



California Center for Population Research
University of California - Los Angeles

**To Compare is to Despair? A
Population-Wide Study of
Neighborhood Composition and
Suicide in Stockholm.**

Ka-Yuet Liu

PWP-CCPR-2016-029

February 26, 2016

*California Center for Population Research
On-Line Working Paper Series*

To Compare is to Despair? A Population-Wide Study of Neighborhood Composition and Suicide in Stockholm

The suicide risk associated with an individual attribute can depend on the context. Eight hypotheses about the interactions between neighborhood composition and ethnicity, income and socially disadvantaged propositions are proposed based on social support, social comparison and regulation mechanisms. They are tested with a population-based dataset of all 1.4 million adults who lived in the greater Stockholm area in the 1990s. Results from multilevel analyses show that the effects of socio-demographic characteristics on suicide vary with neighborhood composition. First, having more neighbors from the same region is found to reduce suicide risk among ethnic minorities. The protective effect, however, is limited to groups with low suicide rates in the home countries. Second, relative income matters more suicide than absolute income: a high average income in the neighborhood *increases* suicide risk, particularly among those with low income. This goes against the common belief that living in wealthy neighborhoods protects the poor from bad health outcomes. Income inequality does not have any effect on suicide once relative income is considered. Third, social welfare recipients have lower suicide risk when more of their neighbors are also social welfare recipients. The results suggest that the effects of neighborhood contexts on suicide can be positive or negative, depending on the individual. Such cross-level interactions contributed to the unstable macro-level results and are relevant to policy debates on rising income inequality and ethnic diversity in many societies.

Key words: Suicide; Neighborhoods; Multi-level models; Income inequality; ethnicity & race; Sweden

INTRODUCTION

A person dies by suicide every 40 seconds somewhere in the world (World Health Organization 2014). Durkheim's idea (1897[2002]) that the extent to which an individual is integrated and regulated by society is important to suicide risk remains to be the bedrock of the sociological understanding of suicide. Yet despite numerous studies and sociologists' long-time interest in this topic, whether neighborhood characteristics have any impact on suicide above and beyond the effects of individual attributes remains to be disputable (Agerbo, Sterne and Gunnell 2007; Mäkinen 1997). Does who our neighbors are matter to our risk of committing suicide? Does "keeping up with the Joneses" leave us in despair? Can more friends in the neighborhood be lifesaving? Do people care about their neighbors' approval when they are thinking about suicide?

Durkheim's and other early macro-sociological theories (e.g., Gibbs and Martin 1964; Henry and Short 1954) have been criticized for a lack of attention to the macro-micro links. *Le Suicide* has been viewed by some as a 'crude, anti-psychological sociology that ignores the individuals (Taylor 1994). This lack of specificity about the macro-micro links in the earlier work was partly due to a heavy reliance on aggregate level data. The bulk of earlier sociological studies were ecological. The findings are often mixed (see Stack 2000a; Stack 2000b for review): conflicting results have been reported on the macro-relationships between suicide rates and area-level socioeconomic status (SES; see Rehkopf and Buka 2006 for review); religious denominations (Breault 1986; Pope and Danigelis 1981); unemployment rates (Platt 1984); and female labor force participation (Davis 1981; Hassan and Tan 1989; Stack 1987b). Mäkinen (1997) rightly questions whether social correlates of

suicide truly exist when he failed to replicate the results from a large-scale study (Sainsbury, Jenkins and Levey 1980).

Making inference to individual-level processes based on ecological data is always problematic (Robinson 1950). With the large number of potential confounders and differences in geographical units, it is not surprising that the findings are mixed. Less well discussed is the possibility that area-level variables can have heterogeneous effects on different individuals and consequently, result in unstable macro relationships. For example, being an ethnic minority has been shown to increase risk in predominately-white neighborhoods, while it reduces risk in mixed neighborhoods (Neeleman and Wessely 1999). Such interactions can make the proportion of ethnicity minority in the neighborhood to appear to increase suicide rate in some samples but reduce it in others.

The increasing availability of large individual level datasets and the advances in multilevel analysis allow us to examine the micro-macro links directly. Recent work has provided important insights on the micro-macro links. For instance, the effect of network structures (Bearman and Moody 2004), suicide contagion (Mueller, Abrutyn and Stockton 2015), social regulation (Maimon and Kuhl 2008; Thorlindsson and Bjarnason 1998; van Tubergen, te Grotenhuis and Ultee 2005), and social support (Pescosolido and Georgianna 1989). More research is needed to follow up this line of research on the social mechanisms of suicide.

This study focuses on the effects of neighborhood compositions: does the distribution of a socio-demographic characteristic in one's neighborhood affect its effect on suicide? First, it is reasonable to expect an individual of a certain socio-demographic characteristic interprets his/her social position with reference to how common it is in his/her social context. Second,

such distributions are likely to shape opportunities of social interactions. This study focuses particularly on income and ethnicity, as much attention has been given to religious and family integration in the literature, while not much is known about integration along the race/ethnicity and income dimensions. The increases in income inequality and ethnic diversity in many societies make the results relevant to policy debates.

To study such neighborhood processes, it is crucial to use ecological units that are theoretically relevant (Diez Roux 2001). Social interactions are unlikely to span large areas. Unfortunately, datasets that have enough statistical power to study suicide deaths usually only have information on large administrative boundaries, such as counties and municipalities. It may explain why existing multilevel studies on suicide found no or limited evidence of cross-level interactions when the geographical units were large (Agerbo, Sterne and Gunnell 2007; Martikainen, Mäki and Blomgren 2004; van Tubergen, te Grotenhuis and Ultee 2005).

