International Journal of Methods in Psychiatric Research
Int. J. Methods Psychiatr. Res. 16(1): 11–22 (2007)
Published online in Wiley InterScience
(www.interscience.wiley.com) **DOI**: 10.1002/mpr.197

Structure analysis of Antonovsky's sense of coherence from an epidemiological mental health survey with a brief nine-item sense of coherence scale

OLAV MARTIN KLEPP,[1,5] ARNE MASTEKAASA,[2] TOM SØRENSEN,[1] INGER SANDANGER,[3] ROBERT KLEINER[1,4]

1 Institute of Psychiatry, Faculty of Medicine, University of Oslo, Norway
2 Faculty of Social Sciences, Department of Sociology, University of Oslo, Norway
3 Norwegian Health Services Research Centre, Department of Quality Control, University of Oslo, Norway
4 Temple University, Philadelphia, USA
5 Norwegian Centre for Minority Health Research, Oslo, Norway

Abstract

Antonovsky has proposed the sense of coherence (SOC) as a crucial factor that protects against symptoms of mental disease. A central issue in research on the SOC construct is whether this is most appropriately considered as one-dimensional or three-dimensional with comprehensibility (C), manageability (Ma) and meaningfulness (Me) as separate dimensions. In this paper we address this issue by means of confirmatory factor analysis of a shortened nine-item version of Antonovsky's original 29- and 13-items Sense of Coherence Scale (SOCS-29), using epidemiological data from a mental health survey of adults in local communities (N = 1,062). In addition to analysing the internal structure of the SOC items, we examine the association between estimated factor scores and variables expected to be statistically related to SOC. Goodness-of-fit indices were very good for the three-factor model but acceptable even for the one-factor model. In the three-factor model, however, the factors were found to be very highly or, with regard to Ma and C, even perfectly correlated. Moreover, the factor scores had very similar correlations with measures of psychological wellbeing, depression and anxiety and they are also very similarly related to age (and none of them are related to gender). We therefore conclude in favour of a one-factor model. Copyright © 2006 John Wiley & Sons, Ltd.

Key words: sense of coherence, Sense of Coherence Scale, mental health promotion, confirmatory factor analysis, dimensionality

Introduction

In recent decades a growing awareness of people's own inherent coping and mastering abilities has developed. These include locus of control (Rotter, 1966, 1975), health locus of control (Wallston et al., 1978), self-efficacy (Bandura, 1977, 1982), hardiness (Kobasa, 1979), coping and adaptation (Lazarus, 1984), dispositional optimism (Scheier et al., 1985, 1987), resilience (Garmezy, 1981, 1993; Rutter, 1985, 1990; Werner, 1989, 1993, 2001; Cederblad, 1996; Lindström, 2001; Friborg, et al., 2003). The concept of salutogenesis was introduced by Aaron Antonovsky (1979, 1987, 1993) and his theory has been widely adopted in research on health and wellbeing. Antonovsky constructed and published his Orientation to Life Questionnaire, also called the Sense of Coherence Scale (SOCS), to measure the

sense of coherence (SOC) (Antonovsky, 1987). The scale exists in two forms: the original longer version with 29 items to measure the SOC construct (SOCS-29) and a short form of 13 of the 29 items (SOCS-13). The 13-item scale was proposed for use when time or space limitations prevented the use of the full scale.

Antonovsky (1979, 1987, 1993) viewed the world as being a ubiquitous source of prevailing internal and external stressors bombarding us night and day and he tried to determine the global resistance factor (GFR) that protects us against disease and death. He wanted to know what the resistance resources had in common and he defined SOC as a global orientation that expresses the extent to which one has a pervasive, enduring though dynamic feeling of confidence that

(a) The stimuli deriving from one's internal and external environments in the course of living are structured, predictable, and explicable.
(b) The resources are available to one to meet the demands posed by these stimuli.
(c) These demands are challenges, worthy of investment and engagement.

In his definition of SOC, (a) is the cognitive component 'comprehensibility', (b) is the instrumental component 'manageability', and (c) is the motivational component 'meaningfulness'.

The 29-item scale includes 11 items that define comprehensibility, 10 items defining manageability and eight accounting for meaningfulness. The shorter 13-item scale contains five comprehensibility, four manageability, and four meaningfulness items (Antonovsky, 1987). Antonovsky (1987, 1993) maintained that these three components are dynamically interrelated; the scale was developed to measure a global orientation, sense of coherence, and hence the components should not be measured as distinct constructs. High intercorrelations between the three components have also been found in several previous studies (for example, Flannery et al., 1990; Hart et al., 1991; Petrie et al., 1992; Bishop, 1993; Krawatz et al., 1993; Pasikowski et al., 1994).

