

Sense of coherence as a mediator
between perceived neighborhood characteristics and health

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Abstract

We examine how sense of coherence (SOC) mediates the association between perceived neighborhood characteristics and health, using micro data collected from a nationwide Internet survey in Japan conducted in 2011 ($N = 9,940$). We focus on the impact of neighborhood dissatisfaction, various aspects of perceived neighborhood characteristics, and trust in neighbors on self-rated health and four types of unhealthy behaviors: performing no exercise, sleeping for short periods, smoking, and eating no breakfast. After controlling for SOC, the direct relationship between subjective neighborhood assessment and health was less pronounced. At the same time, a mediation analysis reveals that the impact of neighborhood characteristics on health is highly mediated by SOC. Moreover, the extent of SOC mediation differs substantially across combinations of specific neighborhood characteristics and health variables. Among neighborhood characteristics, perceived safety tends to directly affect health with limited mediation. Among the unhealthy behaviors, performing no exercise is associated with a wide variety of neighborhood characteristics, the impacts of which are substantially mediated by SOC. We believe that this study presents a new aspect to the analysis of the association between one's perception of his/her neighborhood and health.

Keywords

Sense of coherence, self-rated health, perceived neighborhood characteristics, mediation analysis, Japan

Research highlights

- After controlling for sense of coherence (SOC), the direct impact of neighborhood assessment on health declined in size.
- A mediation analysis reveals that the impact of neighborhood characteristics on health is highly mediated by SOC.
- The extent of SOC mediation differs much across combinations of neighborhood characteristics and health variables.

Introduction

A growing number of empirical studies have investigated the impact of perceived neighborhood characteristics on people's health and health behaviors (Diez, 2001; Kawachi & Berkman, 2004; Sampson et al., 2002). Previous studies in social epidemiology have shown that material neighborhood characteristics—such as income inequality, poverty, unemployment, education, and social capital—affect individual health. Recent research has further revealed that *perceived* neighborhood characteristics are significantly associated with various aspects of health including health outcomes, health activities, and some mediating variables that affect health (Cho et al., 2005; Gidlow et al., 2010; Pamplon et al., 2007). It has also been found that perceived neighborhood characteristics affect health, even after controlling for objective neighborhood characteristics or mediate their impact on health (Bowling & Stafford, 2007; Sooman & McIntyre, 1995; Weden et al., 2008).

A wide variety of neighborhood characteristics potentially affect individual health and health behaviors. However, to capture an individual's general perception of his/her neighborhood, an overall measure of the perceived neighborhood problems or dissatisfaction has often been used (Bowling & Stafford, 2007; Cho et al., 2005). Meanwhile, some studies have focused on specific aspects of neighborhoods, such as the safety (Chandola, 2001), disorder (Ross & Mirowsky, 2001), and physical environment factors including neighborhood recreational opportunities (Tucker et al., 2009) and the diversity of land use (Gidlow et al., 2010). In recent years, more emphasis has been placed on the impact of social networks, social support, and social capital, although their conceptual distinctions and relationships are still

debated (Kawachi & Berkman, 2004; Kawachi et al., 1999; Kawachi et al., 2004; Szreter & Woolcock, 2004).

Thus far, only a few researches have addressed the pathway through which perceived neighborhood characteristics affect individual health. It is reasonable to predict that some physical environmental factors directly affect health or health activities; for example, limited access to recreational facilities in one's neighborhood is likely to restrict one's chances of exercising, and the air pollution in a residential area probably adds to the risk of respiratory disease. The associations between subjective neighborhood assessment and health appear to be less straightforward. As suggested by Wen et al. (2006), the impact of perceived neighborhood environment on health appears to be at least partially mediated by psychosocial factors.

In this study, we hypothesize that Antonovsky's concept of sense of coherence (SOC) mediates the impact of perceived neighborhood characteristics on health. SOC is considered to be at the core of human information processing in resolving conflict and enduring stress (Antonovsky, 1979; Antonovsky, 1987). SOC consists of three components: comprehensibility (the extent of the belief that life makes sense and that information about it is structured and consistent), manageability (the extent of the belief that there are sufficient resources for dealing with events), and meaningfulness (the extent of the belief that a situation is challenging and that it warrants making commitments to cope with it). Higher levels of SOC suggest better skills for maintaining and improving health despite stress. In a quantitative analysis, SOC is measured by the SOC scale, which consists of 29 statements, each reflecting one of the three SOC components (Antonovsky, 1993).

Similar to the findings of Erisksson and Lindström's comprehensive survey (2005), it is

widely believed that SOC is an important contributor to the development and maintenance of people's health. Indeed, many studies have empirically confirmed that SOC moderates or buffers the impact of stressors on health and that SOC per se is an important determinant of health (Höge & Büssing, 2004; Jorgensen et al., 1999; Richardson & Ratner, 2005; Torsheim et al., 2001). These results are reasonably predicted from the concept of SOC.

It should be noted, however, that SOC is not an exogenous variable. Antonovsky (1987) argued that SOC develops with age, and preceding studies examined how socioeconomic factors and life events affect the formation of SOC (Jorgensen et al., 1999; Krantz & Östergren, 2004; Volanen et al., 2004). Combined with the argument that SOC positively affects health, the endogeneity of SOC points to the possibility that SOC works as a mediator between stressors and health. Indeed, it has been found that SOC mediates the impacts of several socioeconomic statuses on health (Ing & Reutter, 2003; Kivimäki et al., 2002; Suominen et al., 1999).