This study is based on a population-wide dataset with detailed individual-level information on all 1.4 million adults who ever lived in the greater Stockholm metropolitan area between 1990 and 1998. It was compiled by Statistics Sweden by merging administrative and population registers. The data have detailed socio-demographic information on the individuals and are of very high quality; non-responses and missing items are virtually non-existent. A residential variable was specifically created to identify socially defined neighborhoods (N=903; average population <2000), which is smaller than the geographical units used in other multi-level studies of suicide deaths (~ 8000 to 60,000). Because the dataset was based on administrative data, information on the actual social ties is unavailable.

However, its large size and the availability of small geographical units make it suitable to study the effects of neighborhood compositions.

ROADMAP

Against this background, I first explore mechanisms through which neighborhood compositions may modulate the effects of the individual characteristics. I focus particularly on ethnicity, income and socially disadvantaged propositions and propose a set of hypotheses that are testable with the Stockholm dataset. This is followed by a more detailed description of the dataset and the results. Finally, I explore more broadly the findings' implications on neighborhood processes and health.

To anticipate the main findings, this study show that the effects of individual socio-demographic characteristics on suicide depends on how those factors are distributed in one's neighborhood. Having more neighbors from the same foreign countries tends to reduce suicide risk among ethnic minorities. Yet the protective effect is limited to groups with low suicide rates in the home countries. Social welfare recipients are found to have lower suicide risk when more of their neighbors are also social welfare recipients. In contrast, having rich neighbors *increases* suicide risk, particularly among those with low income. Taken together, the findings provide individual-level evidence for what Durkheim long argued: the effects of social contexts on suicide can be positive or negative. Macro-level associations are the aggregations of neighborhood-, individual, and cross-level interaction effects, and therefore can vary greatly across samples. This helps explain the conflicting macro-level findings.

NEIGHBORHOOD MECHANISMS

Ethnicity

In Durkheim's theory, suicide rates are high when social integration or social regulation is either too high or too low. Whether social integration and regulation are distinct concepts is heavily debated (Johnson 1965; Pope 1976). One key argument that the two concepts are indistinguishable is that social regulation cannot take place *unless* the individual is well embedded in social relations. Therefore, social integration precedes social regulation and arguably has a more fundamental role.

Attempts to measure social integration vary greatly in the ways it is operationalized. Proxies of social integration are often used because most of these studies rely on aggregate-level data and thus cannot measure the intensity of interactions. For example, since modernized societies are assumed to be less integrated, indicators of modernization have been used to approximate the level of social integration. They include measures of economic development, unemployment, urbanization and industrialization, and the results are mixed (see Stack 2000b for review). Since Durkheim discussed them in length indicators of family and religious integration are also often studied. They include divorce rates, church attendance rates and proportions of population in different religious denominations. While divorce rates are generally found to be positively associated with suicide rates, the findings on religious denominations are heavily contested and seem to depend on what control variables are included (Stack 2000b). There were also attempts to create indices of social fragmentation, but the results are also contradictory (Collings et al. 2009; Congdon 1996).

At the individual level, the operationalization of integration is less diverse and typically measures the utility/density of social ties. It is commonly accepted that a key role of social

integration is provide social support (Berkman et al. 2000). Following Durkheim, Pescosolido's network theory (1989) proposes that the integrative power of religion arises from the power of a religious affiliation to engage individuals in a stable social network. Direct evidence that a stable social network reduces suicide risk comes from Bearman and Moody (2004). Psychological research has consistently demonstrated the effect of social support on suicide (e.g., Heikkinen, Aro and Lönnqvist 1994; Author, Date). The lack of social support is often included as a key vulnerability in diathesis-stress models of suicide that are commonly found in the psychological and medical literatures.

To sum up, empirical evidence suggests availability of companionship and support from social networks can be a potential mechanism that links neighborhood contexts and suicide rates. Unfortunately, information on the presence of social ties is not available from register-based data. However, it is well known that race/ethnicity is an important determinant on the likelihood of social tie formation (McPherson, Smith-Lovin and Cook 2001). As mentioned above, Neeleman and Wessely (1999) show that having more ethnic minority neighbors decreases suicide rates among minorities. Similarly, Campbell and Troyer (2007) find that American Indian adults have lower rates of suicide ideation when they lived in a neighborhood with a bigger minority population. Following these previous studies, the following hypothesis assumes there is a positive association between the size of an ethnic minority group in a neighborhood and the availability of social support.

Hypothesis 1: The social support mechanism suggests that having more neighbors from the same ethnic minority group reduces the suicide risk of minorities.

This is equivalent to predicting a negative cross-level interaction between an ethnic minority origin and the proportion of neighbors from the same ethnic group.

Yet social ties may provide different levels of protection against suicide depending on the social groups. In some cases (e.g., suicide contagion), they may even be harmful (Mueller, Abrutyn and Stockton 2015). It is because social ties do not only provide social support; they can also affect health by providing normative guidance (Berkman et al. 2000). This clarifies some of the confusion caused by Durkheim's separate treatments of social integration and regulation (Johnson 1965; Pescosolido and Georgianna 1989; Thorlindsson and Bjarnason 1998). Psychological research shows that self-reported normative pressure against suicide reduces suicide risk (e.g., Linehan et al. 2000). Van Tubergen, te Grotenhuis and Ultee (2005) take up the regulative function of social networks as an alternative to the network-support mechanism in explaining the relationship between religious denomination and suicide. They found that the proportion of church members in the community lowers the suicide risk among both members and non-members. This finding is interpreted as supportive to the claim that religious communities reduce suicide risk by providing community norms that can extend to non-members. Maimon and Kuhl (2008) also find that the proportion of religiously conservative residents in a neighborhood reduces youth suicide attempts.