Individuals with high scores on all three are considered as having a high SOC; they view the world as highly coherent and are willing to confront and challenge stressors. Such individuals are likely to be assessed as healthy on the health/disease continuum. Many investigations have revealed that a strong sense of coherence is related to better use of available resources, more adaptive coping, and being more resilient (Lundquist, 1995; Johansson et al., 1998; Poppius et al., 1999). However, resilience is not really defined as a distinct clean-cut measure of own personal adjustment skills as the sense of coherence is, but in fact it also measures the ability to use family, social and external support systems to cope better with stress (Friborg et al., 2003). Sense of coherence is not a coping strategy in itself but individuals with a high sense of coherence may be more likely to adopt adaptive strategies flexibly, appropriate to the needs of the specific situation (Antonovsky, 1979). Those who score low on all components are considered as low in SOC; they regard the world as incoherent and hence are less able to master stressor challenges.

Antonovsky (1987) also maintained that the meaningfulness component is the essential component of the sense of coherence construct due to its motivational element. Hence an individual with high comprehensibility and high manageability but lacking in meaningfulness will have an overall weakening of his or her sense of coherence and therefore reduced coping abilities in facing internal or external stimuli or stressors.

Both the 29-item and the shortened 13-item SOC scales have been repeatedly demonstrated to be highly reliable measures with respect to both internal consistency and test-retest reliability (see Antonovsky, 1993). The Cronbach's alpha coefficients range between 0.82 to 0.95 for the 29-item version and from 0.74 to 0.91 for the SOCS 13-item version in various studies in 20 countries (Antonovsky, 1993). This has been confirmed in a number of studies (for example, Languis et al., 1992; Dudek et al., 1993; Frenz et al., 1993). Studies of test-retest reliability have also reported satisfactory stability (Languis et al., 1992; Antonovsky, 1993; Frenz et al., 1993). Some studies have reported test-retest correlations between 0.54 after a two-year interval and 0.97 after a few weeks (Antonovsky, 1996).

With regard to validity, the SOCS has revealed substantial convergent validity with other analogous measures (Antonovsky, 1993; Compton et al., 1996) and substantial construct validity (Frenz et al., 1993; Antonovsky, 1996).

Most previous studies of the dimensionality of SOCS have examined only intercorrelations among the SOCS items themselves, typically using some type of factor analysis. Such analyses of the internal structure of the items are important but they are not sufficient to estab-

DOI: 10.1002/mpr

lish construct validity. To do this, relationships between SOC measures and their assumed correlates should also be considered. More specifically, to the extent that comprehensibility, meaningfulness and manageability are distinct concepts, they should be differentially related to other variables.

The aim of the present paper is to provide further evidence on the dimensionality of SOC measures. The internal structure of the items is analysed by means of confirmatory factor analysis. In line with the theory and the findings in previous research we focus mainly on comparing the three-factor and the one-factor solution. Based on our initial findings, we also include a two-factor solution. (The two-factor solution was suggested by one of the reviewers of an earlier version of this paper.)

On the basis of the factor analyses scales for meaningfulness, comprehensibility and manageability as well as scales based on the one- and two-factor solutions are constructed and construct validity is further assessed by examining the relations between these scales and measures of psychological wellbeing and psychiatric symptoms. Relations with gender and age are also examined.

Method

Subjects and procedure

The data were collected during the summer and autumn of 2000 as part of a mental health survey of local communities. Each community was surveyed separately, one by one. Before distributing the questionnaires an article appeared in the local newspaper explaining the purpose of the survey and how it would be administered. The voluntary nature of the process was emphasized, and the anonymity of the respondents was guaranteed. The survey took place in rural communities of Lofoten in Norway. Most families and single persons in Lofoten generally live in their own small wooden houses. We were two investigators and between the two of us we visited every inhabited house in the communities. Only residents older than 18 who were at home, or would be coming home later that same day received their own questionnaire. If nobody was at home when we called, an appropriate number of questionnaires would be left with the next-door neighbour if it could be confirmed that their neighbours would be home later that same day. Visitors and tourists from outside the community were excluded from the survey and therefore did not receive a questionnaire. Residents not present in their local community on the day of the survey were not included in our study. By visiting every single household we were able to provide more information and answer questions about the survey and the questionnaire. The questionnaires were personally collected by the same two investigators a couple of days later. In that way all unanswered or missing questionnaires were accounted for. People not at home would leave their questionnaire in a plastic bag tied to their front door. In addition a few respondents chose to remit their questionnaires by mail in preaddressed envelopes provided.

Altogether 1,062 questionnaires were answered and retrieved out of the 1,583 distributed, this equals a response rate of 67%. This number 1,583 corresponds to the sum of the total adult population above 18 years of age present at the time of our survey of all inhabited dwellings of the seven local communities in our study. Our sample is thus the 1,062 adults of the seven communities present at the time of the survey that responded and returned their questionnaires to us.

Not all respondents returned complete data on all the variables. In particular, only 905 responded to all the nine SOCS items, and only they were included in the factor analyses.

The mean age of the non-responders on these items was significantly higher than the mean age of the responders ($t = 6.99$, $df = 1054$), and the non-responders also reported significantly less anxiety ($t = 2.17$, $df = 1034$) and depression ($t = 2.10$, $df = 1035$). Responders and non-responders to the SOCS items did not differ significantly in terms of gender ($t = 0.21$, $df = 1042$) or psychological wellbeing ($t = 1.10$, $df = 1045$).