The purpose of our analysis is to explicitly address how SOC mediates the impact of perceived neighborhood characteristics on health. This study was inspired by a combination of the two abovementioned findings from previous studies: first, negative neighborhood assessment negatively affects health, and second, SOC mediates the impact of stressors on health. On the basis of a large dataset collected from a nationwide Internet survey in Japan, we employ the framework of a mediation analysis in addition to conventional logit model estimations to address this issue. Mediation analysis was originally proposed by Baron and Kenny (1986), and it has been developed by MacKinnon and Dwyer (1993), MacKinnon et al. (2007), and others. This analysis can measure the extent to which a mediator (SOC) mediates the impact of an independent variable (perceived neighborhood characteristics) on a dependent

one (health), with a set of covariates controlled for.

With regard to this analytical strategy, it should be noted that perceived neighborhood characteristics are subjective and probably influenced by personal traits and attributes, which affect health variables as well. This points to the risk that the observed association between perceived neighborhood characteristics and health variables—particularly self-rated health (SRH)—may be spurious and/or biased, especially when cross-sectional data are used. We attempt to mitigate this problem in three ways. First, we control for a wide variety of covariates at the individual level, including five personality dimensions—extroversion, agreeableness, conscientiousness, neuroticism, and openness—on the basis of the framework of the Big Five Inventory (BFI) (Benet-Martínez & John, 1998) in addition to SOC, demographics, socioeconomic status, and other individual-level factors.

Second, we compare the results across three types of negative neighborhood assessments: neighborhood dissatisfaction; negative neighborhood assessment, based on a composite index of the perceived neighborhood (referred to as NNA hereafter); and no trust in neighbors. Among these three variables, NNA is likely to be the least subjective because it is based on detailed—albeit, still at least partly subjective—assessments of 18 aspects of neighborhood characteristics such as safety, natural environment, and access to medical services.

Last, we consider the responses regarding four specific unhealthy behaviors: performing no exercise, sleeping for short periods, smoking, and eating no breakfast, which are less subjective than SRH. We investigate how each aspect of neighborhood characteristics affects each behavior and how SOC mediates their associations. For example, we compare the impact of safety on performing no exercise with that of the natural environment on sleeping for short

periods, as well as the degree of SOC mediation for each combination. These comparisons were expected to shed more light on the association between perceived neighborhood characteristics and health as well as on the role of SOC as a mediator between them.

Method

Survey

We use micro data collected from a nationwide Internet survey in Japan, designed and implemented under a research project that investigated the socioeconomic determinants of subjective well-being and sponsored by the Japan Society for the Promotion of Science. The survey provides rich information about an individual's subjective assessments of his/her own well-being, personal traits, demographic and socioeconomic status, and perceived neighborhood characteristics, all of which are useful for examining the relationship between perceived neighborhood characteristics and health.

To ensure that the sample is representative of the actual population of Japan, we constructed targeted proportions of 15 population groups—which correspond to the matrix of five age groups (20s, 30s, 40s, 50s, and 60s) and three household income classes (3 million yen or less, 3–6 million yen, and 6 million yen or more)—on the basis of two official statistical publications: the Population Census of 2005 and the Comprehensive Survey of Living Conditions of People on Health and Welfare of 2009. On the basis of these targeted proportions of the sample, we sent the questionnaires via the Internet to 16,930 randomly selected monitors who were registered in the members list of a private Internet-survey institute. We implemented

the survey between February 16 and 22, 2011 and obtained 11,556 responses in total (response rate: 68.3%).

It should be noted that the micro data collected from this Internet survey have three important biases. First, the gender proportion is somewhat skewed toward men, who comprise 55.4% of the respondents. Second, the respondents are more educated than the actual population; the percentage of those who have graduated from college or have a higher education is about 50.2%, well above the proportion of 23.8% for the actual population aged 20–69 years (according to the Employment Status Survey of 2007). Third, the share of respondents who live in the Tokyo metropolitan area, 35.4%, is much higher than the actual proportion of 26.8% (according to the Comprehensive Survey of Living Conditions of People on Health and Welfare of 2007). We should be cautious in interpreting the estimation results due to these biases, although the distributions of age and household income are not very different from the actual distributions. After separating the responses that were missing key variables such as income, the total number of observations used in the empirical analysis was 9,940 (5,722 men and 4,218 women). The basic features of the sample are summarized in Table 1.

Variables

A key dependent variable in this study is SRH, which has been shown to be a reliable indicator of objective health status (Idler & Benyamini, 1997; Wilcox et al., 1996). The survey presented the question, “How do you describe the current state of your health?” and asked the respondents to choose on a five-point scale from 1 (poor) to 5 (excellent). We constructed a binary variable of poor SRH by allocating one to responses 1 (poor) and 2 (somewhat poor), which comprise

21.7% of the whole sample, and zero to the other three. In addition, we constructed four binary variables of unhealthy behaviors: performing no exercise, sleeping for short periods (defined by sleeping for less than six hours a day), smoking, and eating no breakfast. The proportions of respondents with these behaviors are 46.7%, 17.3%, 22.2%, and 23.6%, respectively, in the whole sample.