Unlike the effect of social support, which is generally considered to be beneficial, group norms may increase suicide risk. While religious norms prohibit suicide, exposure to suicide can increase suicide risk by making it a more acceptable solution to one's problems (Shneidman 1987). Although Durkheim dismissed imitation as a potential explanation that can generate regional patterns of suicide rates, empirical studies have consistently supported

exposure to suicide increases risk of suicide, especially among youths (Stack 1987a). It has also been shown that exposure to suicide in the workplace is associated with suicide deaths among adults (Author, Date). Baller and Richardson (2002) argue imitation can generate geographical patterning of suicide even when multiple dimensions of social integration are controlled for. Interestingly, Mueller and Abrutyn (2015) show that only a friend's suicide attempts and ideation have any impact on one's suicidality only when *disclosed*. Their finding is strong evidence of a social influence process, possibly related to imitation and group values about suicide.

Immigrants' suicide rates are known to correlate with suicide rates in the home countries (Johansson et al. 1997; Kliewer and Ward 1988). It is beyond the scope of this study to examine the many biological, historical, social and cultural factors (e.g., all aspects of social integration/regulation) that might account for cross-country differences in suicide rates. Instead, this study tests a specific hypothesis: the ability of a migrant network to protect against suicide *depends* on the prevalence of suicide in that ethnic group.

Among the ethnic groups in Stockholm, the Finish and the Eastern Europeans have higher suicide rates in their country of origin than Sweden: Suicide rates in Eastern Europe and Finland were about 27 per 100,000 and 20 per 100,000 respectively, compared to 13 per 100,000 in Sweden during the study period (Author, Date). Western Europe's rate of 15 per 100,000 is only slightly higher than Sweden's 13 per 100,000. In contrast, Southern Europe had lower suicide rates of about 9 per 100,000. Reported suicide rates were extremely low in the Middle East (<5 per 100,000). It should be noted that there is a lack of mortality data from Middle Eastern countries, and the validity of the existing statistics has been questioned.

Given the high suicide rates in the home countries, I expect the proportions of Eastern Europeans and Finnish in a neighborhood offer the least reduction in suicide risk of the immigrants from these groups. In contrast, having similar neighbors from Southern Europe and the Middle East should be particularly protective given the low suicide rates in the home countries.

Hypothesis 2: The extent to which the proportion of neighbors from the same foreign countries reduces a minority's suicide risk is negatively correlated with home countries' suicide rates. Having neighbors from the same foreign countries offers the least protection against suicide among those from Eastern European countries. It is followed by the Finnish and Western European populations. The protective effect of having similar neighbors is strongest among those from Southern Europe and the Middle East.

Income Inequality

Although his focus was primarily on religious and familial integration, Durkheim briefly touched on the effect of economic positions on suicide as an example of anomic suicides. Durkheim contended that in time of economic recessions and expansions, the mismatch between aspiration and reality leads to high suicide rates. Durkheim's followers have proposed alternative theories on the relationship between the economy and suicide (c.f. Lester 2001). For example, Henry and Short (1954) expand Durkheim's theory by including homicide in addition to suicide as the response to thwarted aspirations. Individuals of high socio-economic status turn their aggression inward and committing suicide during economic

recessions. In contrast, individuals of low socio-economic status turn their frustrations outward and commit homicide during economic expansions.

Contrary to what Durkheim predicted, empirical studies generally find that suicide rates rise during economic recessions and fall during economic expansions (e.g., Luo et al. 2011; Marshall and Hodge 1981). Such patterns appear to support Henry and Short's theory. However, there is little empirical support that suicides concentrated among those of high status as predicted by their theory (Stack 2000a). However, Durkheim's and Henry and Short's theories are about economic changes, and do not have specific predictions about the effect of economic inequality in cross-sectional data. In fact, Durkheim saw poverty as a form of social restraint that should reduce suicide risk; thus inequality outside times of economic expansions and contractions should not be an issue in Durkheim's view. However, recent work suggests income inequality have direct impacts on health, albeit the exact mechanisms are debated (Lynch et al. 2000). For example, the relationship between income inequality, homicide and other violent crimes has received much attention (e.g., Blau and Blau 1982; Messner 1989).

One of the proposed mechanisms that link income inequality and health is relative income (Rodgers 2002; Wagstaff and van Doorslaer 2000; Wilkinson 1996). Income inequality usually comes with a low relative income and thus unfavorable social comparison for the majority, which results in worse health at the population level. Despite the weak findings on the effects of relative income on health in general (see Wagstaff and van Doorslaer 2000), there is some empirical support for the relative income hypothesis on suicidal behavior. Hawton et al. (2001) find that people who live in wealthy areas are more likely to cite

financial difficulties as a reason for deliberate self-harm. Platt and Kreitman (1990) show that the risk of self-harm among the unemployed in Edinburgh *decreased* when the unemployment rates rose in the 1990s.