Measures

Sense of coherence

For our epidemiological mental health survey of local communities we constructed in 1999 a user-friendly questionnaire of 269 items. A brief new measurement scale of Sense of Coherence was a requirement for this questionnaire. We searched the available literature and databases for the keywords 'sense of coherence' and 'Sense of Coherence Scale'. Of peer-reviewed papers in the databases of PubMed and PsycInfo in the Autumn of 1999, we only came across papers referring to Antonovsky's original 29 items SOCS-29 and its shorter SOCS-13 version. So we decided to construct an even

DOI: 10.1002/mpr

shorter version of Antonovsky's SOCS-29 ourselves. The items we chose were the three highest loading items on each of the three sub-components; comprehensibility (C), manageability (Ma) and meaningfulness (Me), from the Feldt et al. (1998) Confirmatory Factor Analysis (CFA) study of Antonovsky's SOCS-13. We decided to keep the scale in the original Antonovsky format by using the same seven-point Likert scale with anchoring phrases at both extremes in our new brief nine-item Antonovsky SOC scale (SOCS-9). Thirteen of the items in SOCS-29 have reversed scores to avoid response set bias. We retained reversed scores of the same items as Antonovsky in SOCS-9.

The nine items of the short SOCS-9 version of Antonovsky are listed in figure 1. The corresponding numbers of the items from SOCS-29 are in parenthesis (A.).

Psychological wellbeing

This is an additive index with four items asking about degree of happiness, degree of satisfaction, how rewarding or disappointing life is perceived to be and the Cantril ladder (Cantril, 1965; Bradburn, 1969; Andrews et al., 1976; Campbell et al., 1976; Sørensen et al., 1996). (The Cantril ladder is a visual scale shaped as a ladder with 10 rungs where the top rung and the lowest rung are the anchoring points 'best life' and 'worst life'.) Each item was standardized before computing the arithmetic average of the four scores for each respondent.

Psychiatric symptoms

Additive scales for *anxiety* and *depression* were constructed using 14 items from the Hopkins Symptom Check-list 25 (Derogatis et al., 1974; Derogatis, 1977; Winokur et al., 1984; Sandanger, 1999).

1. **(ME)** (A4) Do you have the feeling that you don't really care about what goes on around you?
1 very seldom or never — 2 — 3 — 4 — 5 — 6 — 7 very often

2. **(MA)** (A9) Do you have the feeling that you're being treated unfairly?
1 very often — 2 — 3 — 4 — 5 — 6 — 7 very seldom or never

3. **(C)** (A12) Do you have the feeling that you are in an unfamiliar situation and don't know what to do?
1 very often — 2 — 3 — 4 — 5 — 6 — 7 very seldom or never

4. **(ME)** (A16) Doing the things you do every day is:
1 a source of deep pleasure and satisfaction — 2 — 3 — 4 — 5 — 6 — 7 a source of pain and boredom

5. **(C)** (A19) Do you have very mixed-up feelings and ideas?
1 very often — 2 — 3 — 4 — 5 — 6 — 7 very seldom or never

6. **(C)** (A21) Does it happen that you have feelings inside that you would rather not feel?
1 very often — 2 — 3 — 4 — 5 — 6 — 7 very seldom or never

7. **(MA)** (A25) Many people – even those with a strong character – sometimes feel like sad sacks (losers) in certain situations. How often have you felt this way in the past?
1 never — 2 — 3 — 4 — 5 — 6 — 7 very often

8. **(ME)** (A28) How often do you have the feeling that there's little meaning in the things you do in your daily life?
1 very often — 2 — 3 — 4 — 5 — 6 — 7 very seldom or never

9. **(MA)** (A29) How often do you have feelings that you're not sure you can keep under control?
1 very often — 2 — 3 — 4 — 5 — 6 — 7 very seldom or never

C = comprehensibility; MA = manageability; ME = meaningfulness

Figure 1. Short nine-item version of the Sense of Coherence Scale (Antonovsky, 1987).

DOI: 10.1002/mpr

Statistical methods

In line with previous research we used confirmatory factor analysis, as implemented in the LISREL program (Jöreskog et al., 1993), to examine the internal structure of the SOC items. The items were treated as ordinal measures – polychoric correlations and asymptotic covariances were first estimated and then these estimates were used as input in the factor models. With regard to the latter, both maximum likelihood and weighted least-squares estimation were tried. The differences were very small; only the maximum likelihood results are therefore presented.