For the independent variables, we consider three key variables of neighborhood assessment: neighborhood dissatisfaction, NNA, and no trust in neighbors. Regarding neighborhood dissatisfaction, the survey questioned the respondents on their satisfaction with their neighborhoods on a five-point scale ranging from 1 (dissatisfied) to 5 (satisfied). We allocated one to the bottom two responses, which make up 21.7%.

The survey further asked the respondents to assess each of the 18 aspects of a neighborhood—such as safety, access to medical services, and the natural environment (see the first column in Table 4)—on a five-point scale. We summed up the responses as a composite index (mean = 58.6, S. D. = 10.1, and Cronbach's alpha = 0.845) and constructed a binary variable of NNA by allocating one to the index below the lowest quintile (50.4).

Finally, we used the respondents' perception of trust in neighbors as a proxy for the quality of the social network in a neighborhood, which was not fully captured by the perceptions regarding the 18 aspects of a neighborhood. General trust in others is often used as a comprehensive proxy for social trust (Kim & Kawachi, 2006; Subramanian et al., 2002). The survey included the question "How much can you trust your neighbor as a person with whom you can discuss your daily problems and concerns?" and the respondents selected their responses from a five-point scale ranging from 1 (very trustworthy) to 5 (not trustworthy at all).

We defined no trust in neighbors by the response of “not trustworthy at all,” which was felt by 31.8% of the whole sample.

Regarding SOC, the survey asked the respondents to rate their agreement with 29 statements on a six-point scale ranging from 1 (strongly disagree) to 6 (strongly agree). Each of the statements reflected the following three SOC components: comprehensibility, manageability, and meaningfulness of life. After adjusting the order of the responses when necessary, to make a higher point contribute positively to SOC, we obtained 0.919 as Cronbach’s alpha. Then, we summed up the indices and constructed five binary variables for each quartile of the sum.

In the same manner, we constructed five binary variables for each of the five personality dimensions: extroversion, agreeableness, conscientiousness, neuroticism, and openness. Following the framework of the Big Five Inventory (BFI), the survey asked respondents to rate their agreement with each of the 44 BFI items on a five-point scale ranging from 1 (strongly disagree) to 6 (strongly agree). The number of statements on each of the dimensions were 8, 9, 9, 8, and 10, respectively, and Cronbach’s alphas (after adjusting the order of ranks where needed) were 0.780, 0.743, 0.805, 0.722, and 0.824, respectively. For each dimension, we summed up the indices and constructed five binary variables for each quartile of the sum.

In addition to these key variables, we employed several control variables from the dataset. Specifically, we considered gender, age (20s, 30s, 40s, 50s, and 60s or above) for demographics, marital status (married, unmarried, divorced, and widowed), and educational attainment (graduated from junior high school or below, high school, junior college, college or above). For household income, the respondents had to choose their own and their spouse’s incomes, if any, from among 14 income bands. We calculated the median for each band and defined the sum of a

respondent and his/her spouse's incomes as the household income. Then, we calculated the equivalized income by dividing a respondent's or a couple's income by the root of the number of household members. Finally, we constructed five binary variables for the income quintiles. For occupational status, we focused on whether the respondents were seeking jobs, regardless of their current occupational status, because the survey did not directly ask respondents if they were unemployed. We also considered the number of traumatic events experienced in the past three years, constructing two binary variables for "once" and "twice or more." Finally, we collected data on the size of the residential area, divided into five levels: large, medium, and small cities; towns or villages; and unknown.

Analytical strategy

We employed logit regression models to estimate the association between perceived neighborhood characteristics and health. As a benchmark model, we used poorer SRH as a dependent health variable and neighborhood dissatisfaction as a variable of negative neighborhood assessment. We controlled for demographics (gender and age), socioeconomic factors (marital status, household income, educational attainment, employment search, and the size of the residential area), traumatic experiences, and the five personality dimensions.

We first examined how adding SOC as a predictor in the model affects the observed association between neighborhood dissatisfaction and poor SRH. If SOC moderates the impact of the former, the direct impact of neighborhood dissatisfaction on health should decline. We cannot claim, however, that SOC works as a moderator even if the direct impact of the neighborhood declines, given that SOC mediates it. Indeed, preceding studies have reported that

low SOC tends to reduce health, suggesting that negative neighborhood assessment might indirectly affect health through SOC.

Keeping this possibility in mind, we implemented two additional estimations to elucidate the role played by SOC. First, we added the cross term of two binary variables for neighborhood dissatisfaction and for higher-than-median SOC, and we examined its association with SRH. If SOC moderates the negative impact of neighborhood dissatisfaction on health, we should observe an odds ratio of the cross term that is significantly lower than one. Second, we estimated the model separately for individuals with high and low SOC, which were divided by the median. If SOC works as a moderator, we should observe a smaller impact for high-SOC individuals than low-SOC individuals. We performed these two estimations for NNA and no trust in neighbors, and we repeated similar estimations controlling for SOC to examine the robustness of the results.

Next, we investigated more explicitly how SOC mediates the impact of perceived neighborhood characteristics on health, on the basis of the framework of a mediation analysis. In this estimation, we used three binary indicators of SOC (which corresponded to the second, third, and fourth quartiles of SOC) as a set of mediators between the health variable (as a dependent variable) and neighborhood assessment (as an independent variable), along with other variables (as a set of covariates).