As Wagstaff and van Doorslaer (2000) argue, only individual-level data can arbitrate between the relative income hypothesis and alternative explanations, e.g., the absolute income hypothesis (Rodgers 2002). If relative income matters, we should expect an increase to the average level of income in the neighborhood to *increase* the suicide risk of everyone, even when the effect of personal income is properly controlled for. The logic is that everyone is *relatively* worse off when neighborhood income is high (Wagstaff and van Doorslaer 2000). In contrast, the absolute income hypothesis states that if there is a concave relationship between absolute income and health at the individual level, we will observe a negative correlation between income inequality and health at the population level. It is because the “deficit” of health caused by the high concentration of poor individuals cannot be fully compensated by the small gains of health of their wealthy counterparts. If the association between income inequality and health is simply caused by this concave relationship between income and health, controlling for the non-linear relationship at the individual level will eliminate the association between income inequality and health.

Hypothesis 3: The social comparison notion predicts that the average level of income in the neighborhood increases suicide risk, net of the effect of individual income.

While the relative income hypothesis predicts high average neighborhood income makes everyone worse off, there are reasons to expect it to be particularly impactful on individuals at the lowest end of the income distribution. The most obvious reason is that there can be a

dosage-response relationship between low relative income and suicide. Second, while it has been suggested that upward comparison can have a positive effect, such as providing motivation and information (Festinger 1954), the negative impact of upward comparison on self-esteem has been consistently demonstrated (Marsh 1987). Numerous studies have shown the link between low self-esteem, depression and suicide (e.g., Overholser et al. 1995). Third, although individuals have some say in who should be their reference group (Merton and Rossi 1950), the social environment may impose unwanted comparison (Wood 1989). Lastly, downward comparison, i.e. comparing oneself with someone of lower status, can be an important defensive mechanism that protects one's self esteem (Wills 1981). Taken together, we have another prediction of the relative income hypothesis: the suicide risk of people in the lowest end of the income distribution is particularly sensitive to the level of income in the neighborhood.

Hypothesis 4: The social comparison notion suggests that the negative effect of neighborhood median income on suicide is stronger among the poor than the rich.

This is equivalent to predicting a negative interaction between personal income and neighborhood median income, i.e., the higher the personal income, the smaller the increase in suicide risk when neighborhood income increases.

A different way of thinking about the impact of average level of income in the neighborhood on suicide is to consider neighborhood income as an indicator of community-level resources. Many empirical studies of the social correlates of suicide are implicitly or explicitly making the neo-materialistic assumption that a high neighborhood SES protects us from bad health outcomes. It is assumed that wealthy neighborhoods make more resources available to

everyone, and therefore they are good for health. This predicts the exact opposite of what the relative income hypothesis suggests:

Hypothesis 5: A high median income in the neighborhood reduces everyone's suicide risk due to shared resources, net of the effect of personal income.

Neighborhood resources can have heterogeneous treatment effects. Following the long tradition of research on concentrated poverty (Wilson 1987), one can postulate that people of low income suffer from a "double jeopardy". Unlike their affluent neighbors, poor people cannot buffer the impact of a lack of resources in their neighborhoods with personal resources. Hence, we should expect a high neighborhood median income to be more beneficial to people of low income than people of high income.

Hypothesis 6: A high median income in the neighborhood particularly reduces the suicide risk of individuals with low income.

This is to predict a positive interaction effect between personal income and neighborhood median income, i.e., the higher the personal income, the smaller the reduction in suicide risk that neighborhood resources can bring.

Other than the absolute income hypothesis and relative income hypothesis, social cohesion has been proposed as an alternative explanation of the link between income inequality and health. I.e., income inequality is bad for everyone's health because it erodes social capital/social integration (Kawachi et al. 1997; Wilkinson 1996). Existing studies on the correlation between income inequality and suicide rates have mixed findings (e.g., Andres 2005; Blakely, Atkinson and O'Dea 2003). The problem of the existing studies is that they

tend to focus on ecological relationships and do not control for the effect of personal income. We cannot tell whether any observed association between income inequality and suicide is merely caused by the presence of a high concentration of low-income persons in the high inequality communities, as proposed by the absolute income hypothesis. Nor can we tell whether it is caused by the low relative income for most people when income inequality is high, as the relative income hypothesis proposes. To arbitrate between the social cohesion explanation, the relative income hypothesis and the absolute income hypothesis, we need to simultaneously estimate the effects of income inequality, average level of income in the community, and personal income.

Hypothesis 7: The social cohesion mechanism predicts that income inequality is still associated with suicide risk net of the effects of individual income and neighborhood median income.

Disadvantaged Positions

Social comparison is not limited to health. To test whether cross-level interactions is limited to income or also extend to other social hierarchies, I also explore the cross-level effects of receiving social welfare, unemployment, and being a single parent. Gibbs and Martin's (1964) status integration theory suggests that people who deviate from the "typical" status or role configurations have a high suicide risk because of stress. There is no particular reason that only rare combinations of roles is stressful; any minority status may affect health negatively because of discrimination and stress (Karlsen and Nazroo 2002). The presence of similarly disadvantaged neighbors has been shown to mitigate the negative effect of stigma and discrimination by providing a reference group in similar situations (Crocker and Major 1989).

At the same time, having neighbors in similar situations may reduce suicide risk through providing a network of social support.

Hypothesis 8: Disadvantaged groups, such as people who are receiving social welfare, unemployed, or single parents, have a lower suicide risk when there are more similar neighbors in the neighborhood.

DATA AND METHODS

Sample

The dataset used in this study has information on the entire adult population (ages 16 to 65) who lived in the larger Stockholm metropolitan area between 1990 and 1998. The mean number of years of observation is 8.1. Annual demographic and socio-economic information is available for all individuals in the dataset (1.4 million individuals and 10 million person-years).