In confirmatory factor analysis, the null hypothesis that the model in question is sufficient to generate the observed correlation matrix (or, in other words, that all deviations from the model are purely random) can be tested by means of a chi-square test. This test is, however, vulnerable to deviations from multinormality and is also sensitive to sample size. With moderate or large samples it becomes very difficult to fail to reject the null hypothesis (and thereby obtain support for the model in question). It is therefore generally recommended to evaluate the fit of the model using various fit indices instead of relying on this test. Two of the most commonly used fit indices are included in Table 2: the comparative fit index (CFI) and the root mean square error of approximation (RMSEA) (see Kline, 2004). As a rule of thumb it has been suggested that the CFI should exceed 0.95 and that the RMSEA should not exceed 0.05 (Kline, 2004).

Using the estimated factor score coefficients, estimates of each individual's values on the meaningfulness, comprehensibility and manageability factors were computed. Pearson correlations were used to examine the relationship between these factor scores and psychological wellbeing, anxiety and depression. (Nonparametric Kendall's tau coefficients were also estimated, but are not reported since the results were very similar.) Multiple regression analysis was used to analyse age and gender differences.

All adults in a household were invited to participate, so the resulting clustering of observations should ideally have been taken into account. As all questionnaires were returned anonymously we are not able to do this. This means that the standard errors in the analyses will be underestimated to some extent. We do not see any specific reason to expect bias in the parameter estimates, however.

Results

Descriptive statistics

Table 1 provides descriptive statistics for the variables. The average age of the sample is 52 years, with a range from 18 to 97. The proportion of women is 0.54.

Table 1. Descriptive statistics for SOC items and other variables in the analyses

	N	Minimum	Maximum	Mean	Std. deviation	Cronbach's alpha
A4	984	1	7	4.70	1.92	
A9	992	1	7	5.36	1.57	
A12	984	1	7	5.32	1.53	
A16	977	1	7	5.10	1.26	
A19	976	1	7	4.51	1.63	
A21	951	1	7	4.88	1.73	
A25	940	1	7	4.70	1.57	
A28	953	1	7	5.12	1.56	
A29	951	1	7	5.56	1.34	
Psychological wellbeing	1046	−3.61	1.54	−0.01	0.83	0.841
HSCL-anxiety	1035	1.00	3.43	1.33	0.41	0.836
HSCL-depression	1036	1.00	3.86	1.57	0.48	0.808
Gender (woman = 1)	1043	0	1	0.54	0.50	
Age (years)	1055	18	97	52.29	17.39	

Note: Cronbach's alpha for a summated score based on the nine SOC items is 0.786.
Items A4, A16, and A25 have been reversed so that high scores indicate high SOC.

DOI: 10.1002/mpr

Table 2. Factor loadings with 95% CI's and goodness of fit measures for one, two, and three factor models, N = 905

	One-factor solution	Two-factor solution		Three-factor solution		
	SOC	Meaningfulness	Compr. + Manageab.	Meaningfulness	Comprehensibility	Manageability
A4	0.199 (0.120, 0.279)	0.213 (0.131, 0.295)		0.213 (0.131, 0.295)		
A9	0.563 (0.503, 0.622)		0.565 (0.504, 0.626)		0.548 (0.487, 0.609)	
A12	0.637 (0.579, 0.700)		0.641 (0.582, 0.700)			0.657 (0.597, 0.717)
A16	0.491 (0.421, 0.561)	0.538 (0.469, 0.608)		0.538 (0.468, 0.608)		
A19	0.690 (0.634, 0.746)		0.694 (0.637, 0.750)			0.711 (0.653, 0.769)
A21	0.757 (0.714, 0.799)		0.760 (0.718, 0.803)			0.782 (0.739, 0.825)
A25	0.540 (0.478, 0.603)		0.543 (0.481, 0.606)		0.527 (0.465, 0.589)	
A28	0.704 (0.653, 0.755)	0.796 (0.734, 0.858)		0.797 (0.735, 0.858)		
A29	0.742 (0.701, 0.782)		0.745 (0.703, 0.787)		0.718 (0.669, 0.766)	
Chi square	162.193	129.286			90.773	
Scaled Chi Square[1]	99.861	79.112			55.31	
Degrees of freedom	27	26			24	
Probability	0.000	0.000			0.000	
CFI	0.984	0.988			0.993	
RMSEA	0.055	0.048			0.038	

[1] Satorra-Bentler Scaled Chi Square.

DOI: 10.1002/mpr

As noted above, there is some non-response to the SOC items. The non-response seems to be correlated to some extent with the order in which the items were presented in the questionnaire. This indicates that some respondents started to answer these questions but gave up after a few items.

Table 1 also gives internal consistency estimates (Cronbach's alpha) for the summated scales used in the analyses. All alphas are quite close to 0.80, which is generally considered quite satisfactory. The alpha for a summated scale of the nine SOC items is 0.79. As noted above, alpha for Antonovsky's 13-item version was found to vary between 0.74 and 0.91 in 20 countries (Antonovsky, 1993). The estimate for our data falls within this range, although a somewhat lower alpha is to be expected when the number of items is reduced.

The factor analysis

Table 2 shows factor loadings and goodness-of-fit statistics for a one-factor and for two- and three-factor models with correlated factors. We comment first on the one- and three-factor models because these are the ones suggested in previous research.