We first performed this mediation analysis for three variables of negative neighborhood assessments and poor SRH. Then, we extended it to the combinations of 18 aspects of perceived neighborhood characteristics and four types of unhealthy behaviors. In total, we conducted the mediation analysis in 105 ($= (3 + 18) \times (1 + 4)$) cases in response to each combination of

neighborhood assessment and health variables.

Results

Table 2 summarizes the estimated associations between negative neighborhood assessment and SRH across 21 different model specifications, after controlling for a set of several covariates (which are not reported in the table to save space). For each of the three types of negative neighborhood assessments (neighborhood dissatisfaction, NNA, and no trust in neighbors), the table compares the odds ratios of reporting poor SRH in response to negative neighborhood assessment estimated without controlling for SOC, controlling for SOC, and controlling for SOC and adding the cross term with high SOC, for all individuals. The table also provides the odds ratios estimated separately for low- and high-SOC individuals, both with and without controlling for SOC.

We note that the odds ratios of reporting poor SRH are significantly higher than one for all the seven model specifications, as can be seen from the information at the top of Table 2, in which neighborhood dissatisfaction is used as a neighborhood assessment variable. This underscores the negative impact of neighborhood dissatisfaction on SRH, in line with the results obtained by previous studies. Second, we observe that when controlling for SOC, the odds ratio declines to 1.22 from 1.35 when not controlling for it, for all individuals. We obtained similar results when separately estimating the models: it declines from 1.23 to 1.19 for low-SOC individuals, and from 1.40 to 1.33 for high-SOC individuals. On the basis of these results, it is natural to suspect that SOC moderates the negative impact of neighborhood

dissatisfaction on SRH. However, the odds ratio of the cross term of neighborhood dissatisfaction and high SOC was not significantly different from one (OR: 1.14, 95% CI: 0.85, 1.54). Moreover, when estimating the models separately for high-SOC and low-SOC individuals, we found that the odds ratio is higher, albeit not significantly higher, for high-SOC individuals than for low-SOC individuals, regardless of whether one controls for SOC (OR: 1.33 vs. 1.19) or not (OR: 1.40 vs. 1.23).

The middle and lower parts of the table are the results of when neighborhood dissatisfaction is replaced with NNA and no trust in neighbors, respectively. In general, we obtained a pattern of results that was similar to the case of neighborhood dissatisfaction. The odds ratios of reporting poor SRH in response to negative neighborhood assessment are all significantly above one, except for the case of NNA/controlling for SOC/high-SOC individuals, in which the significance of the estimated association is slightly below 5% (OR: 1.23, 95% CI: 0.99, 1.53). This confirms the negative impact of negative neighborhood assessment on health. In addition, the odds ratios are lower when controlling for SOC than when not controlling for it in all cases, as in the case of neighborhood dissatisfaction. However, the results of separate estimations are different from those for neighborhood dissatisfaction; the odds ratios are slightly higher for low-SOC individuals than high-SOC individuals, except for the case of no trust in neighbors/controlling for SOC. Still, the difference is not significant at the 5% level in all cases. Taken together, the results shown in Table 2 contradict the view that SOC moderates the impact of negative neighborhood assessment on health.

Table 3 presents the full estimation results of the benchmark model that used neighborhood dissatisfaction as the neighborhood assessment, in both controlling for SOC and not controlling

for it. As already observed in the first row in Table 2, there is a negative association between neighborhood dissatisfaction and SRH, and its degree decreases after controlling for SOC. Besides this main result, there are several noteworthy findings shown in this table. Most importantly, SOC has a substantially negative association with SRH, considering that the odds ratio of reporting poor SRH in response to higher SOC is well below one and that this ratio decreases steadily as SOC rises. This result points to the pathway through which SOC mediates the impact of negative neighborhood assessment on health. We will address this issue in more detail when we discuss the results shown in Table 4.

Regarding the control variables, the results are intuitively reasonable and/or in line with the results of preceding studies. Women assess their own health status lower than men, and SRH becomes steadily poorer with increasing age. As for the socioeconomic variables, we note that divorce, lower household income, lower educational attainment, and employment search tend to reduce SRH, whereas the size of a residential area is irrelevant. Experiences with traumatic events have a substantial, negative impact on SRH. Regarding personality, we find that neuroticism substantially lowers SRH. Extroversion raises SRH when SOC is not controlled for, but its association with SRH becomes insignificant when SOC is controlled for. Agreeableness, conscientiousness, and openness are not significantly correlated with SRH.

Table 4 presents the matrix of the estimated impacts of neighborhood variables (row) on health variables (column), along with the proportion of the impacts mediated by SOC. The neighborhood variables include three key negative assessments and 18 aspects of perceived neighborhood characteristics. The health variables include poor SRH and four types of unhealthy behaviors. The 18 perceived neighborhood characteristics are placed in descending

order according to the estimated odds ratios of reporting poor SRH in response to the respondents' negative assessments. The degree of the impact is presented in terms of the odds ratio of reporting poor SRH or engaging in each unhealthy behavior in response to each aspect of negative neighborhood assessment, based on the logit models with all variables other than SOC controlled for. The proportion of the impact mediated by SOC is presented only for the combinations whose relationships are significant at the 5% level.

