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Association between district-level perceived safety and self-rated health: a multilevel study in Seoul, South Korea

Seung-Sup Kim, Jaesung Choi, Kisoo Park, Yeonseung Chung, Sangjo Park, Jongho Heo

ABSTRACT
Objectives: Several studies have reported the relationship between residents’ perceived neighbourhood safety and their health outcomes. However, those studies suffered from unreliability of neighbourhood safety measure and potential residual confounding related to crime rates. In this study, using multilevel analysis to account for the hierarchical structure of the data, we examined associations between district-level perceived safety and self-rated health after adjusting for potential confounders including the district-level crime rate.

Design: Cross-sectional study.

Setting: We used the first wave of Seoul Welfare Panel Study, which has 7761 individuals from 3665 households in 25 administrative districts in Seoul, South Korea. District-level perceived safety was obtained by aggregating responses from the residents that are representative samples for each administrative district in Seoul. To examine an association between district-level safety and residents’ self-rated health, we used mixed effect logistic regression.

Results: Our results showed that higher district-level perceived safety, an aggregated measure of district residents’ responses towards neighbourhood safety, was significantly associated with poor self-rated health after controlling for sex, age, education level, job status, marital status and household income (OR=0.87, 95% CI 0.78 to 0.97). Furthermore, this association was still robust when we additionally adjusted for the district-level crime rate (OR=0.86, 95% CI 0.77 to 0.95).

Conclusions: Our study highlights the importance of improving neighbourhood perceived safety to enhance residents’ health.

INTRODUCTION
Crime is one of the major problems in many metropolitan areas across countries. Although city crime rates have dropped globally since the mid-1990s, there are still large variations and dramatic fluctuations across cities. Past criminological studies revealed that variations in crime rates were explained by characteristics of metropolitan areas, such as population size, ethnic heterogeneity, geographic mobility, economic segregation, unemployment rate, poverty level and degree of social integration and control.

Thus, many governments have made great efforts to reduce the crime rates especially in metropolitan areas by intervening in those characteristics to ensure the safety of their residents.

Safety from crime is not only an essential human need in daily life, but also a prerequisite to human health. A body of past studies has reported the relationship between residents’ perceptions of neighbourhood safety and their health outcomes. For example, one UK survey with 407 adults reported that fear of crime was significantly associated with self-rated health and mental well-being. Ziersch et al showed that perceived neighbourhood safety was related to physical and mental health among 2400 residents in western suburbs of Adelaide, Australia.

However, these earlier studies suffer from the following limitations. First, most of the previous studies used individual-level neighbourhood perceived safety as an exposure variable, which could be influenced by several factors such as the prior individual experience of victimisation or individual health conditions other than neighbourhood-level safety.
This could be particularly a critical issue in previous cross-sectional studies because of the potential reverse causation, meaning that the sick people are more likely to perceive their neighbourhood as unsafe. The second limitation is a lack of representativeness of samples within the operationalised definition of neighbourhood. Few studies had enough sample size or the sample size within neighbourhood to be representative of each neighbourhood. Unless the responses are obtained from a representative sample of participants within each neighbourhood, aggregated perceived neighbourhood measures can potentially be prone to measurement errors. The final limitation is that previous studies did not adjust for the district-level crime rate as a potential confounder although the crime rate has been reported to influence perception of neighbourhood safety as well as residents’ health outcomes.

In this study, we assessed the district-level perceived safety, which was obtained by aggregating responses from the residents that are representative samples for each administrative district in Seoul, the capital of South Korea. Then, using multilevel analysis to account for the hierarchical structure of the data, we examined the association between district-level perceived safety and self-rated health after adjusting for potential confounders including the district-level crime rate.