The chi-square statistics exceed by far the critical limits corresponding to any conventional significance level. Based on this criterion, all models have to be rejected. As noted above, this test is problematic and not very useful for moderate or large samples. The two fit indices are therefore of more interest. Judged by the CFI, the fit of the three-factor model is extremely good but even the two- and one-factor models have highly adequate fit. Even for the RMSEA, the fit of the three-factor model is very good. Here, the fit of the two other models is very close to the rule of thumb criterion for model acceptance (0.05).

For the one-factor solution, eight of the nine factor loadings are in the 0.49 to 0.76 range. One factor loading, for item A4, is very low, however (0.20). Even in the three-factor solution, this loading is a very low 0.21. Otherwise we note that the factor loadings are in general very similar in the two models. With two exceptions the difference is less than 0.03, and even for the remaining items (A16 and A28) it is not higher than 0.05 and 0.09. In substantive terms, then, the difference between these models does not seem to be large. In other words, the three-factor model does not seem to contain much information beyond what is provided by the one-factor model.

This impression is strengthened when we consider the estimated correlations among the factors in the three-factor model (Table 3). The correlations between the comprehensibility and manageability factors is almost perfect (and leads to Lisrel warning that the correlation matrix is not positive definite). The correlation between the meaningfulness and the manageability factors is also very high (0.96). Correlations as high as 0.96 or more clearly suggest that these factors cannot be reliably distinguished from each other. The correlation between factors 1 and 3 is a more moderate 0.78.

To sum up, in our data we find that both the one-factor and the three-factor model achieve acceptable fit as measured by the fit indices and the factor loadings are very similar in the two models. Most importantly, the factors in the three-factor model are very strongly, or even almost perfectly, correlated. It is therefore reasonable to conclude that our results favour the one-factor solution over the three-factor solution.

Although the three-factor solution is problematic, the results suggest that a two-factor model combining the two almost perfectly correlated factors might

Table 3. Correlations of factors in the two- and three-factor models (with 95% CIs in parentheses)

Two-factor model:	Meaningfulness	Comprehensibility and manageability	
Meaningfulness,	1		
Comprehensibility and manageability	0.861 (0.796, 0.926)	1	
Three-factor model:	**Meaningfulness**	**Manageability**	**Comprehensibility**
Meaningfulness	1		
Manageability	0.962 (0.882, 1)	1	
Comprehensibility	0.780 (0.704, 0.856)	1.000 (0.942, 1)	1

Note: upper confidence limits exceeding 1 have been set to that value.

DOI: 10.1002/mpr

provide a better fit. Results for this two-factor solution are also included in Tables 2 and 3. In terms of goodness of fit, the two-factor model falls midway between the two other models. The factor loadings are very close to those for these models. The meaningfulness and the combined comprehensibility and manageability factor are strongly correlated, although clearly not perfect.

Relationships with other variables

Table 4 presents correlations (Pearson's r) between estimated factor scores from the one, two and three factor models on the one hand and the wellbeing and symptom measures on the other. The comprehensibility and manageability factor scores (three-factor solution) have extremely similar correlations with the symptom and wellbeing measures and the correlations are also very similar for the factor scores for the combined comprehensibility and manageability factor (two-factor solution) and for the general SOC factor (one-factor solution). With regard to depression and wellbeing, even the correlations for the meaningfulness factor scores are highly similar. The correlation between anxiety and meaningfulness is slightly lower than the correlations between anxiety and the other factor scores, but the difference is small.

Table 5 shows the relationships between the SOC factor scores on the one hand and gender and age on the other, based on OLS regressions. The highest mean scores on all factors are found in the 51 to 67 age category and the lowest mean scores in the youngest age category. Overall, the age profiles are very similar for all factors, with increasing values up to the 51 to 67 age category followed by a decline among the very old (although the CIs for the coefficients for the oldest age category include zero, thus indicating that the declining means in this age category could be due to random factors).

With regard to gender, the CIs for all of the factor scores include zero. Thus even here the results for the different factors are very similar.

Discussion

We conclude that our results reasonably favour a single global factor sense-of-coherence model. In fact, the one-factor, the two-factor and the three-factor models tested achieved acceptable goodness of fit values and the factor loadings were very similar in the models.

We prefer the one-factor model, however, for several reasons. In the first place, the factors in the two- and three-factor models were very strongly correlated – in the three-factor case even to the extent that it was mathematically impossible to separate the comprehensibility and manageability factors. Even in the two-factor solution the correlation between the meaningfulness and the combined comprehensibility and manageability factor was 0.86. Secondly, the different factors have very similar statistical relationships with other variables expected to correlate with SOC, in particular anxiety, depression and subjective wellbeing, but even with gender and age. Very little additional information is obtained by distinguishing between two or three SOC factors.