Focusing on the impact on SRH (first column), we first note that 54.8% of the impact of neighborhood dissatisfaction on SRH is mediated by SOC. The proportion of mediation is smaller for NNA (50.6%) and no trust in neighbors (41.0%), but is not much different from that for neighborhood dissatisfaction. These findings indicate that SOC works as an important mediator between negative neighborhood assessment and SRH. Second, as can be seen from the lower part of the table, the impact on SRH is mediated quite differently by SOC across different aspects of perceived neighborhood characteristics. Notably, the degree of mediation is relatively high for the negative assessments of the number of acquaintances living nearby (61.2%), job opportunities (46.1%), and cultural atmosphere (45.1%), whereas it is relatively low for the negative assessments of safety (10.6%) and natural environment (17.8%).

With regard to the impacts of three key measures of neighborhood adjustment on five health variables, we note that negative neighborhood assessment affects health behaviors as well as SRH in most cases, and that it tends to be substantially mediated by SOC. In particular, neighborhood dissatisfaction significantly raises the probabilities of all four unhealthy behaviors. In contrast, NNA does not significantly affect sleeping for short periods, and no trust in neighbors does not raise the probability of sleeping for short periods or smoking. In the cases

where negative neighborhood assessment significantly affects health behaviors, the proportion of the impact by SOC ranges between 14.8% (of the impact of no trust in neighbors on eating no breakfast) and 40.7% (of the impact of neighborhood dissatisfaction on performing no exercise).

From the matrix in the lower part of the table, which summarizes the impacts of the negative assessment of each perceived neighborhood characteristic on each health variable, we note that the degree of mediation by SOC differs substantially across the combinations. Most importantly, we note the uniqueness of the effect of negatively assessed safety on health. On the one hand, negatively assessed safety affects four health variables (other than performing no exercise) more substantially than other neighborhood characteristics. Indeed, the odds ratio of reporting poor SRH in response to negatively assessed safety is 1.67, well above the range of 1.11 to 1.31 for other neighborhood characteristics. On the other hand, the degree of mediation by SOC of the impact of safety is relatively limited, compared to other neighborhood characteristics. The proportion of the mediated impact of safety lies in the range of 5.7% (of the impact on smoking) and 13.9% (of the impact on performing no exercise), well below 23.6 % (not reported in the table), which is the mean for other neighborhood characteristics.

It is also noteworthy that the associations with neighborhood characteristics differ remarkably across different health variables. Among 18 perceived neighborhood characteristics, safety, quality of public service, and convenience for commuting significantly affect all the five health variables, whereas other neighborhood characteristics tend to have selective associations with health variables. Poor SRH and performing no exercise are affected by a wide range of perceived neighborhood characteristics, whereas sleeping for short periods is associated with limited types of neighborhood characteristics. We further find that the magnitude of the impact

of each neighborhood characteristic mediated by SOC is larger on poor SRH and performing no exercise than on other health behaviors, which is consistent with the results for the three key variables of neighborhood assessment.

Discussion and conclusion

The aim of this paper was to investigate how SOC mediates the impact of negative neighborhood assessment on health, on the basis of micro data collected from a nationwide Internet survey in Japan. Our regression analysis confirmed two findings that are fully consistent with those obtained in preceding studies. First, negative neighborhood assessment significantly reduces SRH. This result was robust, in that we obtained it for all three variables of negative neighborhood assessment. In addition, negative neighborhood assessment significantly raises the probability of unhealthy behaviors. Second, SOC is highly associated with health and health behaviors; higher levels of SOC significantly reduce the likelihood of reporting poor SRH and engaging in unhealthy behaviors.

In addition to these two findings, which have already been well established, this study highlighted the role that SOC plays as an important mediator between perceived neighborhood assessment and health. Some researchers have emphasized that SOC moderates the negative impact of stressors on health, as mentioned in the Introduction. Indeed, we observed that the direct impact of negative neighborhood assessment on health declined in size after controlling for SOC. However, we obtained two findings that are not supportive of the SOC-as-moderator hypothesis. First, the cross term of the two binary variables of negative neighborhood

assessment and high SOC is not significantly associated with health. Second, the impact of the negative assessment on health is higher—or at least not significantly lower—for high-SOC individuals than low-SOC individuals.

Moreover, the estimation results obtained from the mediation analysis revealed that SOC mediates about half of the impact of neighborhood dissatisfaction on SRH. We obtained a similar magnitude of SOC mediation when we replaced neighborhood dissatisfaction with the composite measure of perceived neighborhood characteristics—which are less subjective than neighborhood dissatisfaction—as well as with no trust in neighbors.

These estimated results indicate that SOC is not fully exogenous in the relationship between neighborhood assessment and health. A negatively perceived neighborhood leads to a reduction in SOC, which in turn affects health negatively. In other words, negative neighborhood assessment reduces the positive impact of SOC on health. These findings do not necessarily contradict the view that SOC moderates the effects of stressors on health, because unlike our estimation models, many preceding studies treated SOC as exogenous. For example, Richardson and Ratner (2005) focused on how SOC measured in 1998 affected the impact of recent stressful events in 2000 on SRH measured in 2000. Their analysis was reasonably designed to capture the role of SOC as an exogenous moderator, but it neglected in advance the path by which stressful events affect SOC.