Statistics Sweden divided the Stockholm metropolitan area into 878 Small Area Market Statistics (SAMS) areas to contain socially homogeneous residential areas. I exclude SAMS areas with fewer than 500 residents because neighborhood-level estimates based on small numbers of residents are unreliable. A robustness check shows that including all SAMS areas does not alter the results of in any substantive way. The multilevel analysis is based on the 578 SAMS areas with 500 or more residents; the mean population size is 2,397.

To reduce the computational power required and model complexity for analyzing such a large database (10 million person-years), a control population was constructed by randomly selecting a one-year record (year t) from each of the adults in the data who had not

committed suicide by the end of the study period. For those adults who committed suicide, data from the year prior to death (year t) were used. The usual practice of studies using large administrative datasets is to select a fixed number of controls per case. This current procedure has the advantage of using information from all individuals and thus maximizing the representation of the neighborhoods, which is appropriate given the aim of this study.¹

Excluding individuals with missing data on the individual-level variables ($N=809$, 0.06%), the final dataset has 1,384,473 individuals (691,062 men and 693,411 women). Of the total, 2,221 committed suicide (1,430 men and 791 women).

Measures

The outcome measure is whether the person committed suicide in year $t+1$. Given that the dataset used in the analyses is at the person-level rather than the person-year level, the dependent variable of the multi-level logistic regression model is equivalent to the log-odds for a person to commit suicide between 1991 and 1999. Information from the National Cause of Death Register (1991–1999) is used to identify the suicide cases. I follow the usual practice in suicide epidemiology and define a suicide on the basis of the following cause-of-death codes: E950-E959 or E980-E989 for 1991-1996 (International Classification of Diseases, 9th revision) and X60-X84, Y87.0, or Y10-Y34 for 1997-1999 (International Classification of Diseases, 10th revision).

¹ The shortcoming of this design is that the effects of moving between neighborhoods and neighborhood changes cannot be examined, e.g., through fixed effect models. However, less than 10% of those individuals who committed suicide in the dataset had moved during the study period and changes in neighborhood compositions over time were minimal. Fixed effects models are not feasible with this lack of variations.

[Table 1 about here]

Table 1 provides the definitions and descriptive statistics of the variables. Cross-level interaction terms between individual-level variables and their average values in the neighborhood are used to test the proposed hypotheses. The interaction between personal income and neighborhood median income is used to test the potentially heterogeneous effect of relative income. Personal income and neighborhood median income in year t are log-transformed because of their skewed distribution. Logged personal income is grand mean centered before entering the model. The interactions between the country of origin variables and the percentages of neighbors from the same region are used to test the hypotheses about social support and normative values about suicide. I classify the countries of origin into six groups following Hjern and Allebeck (2002) to reduce the number of estimated parameters. The interactions between being unemployed, a single parent, and receiving social welfare benefits and their prevalence in the neighborhood in year t are used to test whether having neighbors in similar situations can buffer the negative impact.

Additionally, age and gender are included as control variables since they are consistently associated with suicide. Year is included to control for fluctuations of suicide rate over time. Born in other countries is included as a control variable, but no cross-level interaction is expected. Logged population and population density per km are used to control for the size and urbanicity of the neighborhood. All neighborhood-level variables are grand mean centered.

To evaluate the effect of income inequality, the Gini coefficient is calculated for each SAMS area. Alternative measures of income inequality are used to test whether the result depends on the choice of inequality indices (Table A1 and A2 in the Appendix).

Statistical Methods

Empirical Bayes standardized mortality ratios (EBSMR; Clayton and Kaldor 1987) are used to establish that there are sufficient variations in suicide risk across the SAMS areas (See supplementary methods in the Appendix). 2-level logistic hierarchical regression models are fitted with the HLM 6 software (Scientific Software International, Inc., Lincolnwood, IL). The intercept and coefficients of all individual-level variables, except gender, age and year, are allowed to have a random component. Results from unit-specific model with robust standard errors are reported to account for remaining possibility of spatial clustering in the errors.

RESULTS

Figure 1 is a map of the EBSMRs. An EBSMR higher than 100 indicates excess risk; lower than 100 indicates reduced risk. The map shows that there is a large variation in suicide rates across the neighborhoods despite the relatively small size of the Stockholm metropolitan area. Moreover, the level of spatial autocorrelation in suicide rates adjusted by age and gender is statistically insignificant. See Appendix for a more detailed discussion on the spatial variations.

[Figure 1 about here]

Table 2 reports the multilevel regression results of the main model (Model III in Table 3). Except the Gini Coefficient, it includes all the individual-, neighborhood- and cross-level interactions specified in Table 1.

Ethnicity (Hypotheses 1 & 2)

There is some partial support for Hypothesis 1, which predicts having neighbors from the same ethnic group reduces minority suicide risk through the provision of social support. Except the Eastern Europeans, the percentage of an ethnic minority group in a neighborhood reduces the suicide risk of its members. I.e., the cross-level interactions have the negative sign as predicted. However, only the interaction between being born in Southern Europe and percentage of neighbors who were also born in Southern Europe is statistically significant.

Instead of a general protective effect as proposed by Hypothesis 1, Hypothesis 2 suggests that ethnic networks have heterogeneous effects that correlate with the suicide rates in the home countries. Accordingly, the proportion of neighbors from the same home countries should offer the least reduction of suicide risk among the Eastern Europeans, followed by the Finnish and the Western Europeans. Southern European and Middle Eastern populations should benefit most from having neighbors also from those areas.

