Good Stress Management Capability Is Associated with Lower Body Mass Index and Restful Sleep in the Elderly

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Psychosocial stress is generally associated with adverse health behaviors and has been linked to the development of cardiovascular diseases (CVD). Recently, an individual’s sense of coherence (SOC), which is a concept that reflects the ability to cope with psychosocial stress, has been recognized as an essential component of long-term health and stress management. The association between SOC and traditional and alternative atherosclerotic markers in a community sample, however, has not been thoroughly investigated. In the present study, we evaluated stress management capability and psychological conditions using the Japanese version of the Sense of Coherence-13 (SOC-13) Scale, supplemented by the General Health Questionnaire-12 (GHQ-12) that screens for minor psychiatric disorders. The study subjects were 511 adults, median age 64 years (range 48-70), who participated in a regular medical screening program in Nagasaki Prefecture, Japan. We then correlated our findings with atherosclerotic risk factors in the same community sample, such as body mass index (BMI) and proper and regular sleeping habits. We found that close association between good stress management capability and lower BMI and/or regular sleeping habits in elderly Japanese. This provides strong evidence that BMI and sleep management are contributory to SOC. If the ability to cope with psychosocial stress is important to the prevention of CVD, then weight control and proper sleep habits must be emphasized from a psychosocial stress-management perspective as well as a physical one.

Keywords: capability of stress management; cardiovascular diseases; carotid intima media thickness; psychological condition; sense of coherence

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The accurate assessment and effective prevention of cardiovascular diseases (CVD) based on the identification of risk factors continues to be one of the most important medical endeavors worldwide. The World Health Organization has projected that the annual number of CVD DAILYs (Disability-adjusted life years: a measure that combines years of potential life lost due to premature death with years of productive life lost due to disability) approached 153 million worldwide in 2010, and will reach 169 million by 2020 and 187 million by 2030. Additionally, CVD deaths, which approached 18.1 million in 2010, will reach 20.5 million by 2020 and 24.2 million by 2030 (World Health Organization 2004). Due to the fact that atherosclerosis accounts for much of the morbidity and mortality associated with CVD, the identification of risk factors for atherosclerosis is crucial (Murray and Lopez 1997).

It is well known that Westernized lifestyles, including high-fat diets, widespread sedentary work patterns and various psychological factors, are risk factors for the development of atherosclerosis in Japan (Ohira 2010). Specifically, certain behavioral patterns as well as psychosocial factors, such as stress, depression, anxiety and hopelessness, have been reported to be linked to the development of atherosclerosis and subsequent CVD (Rozanski et al. 1988; Barefoot and Schroll 1996; Pratt et al. 1996; Denollet and Brutsaert 1998). Although associations between stress and CVD have been extensively investigated in the last few decades, the mediating mechanisms of these associations have not yet been fully elucidated (Puustinen et al. 2011).

Sense of Coherence (SOC) is a conventional tool for
measuring stress management capability. This model was designed to explain improvement in one’s location on the health-disease continuum, with SOC representing an individual’s confidence level for embodying the resources needed to cope with problems and challenges (Antonovsky 1993; Myers et al. 2011). These resources, when strong, include the belief that what happens in their lives is rational, predictable, structured, and understandable (comprehensibility); that adequate and sufficient resources are perceived to be available to help resolve difficulties as they arise (manageability); and that the demands created by exposure to adversity are seen as challenges and are worthy of engagement (meaningfulness). SOC has been hypothesized to be a stable personality trait that serves as a major coping resource for preserving health (Nasermaaddeli et al. 2004; Eriksson and Lindström 2005; Eriksson and Lindström 2006). Previous studies have evaluated the association between SOC scores and physical health and reported that high SOC scores, indicate a good stress management capability, were associated with reduced mortality from cancer and CVD, suggesting that SOC characterizes a form of resilience against disease (Barefoot and Schroll 1996). Also, SOC scores can be interpreted as an autonomous internal resource contributing to the favorable development of a subjective state of health, and has been regarded as a complement to and not a substitute for information already known to be associated with increased risk for future illness (Suominena et al. 2001). However, the association between SOC scores and traditional and alternative atherosclerotic markers, such as carotid intima media thickness (CIMT) in a community sample has not been fully investigated. Thus, further examination of the association between SOC and atherosclerotic markers is warranted.