Our empirical analysis has emphasized the role of SOC as a mediator. We estimated the same regression model for four specific health behaviors and confirmed that SOC mediates the impact of the negative assessment on each of them in most model specifications. The magnitude of the SOC mediation is somewhat smaller than that of SRH. This result seems to be reasonable,

considering that both SOC and SRH are subjective measures and are probably affected by the same individual attributes, which were not fully controlled for in the regression models.

We further compared the relationships of the degrees of mediation of SOC between each specific aspect of perceived neighborhood and each health behavior. Perceived safety affects a wide variety of health variables more directly—that is, with less mediation by SOC—than other neighborhood characteristics. This implies that a safety problem in a neighborhood tends to work as a relatively imminent stressor for health. Besides safety, perceived neighborhood characteristics tend to have selective associations with health variables. Meanwhile, performing no exercise is affected by a wide range of neighborhood characteristics, the impacts of which are substantially mediated by SOC.

We believe that this study presents a new aspect to the analysis of the association between the perception of place and health, in that it explicitly discusses SOC as a mediator of the impact of perceived neighborhood characteristics on health and it investigates the relationships between specific neighborhood characteristics and health behaviors. We recognize, however, that this study has several limitations. First, as mentioned in the Variables section, the micro data used in the empirical analysis are not free from biases inherent in an Internet survey; for example, there are disproportionately high proportions of well-educated respondents and respondents residing in the Tokyo metropolitan area. Second and more importantly, the variables of neighborhood assessment employed in our estimation are subjective and probably affected by personal traits and attributes. To address this issue, we controlled for SOC and personality, and we considered a wide variety of specific neighborhood assessments and compared their associations with health. However, endogeneity of perceived neighborhood

characteristics should be taken into account more explicitly. Third, as is often the case for this type of cross-sectional analysis, this study could not precisely identify any causality between perception of place and health. Moreover, as suggested by Boone-Heinonen et al. (2011), individual attributes might influence both the selection of neighborhoods and individual health behaviors. A longitudinal analysis is expected to identify, more precisely, the role played by SOC in a dynamic framework.

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Table 1

Key statistical features of the respondents

| Proportion | | All | Men | Women |
|---|-----------------------------|-------|-------|-------|
| Poor self-rated health (SRH) | | 0.217 | 0.234 | 0.194 |
| Neighborhood dissatisfaction | | 0.155 | 0.143 | 0.170 |
| Marital status | Married | 0.636 | 0.654 | 0.611 |
| | Single | 0.295 | 0.290 | 0.301 |
| | Divorced | 0.054 | 0.044 | 0.067 |
| | Widowed | 0.015 | 0.011 | 0.020 |
| Educational attainment | Junior high school or below | 0.022 | 0.024 | 0.020 |
| | High school | 0.259 | 0.243 | 0.280 |
| | Junior college | 0.215 | 0.120 | 0.343 |
| | College or above | 0.504 | 0.613 | 0.357 |
| Employment search | | 0.215 | 0.196 | 0.241 |
| Traumatic events | None | 0.575 | 0.605 | 0.536 |
| | Once | 0.287 | 0.272 | 0.307 |
| | Twice | 0.138 | 0.123 | 0.157 |
| Size of residential area | Metropolitan | 0.365 | 0.362 | 0.370 |
| | Middle-sized city | 0.139 | 0.124 | 0.159 |
| | Other city | 0.400 | 0.430 | 0.360 |
| | Town and village | 0.073 | 0.070 | 0.076 |
| | Not known | 0.023 | 0.015 | 0.034 |
| Household income (equivalized, mil. yen) | Mean | 3.28 | 3.45 | 3.06 |
| | S. D. | 2.37 | 2.46 | 2.23 |
| Age | Mean | 45.1 | 47.9 | 41.3 |
| | S. D. | 14.1 | 14.3 | 12.9 |
| <i>N</i> | | 9940 | 5722 | 4218 |

Table 2

Comparing the estimated associations of reporting poor self-rated health with three types of negative neighborhood assessments across different model specifications

| | Not controlling for SOC | | Controlling for SOC | | Controlling for SOC + Cross term with high SOC | |
|---------------------------------------|-------------------------|--------------|---------------------|--------------|--|--------------|
| | OR | 95% CI | OR | 95% CI | OR | 95% CI |
| Neighborhood dissatisfaction | | | | | | |
| All individuals | 1.35 | (1.18, 1.54) | 1.22 | (1.07, 1.40) | 1.18 | (1.01, 1.38) |
| Cross term with high SOC ^a | | | | | 1.14 | (0.85, 1.54) |
| Low-SOC individuals | 1.23 | (1.06, 1.44) | 1.19 | (1.01, 1.39) | | |
| High-SOC individuals | 1.40 | (1.08, 1.81) | 1.33 | (1.02, 1.73) | | |
| NNA^b | | | | | | |
| All individuals | 1.38 | (1.23, 1.56) | 1.26 | (1.12, 1.41) | 1.26 | (1.09, 1.45) |
| Cross term with high SOC ^a | | | | | 0.99 | (0.76, 1.28) |
| Low-SOC individuals | 1.32 | (1.15, 1.52) | 1.26 | (1.10, 1.46) | | |
| High-SOC individuals | 1.27 | (1.02, 1.58) | 1.23 | (0.99, 1.53) | | |
| No trust in neighbors | | | | | | |
| All individuals | 1.32 | (1.18, 1.47) | 1.21 | (1.08, 1.36) | 1.21 | (1.06, 1.39) |
| Cross term with high SOC ^a | | | | | 1.00 | (0.80, 1.26) |
| Low-SOC individuals | 1.28 | (1.12, 1.47) | 1.21 | (1.05, 1.39) | | |
| High-SOC individuals | 1.25 | (1.03, 1.51) | 1.25 | (1.03, 1.51) | | |

Gender, age, marital status, household income, educational attainment, employment search, size of residential area, traumatic events, and personality were controlled for in each model.