**METHODS**

**Study population**

Data were obtained from the Seoul Welfare Panel Study (SWPS), which tracked a representative sample of households residing in 25 administrative districts in Seoul, South Korea. The SWPS was launched in 2008 by the Seoul Welfare Foundation. The first wave of the survey was conducted in 2008 and its supplementary survey targeting the low-income households was implemented in 2009. The SWPS was suspended after the second wave of the survey was conducted in September 2010. The survey employed a two-stage stratified cluster sampling approach where a representative sample of census tracts for each district was first drawn, and then households were randomly selected within those sampled census tracts at the baseline. A household representative answered the household survey and all members of a household whose age is 15 or older were interviewed. A total of 7761 individuals completed the interviews in wave 1. The SWPS has been publicly released (www.welfare.seoul.kr). Because all respondents answered on questionnaire items we used in this study, we were able to conduct our analyses based on the entire sample participated in the first wave of SWPS without listwise deletion or missing value imputation for handling missing data. The final sample used in the data analysis of this research consists of 7761 individuals from 3665 households from 25 administrative districts in Seoul. The number of households in each district was 146.6 on average, ranging from 108 to 198. This research received Institutional Review Board exemption from the Division of Research Affairs at the San Diego State University.

**Exposure: district-level perceived safety**

District-level perceived safety was assessed through the household survey using a question about how much a household representative agrees with the following statement: “My current residential environment is unsafe.” Respondents answered in a five level ordinal scale from ‘strongly agree’ (coded as 1) to ‘strongly disagree’ (coded as 5). The response was then dichotomised into ‘unsafe’ (coded as 0) for the response, 1 and 2 and ‘safe’ (coded as 1) for the response, 3–5. The binary responses from household representatives were aggregated to calculate administrative district-level perceived neighbourhood safety by taking a weighted average of household-specific perceived safety within each district with the household size used as weight. Such aggregation results in that the district-level perceived neighbourhood safety is essentially the sample proportion of individuals who answered ‘safe’ within each district.

**Outcome: poor self-rated health**

Poor self-rated health was assessed through the individual interview using the question ‘how would you rate your overall health?’ This question is on the ordinal level, ranging from ‘very good’ (coded as 1) to ‘very poor’ (coded as 5). The response was then dichotomised into ‘good health’ (coded as 0) for the response, 1–3 and ‘poor health’ (coded as 1) for the response, 4 and 5. Although self-rated health cannot assess multidimensional aspects of health conditions, it is known to be a reliable predictor of life expectancy after adjusting for other health indicators.

**Covariates**

We included several confounders in the data analysis. For individual-level confounders, we have sex, age group (15–19, 20–29, 30–39, 40–49, 50–59, 60–69 and 70 or more), education level (elementary school or less, junior high school, high school, college graduate, university graduate and graduate school or more), marital status (married or cohabiting vs others) and job status (employed vs unemployed), household income with six categories (1 000 000 KRW or less; 1 010 000–2 000 000 KRW; 2 010 000–3 000 000 KRW; 3 010 000–4 000 000 KRW; 4 010 000–5 000 000 KRW; and above 5 000 000 KRW) and individual perception of district safety (unsafe vs safe). Because neighbourhood safety was assessed solely from the household survey, we assigned the value of perceived neighbourhood safety measured from each household representative to all members of the household.

We considered the district-level crime rate as a potential covariate at the district level because it can influence residents’ health as well as perceived safety. District-level crime rates for each of the 25 administrative districts (‘Gu’) in Seoul were collected from the ‘analytical
report on crimes, 2008’ that was published by supreme
prosecutors’ office in South Korea. The district-level
crime rate was calculated by dividing the total number of
crimes by the total number of residents in each dis-
trict (expressed in the total number of crimes in 2008/
population in 2008 *100). Using an identifier for each
administrative district in the SWPS, we linked the official
crime rate of each administrative district to our final
dataset of the SWPS.