Accordingly, the present study investigated the association between SOC scores and traditional and alternative atherosclerotic markers in an elderly Japanese sample. The present study’s primary aim was to clarify the relationship between the stress management capability and the risk of developing CVD.

Methods

Study population

Prior to the start of the study, ethical approval was obtained from the ethics committee of Nagasaki University (project registration number 10022468). The study was conducted in August 2010 during a regular medical screening program for the general population who were 30 years of age or older residing in Togitsu town (total population was 30,480 in October 2012) in Nagasaki Prefecture, Japan. Data were collected by the staff of Nagasaki University, in cooperation with the staff of Togitsu town. After obtaining informed consent, we enrolled 538 Japanese adults to participate in the study (participation rate: 91.1%). Since insufficient data were obtained from 27 subjects, analyses were limited to a total of 511 participants (185 men and 326 women).

Data collection and laboratory measurements

Body weight and height were measured, and body mass index (BMI) was calculated as an index of obesity. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were recorded while at rest.

Blood samples were collected from each participant after fasting overnight. High-sensitivity CRP (hs-CRP), Hemoglobin A\textsubscript{1c} (HbA\textsubscript{1c}), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), Aspartate aminotransferase (AST), alanine aminotransferase (ALT), \(\gamma\)-glutamyl transpeptidase (\(\gamma\)-GTP), uric acid (UA), creatinine (Cr), red blood cells (RBC), hemoglobin (Hb) and hematocrit (Ht) were measured using standard laboratory procedures.

Questionnaire items, SOC-13 and GHQ-12

We used the Japanese version of SOC-13 for the evaluation of psychosocial characteristics. SOC consists of three dimensions, including comprehensibility, manageability and meaningfulness, which are equally weighted to create an overall (total) score. Scores range from 7 - 91, with higher scores representing a stronger sense of coherence.

In order to screen for minor psychiatric disorders, we used the General Health Questionnaire-12 (GHQ-12), which is a shortened, modified version of the original 60-item questionnaire, to assess psychological well-being. For GHQ-12 scoring, each item response category was scored using a 4-point scale (0-0-1-1), with total scores ranging from 0-12 points. According to the evaluation standards for level of mental health in the Japanese version of the GHQ-12 (Takemae et al. 2012), a score of \(\geq 3\) was designated as the high (= good) GHQ group, and a score of \(< 3\) was designated as the low (= poor) GHQ group.

Measurement of CIMT

Measurement of CIMT by ultrasonography of the left and right carotid arteries was performed in cooperation with three medical doctors and a medical technologist, using a LOGIC Book XP with a 10 MHz linear artery transducer (GE Medical Systems, Milwaukee, WI, USA). The far wall of the carotid artery was displayed on a longitudinal two-dimensional ultrasonographic image as two bright white lines separated by a hypoechoic space. The distance from the leading edge of the first (lumen-intima interface), to the leading edge of the second (media-adventitia interface) bright line was identified as the CIMT. Images obtained were stored on the hard disk of the ultrasound system, and were analyzed using Intima Scope software (MEDIA CROSS, Tokyo, Japan). Averages of the right and left CIMT were calculated and used in all subsequent analyses. The intraobserver variation of CIMT (N.T., \(n = 32\)) was 0.91 \((p < 0.01)\).

Statistical analysis

Results are expressed as mean ± s.d. or median (25\textsuperscript{th} to 75\textsuperscript{th} quartile). Differences in laboratory values between men and women were evaluated using a t-test and the Mann-Whitney U-test. Comparisons in SOC scores between the high GHQ group and low GHQ group were also evaluated using t-tests. The correlations between SOC scores and other variables were evaluated using both univariate and multivariate linear regression analyses. Statistical analyses were performed using PASW statistics 18 software (SPSS Japan, Tokyo, Japan).
Results

Characteristics of the study participants are shown in Table 1. Men were significantly older than women (67.0 (60.5-72.0) years old vs. 62.0 (37.8-69.0) years old, p < 0.01). Significant differences were also seen in CIMT, BMI, SBP, DBP, HbA1c, TG, HDL-C, AST, ALT, γ-GTP, UA, Cr, RBC, Hb and Ht levels between men and women. In contrast, no significant differences were observed in SOC-13 and GHQ-12 scores between men and women.