Table 4. Correlations of SOC factors with psychological wellbeing and symptom scales

	Scale based on one-factor solution	Scales based on two-factor solution		Scales based on three-factor solution		
	General factor	Meaningfulness	Comprehensibility and manageability	Meaningfulness	Manageability	Comprehensibility
Anxiety (HSCL)	−0.521	−0.470	−0.523	−0.461	−0.510	−0.526
Depression (HSCL)	−0.577	−0.547	−0.576	−0.535	−0.576	−0.574
Wellbeing	−0.488	−0.498	−0.481	−0.488	−0.498	−0.469

Note: all correlations are significantly different from zero at the 0.001 level (two-tailed test). N = 899 to 903.

DOI: 10.1002/mpr

Table 5. Regression of scales based on three factor analyses on gender and age. Coefficients with 95% CI's in parentheses, N = 889

	Scale based on one factor solution	Scales based on two factor solution	
	General factor	Meaningfulness	Comprehensibility + Manageability
Intercept	0.174 (0.039, 0.309)	0.174 (0.039, 0.309)	0.151 (0.016, 0.286)
Gender (1 = woman)	−0.012 (−0.143, 0.119)	−0.014 (−0.145, 0.117)	0.004 (−0.127, 0.135)
Age 18–30	−0.538 (−0.759, −0.317)	−0.543 (−0.764, −0.322)	−0.470 (−0.691, −0.249)
Age 31–50	−0.180 (−0.339, −0.021)	−0.176 (−0.336, −0.017)	−0.172 (−0.333, −0.011)
Age 51–67 (omitted)	–	–	–
Age 68+	−0.171 (−0.359, 0.017)	−0.171 (−0.359, 0.018)	−0.155 (−0.345, 0.035)

	Scales based on three factor solution		
	Meaningfulness	Comprehensibility	Manageability
Intercept	0.138 (0.003, 0.273)	0.175 (0.040, 0.310)	0.180 (0.045, 0.315)
Gender (1 = woman)	0.009 (−0.122, 0.140)	−0.011 (−0.142, 0.120)	−0.021 (−0.152, 0.110)
Age 18–30	−0.426 (−0.649, −0.203)	−0.550 (−0.771, −0.329)	−0.566 (−0.787, −0.345)
Age 31–50	−0.161 (−0.322, −0.000)	−0.183 (−0.342, −0.024)	−0.177 (−0.336, −0.018)
Age 51–67 (omitted)	–	–	–
Age 68+	−0.147 (−0.337, 0.043)	−0.169 (−0.357, 0.019)	−0.172 (−0.360, 0.016)

Our findings corroborate Antonovsky's theoretical view that SOCS measures a single dimension. He objected to deriving subscores or studying component interrelations. Our finding of very highly, almost perfectly correlated factors may be seen as supporting this argument.

In Antonovsky's view, the three SOC components are elements of a facet rather than factors in the sense of factor theory. Antonovsky stated that the SOCS items, in line with the requirements of facet design (Foa, 1965; Antonovsky, 1993), were constructed to express one and only one element of each facet and that an item was included only after three judges agreed that it referred cleanly to one and only one of the three SOC components (Antonovsky, 1987).

Most of the factor loadings were high in all models. In the one-factor model, for instance, eight of the nine items had loadings in the 0.49 to 0.76 range. Item A4 is a clear exception, however, with factor loadings of only about 0.2 irrespective of whether a one-, two- or three-factor model is estimated. We note that similar deviant results for this item has been found in previous research. Gana et al. (2001) analysed both the 29- and the 13-item version of SOCS and in both the factor loading for A4 was a quite low 0.27, whereas the factor loadings for the remaining eight items that were also included in our study were in the 0.41 to 0.71 (SOCS-29) or 0.37 to 0.68 (SOCS-13) range. Although, there are also examples of studies that do not find particularly deviant results for this item (for example, Feldt et al., 1998), we believe there are sufficient indications to suggest that a particular focus should be devoted to the performance of this item in future research.

From other factor analytic studies that have been performed on the SOCS items, Antonovsky (1993) has cited findings to argue that the SOC reflects a single, common factor. One argument is that the first factor is so dominant that subsequent factors are of minor interest only (Foa, 1965; Flannery et al., 1990; see also Antonovsky`s (1993) references to unpublished studies by Colby and Pottie).

DOI: 10.1002/mpr

However, the factorial structure of the SOCS remains problematic. Indeed, the three components do not appear every time a factor analysis is used and few confirmatory factor analyses (CFA) have confirmed a single-factor solution. In Leipzig they did, however, find that the SOC-subscales were correlated and ended up with one global factor as the best solution when doing an exploratory factor analysis of their own nine-item short version (SOC-L9) (Schumacher et al., 2000). According to Larsson et al. (1999) the 13-items (SOCS-13) is neither one-dimensional nor three-dimensional. In an analysis of the full 29-item scale, Sandell et al. (1998) also obtained very poor fit for both one-factor and three-factor models in confirmatory factor analyses. Exploratory factor analyses provided some support for the existence of meaningfulness and comprehensibility factors but they were more sceptical about manageability. Gana et al. (2001) found SOC to be a multidimensional construct and the SOCS seemed adequately described by a three-correlated structure. Feldt et al. (1998) investigated the structure of Antonovsky's (1987) 13-item short scale (SOCS-13) using CFA. In their study they found that the three-factor structure as well as a second-order model with three first-order and one second-order factors fitted the data better than the one-factor structure.

