpha	Communality Estimates
Hardiness 1	(n = 8 949)	(n = 8 949)	(n = 7 979)
None		0.83	0.56
a	0.62	0.79	0.54
c	0.60	0.80	0.41
f	0.53	0.81	0.33
g	0.46	0.82	0.41
i	0.51	0.81	0.62
l	0.68	0.79	0.58
m	0.63	0.79	
Hardiness 2	(n = 8 908)	(n = 8 908)	(n = 7 979)
None		0.68	
b	0.47	0.62	0.46
d	0.44	0.63	0.44
e	0.30	0.66	0.32
h	0.28	0.67	0.26
j	0.42	0.63	0.43
k	0.45	0.62	0.46
n	0.34	0.66	0.39

Table 6 Number and percent of items missing for the “hardiness 1” and “hardiness 2” factors (n = 9 501)

Number of items missing	Hardiness 1			Hardiness 2		
	Number	Percent	Cumulative percent	Number	Percent	Cumulative percent
0	8 229	86.6	86.6	8 081	85.1	85.1
1	555	5.8	92.4	652	6.9	92.0
2	165	1.7	94.1	175	1.8	93.8
3	103	1.1	95.2	107	1.1	94.9
4	93	1.0	96.2	96	1.0	95.9
5	144	1.5	97.7	83	0.9	96.8
6	77	0.8	98.5	122	1.3	98.1
7	135	1.4	99.9	185	2.0	100.1

Table 7 Standardised Scoring Coefficients for 2-Factor Solution based on Varimax and Promax rotations (n = 7 679)

Item	Varimax		Promax	
	Factor 1	Factor 2	Factor 1	Factor 2
Hardiness 1				
a	0.201	0.034	0.200	0.028
c	0.196	0.032	0.195	0.027
f	0.168	-0.009	0.169	-0.014
g	0.154	0.012	0.154	0.008
i	0.163	-0.047	0.164	-0.051
l	0.211	0.015	0.210	0.010
m	0.201	-0.022	0.201	-0.027
Hardiness 2				
b	-0.021	0.270	-0.028	0.271
d	-0.039	0.257	-0.046	0.258
e	0.082	0.211	0.076	0.209
h	-0.053	0.180	-0.058	0.181
j	-0.047	0.248	-0.054	0.249
k	0.055	0.274	0.047	0.273
n	0.093	0.231	0.086	0.229

Distributional properties of the sum and factor scores are shown in Table 8. All scores were approximately normally distributed.

Table 8 Distributional properties of sum and factor scores (n = 9 501)

Score	Mean	SD	Median	Skewness	Range
Summed score					
Hardiness 1	29.57	6.13	30.00	-0.64	7 to 42
Hardiness 2	27.08	6.02	27.00	-0.11	7 to 42
Factor score - Varimax					
Hardiness 1	5.84	1.24	6.00	-0.60	0.79 to 8.98
Hardiness 2	6.54	1.46	6.55	-0.08	1.73 to 10.40
Factor score - Promax					
Hardiness 1	5.66	1.25	5.82	-0.60	0.60 to 8.98
Hardiness 2	6.39	1.45	6.39	-0.09	1.56 to 10.29

For women with complete data on all 14 items, the correlation between summed scores and factor scores were very high (>0.98; Table 9). It is assumed that the high correlation between scores for complete cases will also apply to incomplete cases.

Table 9 Correlation of summed and factor scores (n = 7679)

Summed score	Varimax factor score	Promax factor score
Hardiness 1	0.98	0.98
Hardiness 2	0.99	0.99

Since the correlation between summed scores and factor scores were very high and since the summed scores are more generalisable (not population specific), the summed scores with mean-substitution for up to two missing items are used as measure of health-related hardiness.

Interpretation

Summed scores for 7 positive items and 7 negative items are referred to as "hardiness 1" and "hardiness 2" respectively. Higher scores for "hardiness 1" indicate that the woman has a stronger belief in self-control of health or internal locus of control. A higher score on "hardiness 2" indicate that the woman has a lower belief in the role of chance or luck in health. "Hardiness 1" has better psychometric properties than "hardiness 2" and may be more useful when used in analysis.

Recommendation for usage

The approximate normality of these two scores suggests treating scores as continuous for the purpose of analysis is appropriate.

The SAS code defining the two hardiness scores is:

```
/* Calculate o2hard1 - "hardiness 1" score (sum of the 7 positively worded
items) - Allow mean-substitution for up to two missing items */
array hard1 {7} o2q77a o2q77c o2q77f o2q77g o2q77i o2q77l o2q77m;
sumhard1 = sum(of hard1{*});
meanhard1 = mean(of hard1{*});
misshard1 = nmiss(of hard1{*});

if o2survey ne 2 then do ;
  if misshard1 in (0,1,2) then
    o2hard1 = sumhard1 + (misshard1 * meanhard1) ;
  else o2hard1 = . ;
end ;

/* Calculate o2hard2 - "hardiness 2" score (sum of the 7 negatively worded
items)- Allow mean-substitution for up to two missing items */

/* reverse score negatively worded hardiness items*/
o2q77br=7-o2q77b ;
o2q77dr=7-o2q77d ;
o2q77er=7-o2q77e ;
o2q77hr=7-o2q77h ;
o2q77jr=7-o2q77j ;
o2q77kr=7-o2q77k ;
o2q77nr=7-o2q77n ;

array hard2 (7) o2q77br o2q77dr o2q77er o2q77hr o2q77jr o2q77kr o2q77nr;
sumhard2 = sum(of hard2{*});
meanhard2 = mean(of hard2{*});
misshard2 = nmiss(of hard2{*});

if o2survey ne 2 then do ;
  if misshard2 in (0,1,2) then
    o2hard2 = sumhard2 + (misshard2 * meanhard2) ;
  else if 3<=misshard2<=7 then o2hard2 = . ;
end ;
```

References

1. Pollock S. Human responses to chronic illness: physiologic and psychosocial adaptation. *Nursing Research* 1986;35(2):90-95
2. Pollock S, Duffy M. The Health-Related Hardiness Scale: Development and psychometric analysis. *Nursing Research* 1990;39:218-222
3. Sinclair R, Tetrick L. Implications of item wording for hardiness structure, relation with neuroticism, and stress buffering. *Journal of Research in Personality*; 2000;34:1-25
4. Funk S, Houston B. A critical analysis of the Hardiness Scale's validity and utility. *Journal of the Personality and Social Psychology* 1987;53(3):572-578