After adjusting for age, SOC-13 scores with the item “having enough rest from sleep” were significantly higher than SOC-13 scores without the item “having enough rest from sleep” in men (46.5 ± 7.0 vs. 43.6 ± 8.0, p = 0.03), women (47.2 ± 7.0 vs. 45.9 ± 7.2, p < 0.001) and in all participants (47.0 ± 7.9 vs. 44.7 ± 7.5, p = 0.05), respectively (Table 2). Additionally, SOC-13 scores including the item “current smoker” were significantly lower than SOC-13 scores without the item “current smoker” in women (45.3 ± 14.6 vs. 45.9 ± 7.2, p = 0.04), and SOC-13 scores with the item “exercise regularly” were significantly higher than SOC-13 scores without the item “exercise regularly” in the whole sample (47.0 ± 7.9 vs. 44.7 ± 7.5, p = 0.05).

The SOC scores for the low GHQ group were significantly higher than those in the high GHQ group in men [low GHQ: 45.1 (42.2-52.1) vs. high GHQ: 38.3 (34.8-42.1), p < 0.001], women [low GHQ: 47.8 (42.0-51.5) vs. high GHQ: 39.3 (34.9-45.4), p < 0.001] and in all participants [low GHQ: 45.4 (41.6-51.7) vs. high GHQ: 38.4 (35.8-42.2), p < 0.001] (data not shown).

Using univariate linear regression analyses, SOC scores were significantly correlated with age in men (r = 0.22, p < 0.01), women (r = 0.14, p < 0.05) and in all participants (r = 0.17, p < 0.01), respectively. Also, SOC scores were significantly correlated with CIMT in women (r = 0.11, p < 0.05) as well as in the whole sample (r = 0.11, p < 0.05), respectively. Furthermore, SOC scores were significantly correlated with UA (r = 0.11, p < 0.05), Hb (r = 0.12, p < 0.05) and Ht (r = 0.13, p < 0.05) in women, respectively. However, SOC was not significantly correlated with BMI (r = −0.039, p = 0.096).

Multivariate linear regression analyses adjusted for sex revealed that SOC scores were significantly correlated with age (β = 0.08, p = 0.001), BMI (β = −0.24, p = 0.02) and “having enough rest from sleep” (β = 4.57, p < 0.001, Table 3). Furthermore, multivariate linear regression analyses