An interesting finding in this study is the apparent non-gender specific nature of SOC and also the results showing that SOC in fact increases in an orderly fashion through adult-hood up to the age group 51 to 67.

The present study had a reasonable overall response rate. However, only 85% of the sample responded to all SOC items. The item specific non-response was greater for these items than for items measuring wellbeing or psychiatric symptoms. It also seems as if quite a few respondents responded to the first few SOC items, but then skipped the rest. The non-response was also much higher among older respondents. These patterns may indicate that a considerable number of "particularly older" respondents find these items difficult.

Our sample had no upper age limit and the mean age was 52. Since the item non-response increases with age, this explains the quite high proportion of non-responders in our data. Of those below 50 years of age, 92% provided complete data. We are not able to investigate the possible implications of non-response for the validity of the results. Supplementary analyses excluding the oldest respondents (>70 years of age) did not, however, provide results that differed from those reported above in important ways.

It is probable that a salutogenic approach to promoting mental health will become increasingly important. The psychometric properties of short versions of SOCS like the nine items version used in this paper need to be studied more to see if they are valid and reliable.

More research is needed on the concept of salutogenesis and the dimensions of SOC in order to further develop valid, reliable and handy instruments for measuring empowerment and the sense of coherence. In the evidence-based implementation of mental-health promotion programmes such tools will be essential.

Acknowledgements

We are grateful for the grant from the Norwegian Research Council awarded to Olav Martin Klepp for his PhD research studies and for financial support received from the Institute of Psychiatry and The Medical Faculty at the University of Oslo, and from the Norwegian Centre for Minority Health Research (NAKMI), and from Ullevaal University Hospital. Oslo.

References

Andrews FM, Withey SB. Social Indicators of Wellbeing: America's Perception of Life Quality. New York: Plenum, 1976.

Antonovsky A. Health, Stress, and Coping: New Perspectives on Mental and Physical Wellbeing. San Francisco: Jossey-Bass Publishers, 1979.

Antonovsky A. The sense of coherence. An historical and future perspective. Isr J Med Sci 1996; 32: 170–8.

Antonovsky A. The structure and properties of the Sense of Coherence Scale. Soc Sci Med 1993; 36(6): 725–33.

Antonovsky A. Unravelling the Mystery of Health: How People Manage Stress and Stay Well. San Francisco: Jossey-Bass Publishers, 1987.

Antonovsky A, Sagy S. The development of a sense of coherence scale and its impact on responses to stress situations. J Soc Psy 1986; 126: 213–25.

Bandura A. Self-efficacy in human agency. Am Psychol 1982; 37: 122–147.

Bandura A. Self-efficacy: toward a unifying theory of behavioral change. Psychol Rev 1977; 84: 191–215.

Bradburn NM. The Structure of Psychological Wellbeing. Chicago: Aldine, 1969.

Campell A, Converse PE, Rodgers WL. The Quality of American Life. New York: Russell Sage Foundation, 1976.

Cantril H. The Pattern of Human Concerns. New York: Rutgers University Press, 1965.

DOI: 10.1002/mpr

Cederblad M. Fifty years of epidemiologic studies in child and adolescent psychiatry in Sweden. Nord J Psychiatry 1996; 244: 1–11.

Compton WC, Smith ML, Cornish KA, Qualls DL. Factor structure of mental health measures. J Pers Soc Psychol 1996; 71: 406–13.

Derogatis LR. SCL-90R: Administrative, Scoring and Procedure Manual I for the R Version. Baltimore: John Hopkins University School of Medicine, Psychometrics Research Unit, 1977.

Derogatis LR, Lipman RS, Rickels K, Uhlenhuth EH, Covi L. The Hopkins Symptom Checklist (HSCL): a self-report symptom inventory. Behav Sci 1974; 19: 1–15.

Dudek B, Makowska Z. Psychometric characteristics of the Orientation to Life Questionnaire for measuring the sense of coherence. Polish Psych Bull 1993; 24: 309–18.

Feldt T, Rasku A. The structure of Antonovsky's Orientation to Life Questionnaire. Pers Indiv Dif 1998; 25: 505–16.

Flannery RB, Flannery GJ. Sense of coherence, life stress, and psychological distress: a prospective methodological inquiry. J Clin Psychol 1990; 46: 415–20.

Foa UG. New developments in facet design and analysis. Psychol Rev 1965; 72: 262–74.

Freire P. Education for Critical Consciousness. New York: Seabury Press, 1973.

Frenz AW, Carey MP, Jörgensen RS. Psychometric evaluation of Antonovsky's Sense of Coherence Scale. Psychol Assess 1993; 5: 145–53.

Friborg O, Hjemdal O, Rosenvinge JH, Martinussen M. A new rating scale for adult resilience: what are the central protective resources behind healthy adjustment? IJMPR 2003; 12: 65–76.