^a The cross term with high SOC is the product of the binary variables of negative neighborhood assessment and high SOC (above the median).

^b NNA is a negative neighborhood assessment based on a composite index of perceived neighborhood characteristics.

Table 3

The estimated association of poor self-rated health with neighborhood dissatisfaction and other variables with and without controlling for sense of coherence (SOC)

| | | Not controlling for SOC | | Controlling for SOC | |
|--|--------------------|-------------------------|--------------|---------------------|--------------|
| | | OR | 95% CI | OR | 95% CI |
| Neighborhood dissatisfaction | | 1.35 | (1.18, 1.54) | 1.22 | (1.07, 1.40) |
| Sense of coherence (SOC) (ref. = Level 1) | Level 2 | | | 0.57 | (0.49, 0.66) |
| | 3 | | | 0.43 | (0.36, 0.50) |
| | 4 (= highest) | | | 0.25 | (0.21, 0.31) |
| Gender | Female | 0.76 | (0.68, 0.85) | 0.79 | (0.70, 0.88) |
| Age (ref. = 20s) | 30s | 1.24 | (1.04, 1.47) | 1.13 | (0.94, 1.35) |
| | 40s | 1.84 | (1.52, 2.22) | 1.57 | (1.30, 1.90) |
| | 50s | 2.11 | (1.74, 2.54) | 1.83 | (1.51, 2.21) |
| | 60s or above | 2.58 | (2.10, 3.17) | 2.35 | (1.91, 2.89) |
| Marital status (ref. = Married) | Unmarried | 1.20 | (1.04, 1.38) | 1.08 | (0.94, 1.25) |
| | Divorced | 1.60 | (1.30, 1.96) | 1.45 | (1.18, 1.78) |
| | Widowed | 0.83 | (0.55, 1.27) | 0.84 | (0.54, 1.29) |
| Household income (ref. = Level 5) | Level 1 (= lowest) | 1.51 | (1.25, 1.81) | 1.44 | (1.19, 1.73) |
| | 2 | 1.24 | (1.04, 1.48) | 1.17 | (0.98, 1.41) |
| | 3 | 1.11 | (0.93, 1.33) | 1.07 | (0.89, 1.27) |
| | 4 | 1.07 | (0.90, 1.27) | 1.04 | (0.87, 1.24) |
| Educational attainment (ref. = College or above) | Junior high school | 1.48 | (1.09, 2.00) | 1.45 | (1.07, 1.97) |
| | High school | 1.05 | (0.92, 1.18) | 1.04 | (0.92, 1.18) |
| | Junior college | 0.91 | (0.79, 1.05) | 0.91 | (0.79, 1.05) |
| Employment search | | 1.22 | (1.08, 1.38) | 1.15 | (1.01, 1.30) |
| Size of residential area (ref. = Metropolitan area) | Middle-sized city | 0.93 | (0.79, 1.09) | 0.95 | (0.80, 1.12) |
| | Other city | 0.96 | (0.85, 1.07) | 0.97 | (0.86, 1.09) |
| | Town or village | 1.11 | (0.91, 1.35) | 1.13 | (0.93, 1.39) |
| | Unknown | 0.99 | (0.71, 1.39) | 1.06 | (0.76, 1.49) |
| Traumatic events (ref. = None) | Once | 1.89 | (1.68, 2.12) | 1.87 | (1.67, 2.10) |
| | Twice or more | 2.54 | (2.21, 2.92) | 2.47 | (2.14, 2.85) |
| Extroversion (ref. = Level 1) | Level 2 | 0.87 | (0.75, 1.00) | 1.02 | (0.87, 1.18) |
| | 3 | 0.83 | (0.71, 0.96) | 1.06 | (0.91, 1.25) |
| | 4 (= highest) | 0.74 | (0.63, 0.86) | 1.08 | (0.92, 1.27) |
| Agreeableness (ref. = Level 1) | Level 2 | 0.91 | (0.78, 1.06) | 1.01 | (0.86, 1.18) |
| | 3 | 0.93 | (0.80, 1.08) | 1.09 | (0.93, 1.27) |
| | 4 (= highest) | 0.94 | (0.79, 1.11) | 1.21 | (1.01, 1.44) |
| Conscientiousness (ref. = Level 1) | Level 2 | 0.90 | (0.78, 1.05) | 0.93 | (0.80, 1.08) |
| | 3 | 1.01 | (0.86, 1.18) | 1.10 | (0.93, 1.29) |
| | 4 (= highest) | 0.87 | (0.74, 1.03) | 1.01 | (0.85, 1.19) |