<table>
<thead>
<tr>
<th>Variable</th>
<th>Men (n = 185)</th>
<th>Women (n = 326)</th>
<th>All (n = 511)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>67.0 (60.5-72.0)</td>
<td>62.0 (37.8-69.0) *</td>
<td>64.0 (48.0-70.0)</td>
</tr>
<tr>
<td>CIMT (mm)</td>
<td>0.645 (0.58-0.72)</td>
<td>0.59 (0.54-0.66) *</td>
<td>0.61 (0.55-0.69)</td>
</tr>
<tr>
<td>hs-CRP (mg/l)</td>
<td>0.094 ± 0.185</td>
<td>0.066 ± 0.129</td>
<td>0.076 ± 0.152</td>
</tr>
<tr>
<td>log hs-CRP</td>
<td>−1.319 ± 0.471</td>
<td>−1.598 ± 0.578 *</td>
<td>−1.497 ± 0.558</td>
</tr>
<tr>
<td>SOC scores</td>
<td>45.0 (40.0-51.0)</td>
<td>45.5 (41.0-51.0)</td>
<td>45.0 (41.0-51.0)</td>
</tr>
<tr>
<td>GHQ scores</td>
<td>0.00 (0.00-1.00)</td>
<td>0.00 (0.00-2.00)</td>
<td>0.00 (0.00-2.00)</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>23.5 ± 3.1</td>
<td>24.5 ± 3.3 *</td>
<td>22.7 ± 3.4</td>
</tr>
<tr>
<td>SBP (mmHg)</td>
<td>130.1 ± 17.5</td>
<td>120.4 ± 19.2 *</td>
<td>124.1 ± 19.2</td>
</tr>
<tr>
<td>DBP (mmHg)</td>
<td>75.6 ± 11.5</td>
<td>69.1 ± 11.5 *</td>
<td>71.5 ± 11.9</td>
</tr>
<tr>
<td>HbA1c (%)</td>
<td>5.20 (5.00-5.50)</td>
<td>5.10 (4.90-5.40) *</td>
<td>5.2 (4.90-5.4)</td>
</tr>
<tr>
<td>TG (mg/dl)</td>
<td>93.0 (72.0-132.5)</td>
<td>81.0 (56.8-115.0) *</td>
<td>87.0 (62.0-120.0)</td>
</tr>
<tr>
<td>HDL-C (mg/dl)</td>
<td>54.0 (46.0-65.5)</td>
<td>63.0 (54.0-73.0) *</td>
<td>61.0 (50.0-70.0)</td>
</tr>
<tr>
<td>LDL-C (mg/dl)</td>
<td>116.2 ± 29.2</td>
<td>121.2 ± 32.3</td>
<td>119.4 ± 31.3</td>
</tr>
<tr>
<td>AST (IU/l)</td>
<td>21.0 (19.0-27.0)</td>
<td>19.0 (16.0-24.0) *</td>
<td>20.0 (17.0-24.0)</td>
</tr>
<tr>
<td>ALT (IU/l)</td>
<td>19.0 (15.0-27.0)</td>
<td>15.0 (12.0-19.0) *</td>
<td>16.0 (13.0-22.0)</td>
</tr>
<tr>
<td>γ-GTP (IU/l)</td>
<td>28.0 (21.0-44.5)</td>
<td>15.5 (13.0-22.0) *</td>
<td>19.0 (14.0-29.0)</td>
</tr>
<tr>
<td>UA (mg/dl)</td>
<td>5.7 ± 1.4</td>
<td>4.3 ± 1.0 *</td>
<td>4.8 ± 1.3</td>
</tr>
<tr>
<td>Cr (mg/dl)</td>
<td>0.82 (0.75-0.91)</td>
<td>0.64 (0.58-0.70) *</td>
<td>0.68 (0.60-0.80)</td>
</tr>
<tr>
<td>RBC</td>
<td>460.8 ± 40.1</td>
<td>425.1 ± 34.2 *</td>
<td>438.0 ± 4.01</td>
</tr>
<tr>
<td>Hb (g/dl)</td>
<td>14.5 ± 1.2</td>
<td>12.8 ± 1.0 *</td>
<td>13.4 ± 1.3</td>
</tr>
<tr>
<td>Ht (%)</td>
<td>43.9 ± 3.2</td>
<td>39.4 ± 2.8 *</td>
<td>41.0 ± 3.7</td>
</tr>
</tbody>
</table>

Values are mean ± standard deviation or median (25th - 75th quartile).

CIMT, carotid intima-media thickness; hs-CRP, high-sensitivity; SOC, Sense of Coherence; GHQ, General Health Questionnaire; BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; HbA1c, hemoglobin A1c; TG, triglyceride; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; AST, aspartate aminotransferase; ALT, alanine aminotransferase; γ-GTP, γ-glutamyl transpeptidase; UA, uric acid; CRE, creatinine; RBC, red blood cell; Hb, hemoglobin; Ht, hematocrit.

*P < 0.01 vs. men.
adjusted for age and sex revealed that SOC scores were independently correlated with BMI ($\beta = -0.28$, $p = 0.006$) and “having enough rest from sleep” ($\beta = 4.56$, $p < 0.001$, Table 4).