Gana K, Garnier S. Latent structure of the sense of coherence scale in a French sample. Pers Individ Dif 2001; 31: 1079–90.

Garmezy N. Children in poverty: resilience despite risk. Psychiatry 1993; 56: 127–36.

Garmezy N. Children under stress: perspectives on antecedents and correlates of vulnerability and resistance to pathology. In AL Rabin, J Arnoff, AM Barclay, RA Zuckers (eds) Further Explorations in Personality. New York: Wiley, 1981, pp. 196–296.

Johansson I, Larsson G, Hamrin E. Sense of coherence, quality of life, a function among elderly hip fracture. Aging (Milano) 1998; 10: 377–84.

Jöreskog KG, Sörbom D. LISREL 8 User's Reference Guide. Chicago: Scientific Software, 1993.

Kline, RB. Principles and Practice of Structural Equation Modeling. 2 edn. New York: Guilford, 2004.

Kobasa SC. Stressful life events, personality and health: an inquiry in hardiness. J Pers Soc Psychol 1979; 34: 839–50.

Languis A, Björvell H, Antonovsky A. The sense of coherence concept and its relation to personality traits in Swedish samples. Scand J Caring Sci 1992; 6: 165–71.

Larsson G, Kallenberg K. Dimensional analysis of sense of coherence using structural equation modelling. Eur J Pers 1999; 13: 51–61.

Lazarus RS, Folkman S. Stress, Appraisal, and Coping. New York: Springer, 1984.

Lindström B. The meaning of resilience. Int J Adolesc Med Health 2001; 13(1): 7–12.

Lundquist T. Chronic cannabis use and the sense of coherence. Life Sci 1995; 56: 2145–50.

Poppius E, Tenkanen L, Kalimo R, Heinsalmi P. The sense of coherence, occupation, and the risk of coronary heart disease in the Helsinki Heart Study. Soc Sci Med 1999; 49: 109–20.

Rotter JB. Generalized expectancies for internal versus external control of reinforcement. Psychological Monographs 1966; 80: 1–28.

Rotter JB. Some problems and misconceptions related to the construct of internal versus external control of reinforcement. J Consult Clin Psychol 1975; 43: 149–55.

Rutter M. Psychosocial resilience and protective mechanisms. In JE Rolf, AS Masten (eds) Risk and Protective Factors in the Development of Psychopathology. New York: Cambridge University Press, 1990: 181–214.

Rutter M. Resilience in the face of adversity. Br J of Psychiatry 1985; 147: 598–611.

Sandanger I. Occurrence of Psychiatric Disorders- An Epidemiological Study, Conceptual, Methodological, and Empirical issues. Oslo: Institute of General Practice and Community Medicine, and Institute Group of Psychiatry, University of Oslo, 1999.

Sandell R, Blomberg J, Lazar A. The factor structure of Antonovsky's sense of coherence scale in Swedish clinical and nonclinical samples. Pers Individ Dif 1998; 5: 701–11.

Scheier MF, Carver CS. Dispositional optimism and physical wellbeing: the influence of generalized outcome expectancies on health. J Pers 1987; 55: 169–210.

Scheier MF, Carver CS. Optimism, coping, and health: assessment and implications of generalized outcome expectancies. Health Psychol 1985: 219–47.

Schumacher J, Wilz G, Gunzelmann T, Brähler E. Die sense of coherence scale von Antonovsky. Psychoter Psychosom Med Psychol 2000; 50: 472–82.

Sørensen T, Næss S. To measure quality of life. Relevance and use in the psychiatric domain. Nord J Psychiatry 1996; 50: Suppl 37: 29–39.

Wallston BS, Wallston KA. Locus of control and health: a review of the literature. Health Educ Monog 1978; 6: 107–17.

Werner EE. High-risk children in young adulthood: a longitudinal study from birth to 32 years. Am J Orthopsychiatry 1989; 59: 72–81.

DOI: 10.1002/mpr

Werner EE. Journeys from Childhood to Midlife: Risk, Resilience and Recovery. Ithaca NY: Cornell University Press, 2001.

Werner EE. Risk, resilience and recovery: perspectives from the Kauai longitudinal study. Dev Psychopathol 1993; 5: 503–15.

WHO. Ottawa Charter 1986. An international conference on health promotion. Health Promot 1986; 1: iii–462.

Winokur A, Winokur DF, Rickels K, Cox DC. Symptoms of emotional distress in a family planning service: stability over a four-week period. Br J Psychiatry 1984; 144: 395–99.

Correspondence: Olav Martin Klepp, Ullevaal University Hospital, Psychiatric Division, Department of Research and Education, University of Oslo, Kirkeveien 166, N-0407 Oslo, Norway.
Telephone (+47) 90876569 or (+47) 22118445
Fax (+47) 23016061
Email o.m.klepp@medisin.uio.no and olavmartin.klepp@nakmi.no

DOI: 10.1002/mpr