The findings are largely consistent with Hypothesis 2. The cross-level interaction for Eastern Europe has a *positive* coefficient. It means having the proportion of Eastern European neighbors increases rather than decreases the suicide risk of Eastern Europeans, although the result does not reach statistical significance ($p=0.2$). It is followed by the small negative coefficients for Finnish and Western Europeans. As predicted, having similar neighbors

shows the greatest reduction of risk among the Southern European population. While the sizes of four of the five interaction parameters followed the predicted order, the Middle Eastern population is the exception. Despite the low suicide rate in the region, the proportion of Middle Eastern neighbors is not associated with a strong reduction in suicide risk among the Middle Eastern population. Unfortunately, the unreliability of the suicide statistics in the Middle East makes it difficult to interpret this result.

[Table 2 about here]

Figure 2(a) illustrates the effect of having neighbors from Southern Europe. Comparing two persons born in Southern Europe with the same measured personal and other neighborhood attributes, the person who lives in a neighborhood with very few residents from Southern Europe (5th percentile among the SAMS) has about four times the risk (0.4% vs 0.01%) of committing suicide than the one who lives in a neighborhood with a higher percentage (95th percentile) of neighbors from Southern Europe.

Unlike what van Tubergen et al (2005) have found about having church members in the community, the protective effect of having neighbors from Southern Europe does not spillover to the native born, nor to other ethnic groups. The percentage of residents born in Southern Europe has a statistically significant positive association with the suicide risk of the native born (O.R.=1.05, p=0.03). A supplementary analysis (results not shown) shows that none of the other ethnicities has a statistical significant interaction with the percentage born in Southern Europe variable.

Income Inequality (Hypotheses 3-7)

A series of models are used to vary the specifications of the income parameters and test hypotheses 3 to 7. All the models control for the effects of the other variables in the main model (Table 2, also Model III in Table 3). Table 3 only shows the results on the income parameters as the coefficients of the other variables are almost identical across models.

[Table 3 about here]

Hypothesis 3 predicts a positive relationship between neighborhood median income and suicide while Hypothesis 5 predicts a negative relationship. The results support Hypothesis 3. Logged neighborhood median income *increases* suicide risk even after controlling for a host of individual and neighborhood-level variables, including other SES indicators (Model I). The positive association remains robust after controlling for the effect of logged personal income (Model II). It suggests that relative income is more relevant to suicide risk than neighborhood resources. Measuring income in quadratic form instead of logarithmically does not alter the conclusion (Table A3). Thus, the absolute income hypothesis do not explain the association between neighborhood median income and suicide.

Hypothesis 4 predicts individuals with low income are more adversely affected by a high neighborhood median income than people with high income because of the unfavorable social comparison. Model III shows that the interaction between logged personal income and logged neighborhood median income is negative as predicted (O.R.=0.737; $p<0.05$).

The interaction effect is illustrated in Figure 2(b). It plots the levels of predicted suicide risk among individuals at the 5th and the 95th percentile of the income distribution of the Stockholm population. The suicide risk of those with low income increases more rapidly with neighborhood median income than those with high income. The result is consistent

with a dosage-response relationship between relative income and suicide risk. However, people with high income is still affected by relative income. A supplementary analysis shows that even the richest 10% are negatively affected by neighborhood median income (Table A4).

The negative interaction between neighborhood and personal income contradicts Hypothesis 6, which predicts a positive interaction due to a buffering effect of shared resources. In fact, Figure 2(b) seems to indicate that, instead of being particularly vulnerable due to “double jeopardy”, low-income people in poor neighborhoods have a *lower* suicide risk than their wealthy counterparts. A robustness check confirms that those who earned less than the 10th percentile of the income distribution have a lower suicide risk than their neighbors who earned more (O.R.=0.82, p=0.03, Table A5) in the poorest neighborhoods (lowest quintile of the neighborhood median income distribution).

[Figure 2 about here]

Model IV - VII seek to unpack the association between income inequality and suicide (Hypothesis 7). Model IV shows that the Gini coefficient does seemingly have a positive relationship with suicide risk when the personal and neighborhood income are uncontrolled for. The association persists after controlling for personal income (Model V). Modeling personal income as a quadratic function does not alter the result (result not shown). Thus, the positive effect of the Gini Coefficient cannot be explained by a curvilinear relationship between income and health, i.e., the absolute income hypothesis. However, controlling for personal income alone does not control for the effect of relative income, which requires controlling for neighborhood median income and its interaction with personal income

(Hypotheses 3 & 4). The results show that inequality is no longer statistically significant once the effect of relative income is controlled for (Model VI & VII). In other words, the association between income inequality and suicide is mediated by relative income, and the results do not support the claim that income inequality directly increases suicide risk through erosion of social capital/integration. Using other measures of income inequality yield the same result (Table A2). In sum, among the hypotheses about income, only Hypotheses 3 and 4, the two concerning social comparison, are supported.

Disadvantaged Groups (Hypothesis 8)

Hypothesis 8 suggests that disadvantaged groups have a lower suicide risk when there are more similar neighbors in the same positions, which can be due to the effects of social comparison and/or social support. There is some limited support for the hypothesis. The interactions between unemployment, single parenthood, and receiving social welfare and the percentages of neighbors in the same situations all have the predicted negative sign. However, only the interaction between receiving social welfare and the percentage of neighbors also receiving social welfare benefits is statistically significant.