Data analysis
Mixed effect logistic regression was used to investigate
the association between district-level perceived safety
and self-rated health. Because of the hierarchical struc-
ture in our data (ie, individuals are nested in house-
holds, which in turn are nested in districts), within-household and within-district correlations were
incorporated using household-specific and district-
specific random intercepts. We made stepwise adjust-
ments of potential confounders in the data analysis.
First, we adjusted for potential confounders including
sex, age, education level, job status, marital status and
household income. Second, we additionally adjusted for
the district-level crime rate. Finally, we examined the
association after adjusting for individual perception of
district safety in addition to all of the previously men-
tioned confounders. All of the confounders were
included as categorical variables, and the district-level
perceived safety was included after standardisation for
simple interpretation in the model. All computations
were performed using the R statistical software.

RESULTS
Table 1 presents the distribution of the study population
and the prevalence of poor self-rated health by each of
the individual-level, household-level and district-level
characteristics. Overall, poor self-rated health was
reported at 20.9% (1620 of 7761 participants). The
proportion was higher for women and showed an
increasing pattern with age. Higher prevalence of poor
self-rated health were observed for participants with
lower education levels. The unemployed and people
living in an unsafe neighbourhood exhibited higher
prevalence of poor self-rated health than the employed
and those living in a safe neighbourhood. The house-
hold income was fairly equally distributed in the SWPS.
As to the district-level perceived safety and crime rate,
given the overall mean of each variable, the relative
size of each SD shows that there were considerable var-
iations among the 25 districts.

District-level perceived safety was significantly asso-
ciated with poor self-rated health while different sets of
confounders being step-wisely adjusted (Table 2). Living
in a district where its safety level is 1 SD (0.08) higher
resulted in 13% lower odds of reporting self-rated poor
health status (OR=0.87, 95% CI 0.78 to 0.97) after
adjusting for sex, age, education level, job status, marital
status and household income. When we additionally
adjusted for the district-level crime rate, this association
was slightly attenuated but still significant (OR=0.86,
95% CI 0.77 to 0.95). When we adjusted for individual
perception of district safety in addition to previously
mentioned potential confounders, the magnitude of this
association remained significant (OR=0.86, 95% CI 0.77
to 0.96).

DISCUSSION
Evidence from our study indicated that district-level per-
cieved safety, which was assessed by aggregating responses
from residents in each district, was significantly associated
with poor self-rated health even after controlling for
demographic information, socioeconomic status (SES) and
district-level crime rate. Notably, this association was
robust also when we additionally adjusted for individual
perception of district safety.

Our findings are in line with previous research that
showed association between perceived neighbourhood
safety and health outcomes. Past studies have also
reported that residents who perceived that their neigh-
bourhood had more severe problems were more likely to
experience greater anxiety, stress and depression. The
studies, which sampled women, children and the elderly,
also provided consistent evidence of a relationship
between perceived crime risk and physical health.

In this study, district-level crime rate was not associated
with self-rated health in the fully adjusted model.
Furthermore, our post-hoc analysis showed that there
was no statistically significant relationship between dis-
trict crime rate and residents’ self-rated health regardless
of adjustment of confounders, although the district-level
crime rate could have a major influence on district-level
perceived safety. This finding is different from past
studies that reported a significant relationship between
district crime rate and residents’ health such as coronary
heart disease and low birth weight.

The differential association between district-level per-
cieved safety and crime rate in relation to self-rated
health could be explained in three ways. First, mass
media may increase individual-level perceived neigh-
bourhood insecurity regardless of their neighbourhood
crime rates, especially when they reported the crime in
ways of exaggeration. The mass media tend to
emphasise criminal stories which can draw attention
from the audience. Previous studies called this phe-
nomenon the ‘cultivation effect’ meaning that exposure
to the world of television cultivates exaggerated percep-
tions of viewers and magnifies viewers’ fear about
crime. The residents who watched news about neigh-
bourhood crimes are more likely to perceive their neigh-
bourhood as more vulnerable regions to crime.