**Discussion**

The present study showed that SOC scores were independently correlated with BMI ($\beta = -0.28$, $p = 0.006$) and the item “having enough rest from sleep” in an elderly Japanese sample. Thus, our results suggested that high SOC scores, which indicate good stress management capability, is closely related with lower level of BMI and restful sleep, as an important factor for the prevention of metabolic disorders. SOC scores can be interpreted as an autonomous internal resource contributing to the favorable development of a subjective state of health. SOC scores should be regarded as complementary to and not a substitute for information already known to be associated with an increased
Our results demonstrated that SOC scores within the low GHQ-12 group were significantly higher than those in the high GHQ group, which is consistent with previous studies (Matsuzaki et al. 2007; Sagara et al. 2009; Urakawa and Yokoyama 2009). Generally, the GHQ-12 has been used in primary health care screenings in general population surveys as well as in general medical practice (Doi and Minowa 2003). SOC scores were positively related to psychological well-being, suggesting a buffering effect from SOC on the maintenance of normal psychological health in dealing with stressful life events (Matsuzaki et al. 2007). Appropriate use of the SOC-13 in combination with the GHQ-12 is important for the screening of mental health among the general population.

In the present study, we found that high SOC scores are closely related with lower level of BMI ($\beta = -0.28$, $p = 0.006$) in a community dwelling general population, after adjusting for age and sex. This suggests close association between good stress management capability and lower BMI in elderly Japanese. In a recent study, Matsuzaki et al. (2007) screened Japanese male workers and found that low SOC scores were significantly associated with weight gain and poorer psychological well-being, results which were supported by the present multivariate regression analyses. Kivimäki et al. (2009) also demonstrated that SOC was an important psychological modifier determining lifestyle, including exercise and dietary habits. Similarly, the present study’s findings also suggest that inappropriate coping methods for stress lead to weight gain and poorer psychological well-being.

Additionally, our results demonstrated that SOC score was significantly correlated with “having enough rest from sleep” after adjusting for age and sex ($\beta = 4.56$, $p < 0.001$). Previous research has demonstrated that sufficient rest is an important factor for stress management. Short duration sleep has also been associated with obesity, diabetes, fatty liver and multiple behavioral factors. Additional studies have also shown that short duration sleep and sleep deprivation was associated with a higher risk of obesity and diabetes (Cauter and Knutson 2008; Patel and Hu 2008; Beihl et al. 2009; Watanabe et al. 2010). For example, Gouttlib et al. (2005) demonstrated that sleep durations of 6 hours or less, or 9 hours or more were associated with an increased prevalence of diabetes mellitus and impaired glucose tolerance. Accordingly, restful sleep is an important factor for the prevention of metabolic disorders including obesity and diabetes as well as for stress management.

The prevalence of several chronic and degenerative diseases increases with age (Westerlund et al. 2010). However, our results demonstrated that SOC scores were positively correlated with age, which suggests that the stress management capability may improve with age. Moreover, Westerlund et al. (2010) screened the incidence of chronic diseases, mental fatigue and physical fatigue 7 years before and after retirement, and showed that retirement did not change the risk for developing major chronic diseases, but was associated with a substantial reduction in mental physical fatigue and depressive symptoms. This may be due to the elimination of the source of the problem through retiring, and a less demanding workload. Thus, in the present study, many of the participants, they were over 60 years old and already retired, may have influenced our current findings.

The results from the present study should be taken with several limitations in mind. First, there is the potential participation bias. In the present study, more woman than man participated in a regular medical screening program, because many men participate in a screening program at their workplace. Second, information regarding lifestyle habits was acquired through self-report measures, which may have been influenced by recall bias. Third, we could not obtain information on potential confounding factors such as detailed lifestyle habits. Additionally, we could not exclude unrecognized confounding variables such as depression and medications such as antipsychotic drugs. Further studies are needed to clarify the relationship between the stress management capability and the risk of CVD.

In conclusion, our results suggest that the stress management capability is closely associated with age, BMI and sleeping habits in elderly Japanese. Since poor psychological conditions and obesity are recognized as risk factors for lifestyle related diseases and subsequent CVD, total health promotion, including the improvement of mental health status is crucial for the development of effective prevention plans for these diseases.

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Conflict of Interest

The authors declare no conflict of interest.

References