| | | | | | |
|---------------------------------|---------------|----------|--------------|----------|--------------|
| Neuroticism (ref. = Level 1) | Level 2 | 1.30 | (1.09, 1.55) | 1.18 | (0.99, 1.42) |
| | 3 | 1.71 | (1.43, 2.04) | 1.45 | (1.21, 1.75) |
| | 4 (= highest) | 2.95 | (2.46, 3.54) | 2.28 | (1.89, 2.76) |
| Openness (ref. = Level 1) | Level 2 | 0.91 | (0.78, 1.07) | 0.98 | (0.83, 1.15) |
| | 3 | 0.95 | (0.72, 1.09) | 1.08 | (0.94, 1.26) |
| | 4 (= highest) | 1.15 | (0.98, 1.34) | 1.46 | (1.24, 1.72) |
| <hr/> | | | | | |
| Pseudo <i>R</i> -squared | | 0.0890 | | 0.1081 | |
| Log likelihood | | -4734.38 | | -4634.89 | |
| Number of observations | | 9940 | | 9940 | |
| <hr/> | | | | | |

Table 4

The impact of perceived neighborhood characteristics on self-rated health and unhealthy behaviors and the proportion of the impact mediated by sense of coherence (SOC)

| | Poor self-rated health | | Performing no exercise | | Sleeping for short periods | | Smoking | | Eating no breakfast | |
|--|------------------------|--------|------------------------|--------|----------------------------|--------|---------|--------|---------------------|--------|
| | OR | % | OR | % | OR | % | OR | % | OR | % |
| Neighborhood dissatisfaction | 1.35 | [54.8] | 1.26 | [40.7] | 1.31 | [33.4] | 1.21 | [30.3] | 1.38 | [21.7] |
| NNA ^a | 1.38 | [50.6] | 1.35 | [32.2] | 1.19 | [47.4] | 1.11 | | 1.34 | [22.9] |
| No trust in neighbors | 1.32 | [41.0] | 1.37 | [18.7] | 1.09 | | 1.02 | | 1.32 | [14.8] |
| Negative assessment of: | | | | | | | | | | |
| Safety | 1.67 | [10.6] | 1.21 | [13.9] | 1.24 | [12.0] | 1.30 | [5.7] | 1.34 | [6.2] |
| Access to medical services | 1.31 | [17.8] | 1.21 | [14.2] | 1.19 | [13.7] | 1.12 | | 1.19 | [11.9] |
| Natural environment | 1.26 | [31.6] | 1.23 | [19.2] | 1.03 | | 1.26 | [9.8] | 1.11 | |
| Education-mindedness of neighbors | 1.24 | [41.7] | 1.12 | [43.0] | 1.11 | | 1.23 | [15.1] | 1.05 | |
| Access to good schools | 1.24 | [30.6] | 1.13 | [28.0] | 1.02 | | 1.24 | [9.5] | 1.07 | |
| Residential environment | 1.23 | [37.3] | 1.14 | [29.3] | 0.99 | | 1.13 | | 1.19 | [16.4] |
| Quality of public service | 1.22 | [42.4] | 1.12 | [40.2] | 1.22 | [23.0] | 1.26 | [12.4] | 1.14 | [25.6] |
| Convenience for business | 1.22 | [30.3] | 1.15 | [22.1] | 1.11 | | 1.15 | [12.9] | 1.20 | [11.8] |
| Cultural atmosphere | 1.20 | [45.1] | 1.12 | [36.4] | 1.10 | | 1.30 | [9.5] | 1.23 | [15.0] |
| Income level of neighbors | 1.20 | [28.5] | 1.13 | [22.5] | 1.05 | | 1.15 | [12.0] | 1.09 | |
| Pollution | 1.19 | [26.0] | 1.12 | [20.9] | 1.07 | | 1.09 | | 1.01 | |
| Job opportunities | 1.18 | [46.1] | 1.15 | [29.9] | 1.03 | | 1.20 | [13.3] | 1.19 | |
| Acquaintances living nearby | 1.18 | [61.2] | 1.46 | [17.3] | 1.08 | | 0.95 | | 1.26 | [19.7] |
| Access to nursing facilities | 1.14 | | 1.33 | [15.8] | 1.02 | | 1.07 | | 1.33 | [11.0] |
| Convenience for commuting | 1.14 | [38.2] | 1.10 | | 1.19 | [15.4] | 1.15 | [10.4] | 1.13 | [13.7] |
| Access to cultural and recreational facilities | 1.13 | [44.4] | 1.29 | [12.9] | 1.03 | | 1.09 | | 1.03 | |
| Convenience for shopping | 1.13 | | 1.16 | [21.3] | 1.07 | [45.0] | 1.10 | | 1.19 | [12.8] |
| Family members or relatives living nearby | 1.11 | | 1.10 | [13.9] | 1.04 | | 1.01 | | 1.23 | [4.6] |
| Proportion in sample (%) | 21.7 | | 46.7 | | 17.3 | | 22.2 | | 23.6 | |

The figures in brackets indicate the proportion (%) of the impact mediated by SOC when the impact was significant at the 5% level. Gender, age, marital status, household income, educational attainment, employment search, size of residential area, and personality were controlled for in each model.

^a NNA is a negative neighborhood assessment based on a composite index of perceived neighborhood characteristics.