Second, different types of crimes would have different
effects on the perceived risk or fear of crime. For
example, murder, rape and personal theft may have


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stronger effects on the fear of crime than larceny and auto theft. Hence, the total crime rate that was used in this research might not be sophisticated enough to examine the association between the prevalence of crime in the district and the residents’ health condition.\textsuperscript{23} However, when we conducted a post-hoc analysis using a different measure, ‘5 index crime rate’, which includes five major serious crimes (ie, murder, robbery, rape, assault and theft) that has been adopted by the Korean police to indicate violent crime rate, still we could not find association with residents’ self-rated health.

Finally, if social and physical resources of neighbourhood are deteriorated or deprived, residents tend to perceive neighbourhood safety more irrespective of the objective neighbourhood crime rate.\textsuperscript{24} The poor quality of the social and physical environment, such as dilapidated houses or having a lack of formal or informal neighbourhood networks, may work as a trigger to make residents perceive their neighbourhood as dangerous.\textsuperscript{25,26}

There could be several pathways linking district-level perceived neighbourhood safety to residents’ self-rated health. First, poor district-level perceived safety may cause less outdoor physical activities\textsuperscript{7,27} leading to poor health. Second, poor district-level perceived safety may aggravate social supports which may harm mental and physical health of residents.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Distribution of study population and prevalence of poor self-rated health by key covariates among 7761 residents from 25 districts in Seoul, South Korea (2008)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
<td>Total</td>
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<tr>
<td></td>
<td>N</td>
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<tr>
<td>Individual level variables (N=7761)</td>
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<tr>
<td>Sex</td>
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<td>Male</td>
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<td>Female</td>
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<tr>
<td>Age (years)</td>
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<tr>
<td>15–19</td>
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<td>20–29</td>
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<td>Junior high school</td>
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<td>University graduate</td>
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<td>Graduate school or more</td>
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<tr>
<td>Individual perception of district safety</td>
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<td>Safe</td>
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<tr>
<td>Unsafe</td>
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<td>Household level variables (N=3665)</td>
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<td>Household income</td>
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<td>3 010 000–4 000 000 KRW</td>
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<td>4 010 000–5 000 000 KRW</td>
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<td>Above 5 000 000 KRW</td>
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<tr>
<td>District level variables (N=25)</td>
<td>Mean</td>
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<td>District-level perceived safety*</td>
<td>0.87</td>
</tr>
<tr>
<td>District-level crime rate†</td>
<td>4.63</td>
</tr>
</tbody>
</table>

*p Value of the Chi-Square test comparing prevalence of poor self-rated health across different socio-demographic groups. **District-specific proportion of people who perceived their district safe. †Expressed in the total number of crimes in 2008/population in 2008 *100.
physical outcomes. Lastly, poor district-level perceived safety may be a latent stressor causing chronic stress status that could undermine residents’ mental health.

Our study has several limitations. First, potential reverse causation is of concern due to its cross-sectional study design, implying that people with poor self-rated health are more likely to perceive their neighbourhood as unsafe. Future studies are required to examine the causal association between district-level perceived safety and health outcomes. Second, this study assessed perceived neighbourhood safety through a single-item measure. This item may not reflect multidimensional aspects of the neighbourhood safety. Despite these limitations, our study has the strength in that we used representative samples for each operationalised administrative district, which enabled multilevel analysis using a district-level aggregate measure of perceived safety whereas most of the previous studies used individual reporting of perceived safety as an exposure variable. Furthermore, to the best of our knowledge, this is one of the first studies to examine the association between district-level perceived neighbourhood safety and health outcome after adjusting for the district-level crime rate.

In summary, our study showed that district-level perceived safety was associated with residents’ poor self-rated health even after controlling for demographic information, SES and district-level crime rate. Our study results evoke the importance of local authorities (or governments) to make efforts toward improving neighbourhood perceived safety to enhance residents’ health.

### REFERENCES