Figure 2(c) illustrates how the suicide risk of social welfare recipients depends on how many recipients there were in a neighborhood. The probability of a social welfare recipient living in a neighborhood with very few social welfare recipients (5th percentile among the SAMs) to commit suicide during the study period is 0.43%. In comparison, a social welfare recipient with the same attributes living in a neighborhood with the highest concentration of social welfare recipients (95th percentile among the SAMs) has 16% less chance of committing suicide (0.36%).

The lack of significant cross-level interactions concerning unemployment status and single parenthood may be due to the little variations across the SAMS areas, which make cross-level effects difficult to estimate. As Table 1 shows, the standard deviations of percentage unemployed and percentage being a single parent in the neighborhood are only half the size of the standard deviation of percentage receiving social welfare benefits.

Other Covariates

Table 2 reports the coefficients of other covariates. At the individual-level, age and gender have the expected effect. Suicide risk increases with age and is lower among women. Year reduces suicide risk. Among these three potential indicators of social disadvantages, receiving social welfare benefits is the only one with a statistically significant association with suicide at the individual level. In contrast, people who were unemployment benefits recipients might come from more diverse backgrounds in Sweden, perhaps making unemployment less relevant to suicide. Having children is known to be a protective factor against suicide, which may explain the negative, albeit statistically insignificant, association between being a single parent and suicide at the individual level.

As expected, those born in Finland have a higher suicide risk, while those born in Southern Europe, the Middle East, and other non-European countries have a lower risk compared to the native-born. The suicide risk among those born in Western Europe is not statistically significantly different from that of the local born, which is not surprising given the similar suicide rates. Surprisingly, suicide risk among those born in Eastern Europe does not differ statistically significantly from the native-born.

Logged personal income does not have a statistically significant effect—personal income has either a positive or negative effect depending on neighborhood median income, and thus has no clear relationship with suicide on average level. This clearly demonstrates that the absence of an association at the individual level does not mean the cross-level interaction is irrelevant.

At the neighborhood level, the percentage of residents who are unemployed and percentage receiving social welfare have a marginally significant positive effect on suicide risk. The effect of percentage of single parents is also positive but is statistically insignificant. Among the ethnicity variables, only the percentage born in Southern Europe has a statistically significant positive association with suicide risk, although being born in Southern Europe is negatively associated with suicide at the individual level. Logged population and population density do not have any effect.

DISCUSSION

Following calls to develop mechanisms connecting neighborhood contexts and health outcomes (e.g., Entwisle 2007; Sampson, Morenoff and Gannon-Rowley 2002), this study examines how the effects of socio-demographic factors on suicide vary with neighborhood compositions. Results from multi-level analyses show that suicide risk of social welfare recipients decreases when the proportion of social welfare recipients in the neighborhood increases. Individuals with low income have a higher risk of suicide when they live among rich neighbors, net of the effect of personal income. Having neighbors from the same home countries reduces suicide risk among ethnic minorities, but the level of reduction depends on the suicide rates in the home countries. Through these interactions, neighborhood

composition affects suicide risk above and beyond the effects of the characteristics of the residents. Durkheim argued that suicide rates increase when social integration/regulation are too low or too high. The current study highlights another source of complexity: a neighborhood context can be a risk or a protective factor, depending on the individual.

In a time of rising income inequality in many countries, research on its effect on health is highly relevant. This study shows that relative income matters more to suicide than absolute income and neighborhood resources. The results are consistent with the notion that social comparison can be an important mechanism, in addition to the better-known effect of social support. Considering these alternative mechanisms can enrich the research agenda of social networks and health (Tsai and Papachristos 2015). In this study, income inequality does not have any statistically significant effect when the effect of relative income is considered. This is not to say income inequality does not affect suicide risk; just that in this data the causal pathway linking income inequality and suicide is likely to be subjective status. Having said that, the current findings do not imply social cohesion has no impact on suicide. Studies with more direct measures have shown that social cohesion and collective efficacy are particularly relevant to crime (Sampson, Morenoff and Gannon-Rowley 2002). Similar research with direct measures of socio cohesion, i.e., the intensity and quality of neighborhood interactions, are needed to fully evaluate its impact on suicidality. Without such direct measures, this study cannot isolate the effects of integration and regulation.

Among different health outcomes, there are reasons to suspect suicide is particularly affected by subjective status. Depression is a major risk factor of suicide (Lonnqvist 2000) and Beck's (2005) cognitive theory proposes depression is the result of negative views on oneself, the

world, and the future. Social comparison is crucial to how these views are formed. Subjective status may also be relevant to psychological health in general—research has shown neighbors' income lowers the level of self-reported happiness (Luttmer 2005). Compared to research on homicide, income inequality has received much less attention in suicide research. Research using new data and methods (e.g., Chon 2013) should be used to test integrated models of inequality, self-directed and other-directed violence.

Increasing ethnic diversity is another trend that has been observed in many societies. This study finds that the protective effect of having neighbors of the same ethnic origin depends on the suicide rates in the home countries. Future studies on geographical patterns of suicide and ethnicity should consider the dynamics between network density and prevalence of suicide in the home countries. As Mueller and Abrutyn (2015) point out, social learning theory is prominent in the literature on suicide contagion, and the current results are consistent with the literature on social learning and delinquent behaviors. Certainly, many crucial factors that can affect an ethnic group's values about suicide, e.g., religiosity (Stack and Kposowa 2011), are unmeasured in the current dataset and should be investigated in future research. Besides, this study does not control for the many factors that can affect the assimilation process. Most importantly, this study does not control for the level of social integration among the different ethnic groups. Studies with more detailed information on the social ties (e.g., Maimon and Kuhl 2008) and the level of assimilation (e.g., Wadsworth and Kubrin 2007) are needed to disentangle the social integration and regulation effects.

This study demonstrates the benefits of using multilevel data to study neighborhood processes. The danger of ecological fallacy (Robinson 1950) is illustrated by the fact that

many predictors in this study have opposite effects at the individual- and neighborhood-levels. Making inference across levels has led to inconsistent results on the social correlates of suicide. Moreover, this study shows that the effect of individual attribute depends on the social contexts. Under such contextual dependencies, macro-level correlations can vary greatly across samples, and are very sensitive to the choice of geographical units. This has contributed to the conflicting findings in the literature.

Instead of trying to identify stable social correlates of suicide, it may be more fruitful to try to identify underlying mechanisms. Administrative datasets have the advantage of a complete survey of neighborhoods, as well as the statistical power to study relatively rare outcomes. In contrast, survey data may have more detailed information on the actual social ties as well as health behaviors than administrative datasets. Such data and other approaches are needed to shed light on the micro-level processes.

This study has other limitations. First, the SAMS areas are not direct measures of the actual fields of neighborhood interactions. Thus the effects of neighborhood compositions may have been underestimated. Second, this study only focuses on the effects of neighborhood compositions; other social settings are beyond its scope. Third, country of origin is not a direct measure of ethnicity. Third, there is no information about suicides committed by the individuals who moved outside the Stockholm metropolitan area. Fourth, like any observational studies, there may be omitted variables at the individual and neighborhood levels. It is possible that self-selection into neighborhoods according to some unobserved characteristics could have biased the results. However, selection is less of a concern in this study than in ecological studies because its goal is to test specific hypotheses on

neighborhood interactions, rather than to yield crude estimates of area-level effects. Lastly, the findings may not generalize to countries that are vastly different from Sweden. E.g., neighborhood resources might be important to suicide in less developed countries. The mechanisms of social comparison, social integration and social regulation may be universal; but how they affect suicide risk depends on the local contexts.

References

- Agerbo, E., J. A. Sterne, and D. J. Gunnell. 2007. "Combining individual and ecological data to determine compositional and contextual socio-economic risk factors for suicide." *Social Science and Medicine* 64(2):451-61.
- Andres, A. R. 2005. "Income inequality, unemployment, and suicide: a panel data analysis of 15 European countries." *Applied Economics* 37(4):439-51.
- Baller, R. D., and K. K. Richardson. 2002. "Social Integration, Imitation, and the Geographic Patterning of Suicide." *American Sociological Review* 67(6):873-88.
- Bearman, P. S., and J. Moody. 2004. "Suicide and friendships among American adolescents." *American Journal of Public Health* 94(1):89-95.
- Beck, A. T. 2005. "The current state of cognitive therapy: a 40-year retrospective." *Arch Gen Psychiatry* 62(9):953-9.
- Berkman, L. F., T. Glass, I. Brissette, and T. E. Seeman. 2000. "From social integration to health: Durkheim in the new millennium." *Soc Sci Med* 51(6):843-57.
- Blakely, T., J. Atkinson, and D. O'Dea. 2003. "No association of income inequality with adult mortality within New Zealand: a multi-level study of 1.4 million 25-64 year olds." *Journal of Epidemiology and Community Health* 57(4):279-84.
- Blau, J. R., and P. M. Blau. 1982. "The Cost of Inequality - Metropolitan Structure and Violent Crime." *American Sociological Review* 47(1):114-29.
- Breault, K.D. 1986. "Suicide in America: a test of Durkheim's theory of religious and family integration, 1933-1980." *American Journal of Sociology* 92(3):628-56.
- Campbell, Mary E., and Lisa Troyer. 2007. "The Implications of Racial Misclassification by Observers." *American Sociological Review* 72(5):750-65.
- Chon, D. S. 2013. "Economic Development, Change of Age Distribution, and Stream Analogy of Homicide and Suicide: A Cross-National Assessment." *Justice Quarterly* 30(1):169-93.

- Clayton, D., and J. Kaldor. 1987. "Empirical Bayes estimates of age-standardized relative risks for use in disease mapping." *Biometrics* 43(3):671-81.
- Collings, S, V Ivory, T Blakely, and J Atkinson. 2009. "Are neighbourhood social fragmentation and suicide associated in New Zealand? A national multilevel cohort study." *Journal of Epidemiology and Community Health* 63(12):1035-42.
- Congdon, P. 1996. "Suicide and parasuicide in London: A small-area study." *Urban Studies* 33(1):137-58.
- Crocker, J., and B. Major. 1989. "Social Stigma and Self-Esteem - the Self-Protective Properties of Stigma." *Psychological Review* 96(4):608-30.
- Davis, R. A. 1981. "Female labor force participation, status integration and suicide, 1950-1969." *Suicide Life Threat Behav* 11(2):111-23.
- Diez Roux, A. V. 2001. "Investigating neighborhood and area effects on health." *American Journal of Public Health* 91(11):1783-9.
- Durkheim, E. 1897[2002]. *Suicide : A Study in Sociology*. Oxon: Routledge Classics.
- Entwisle, B. 2007. "Putting people into place." *Demography* 44(4):687-703.
- Festinger, Leon. 1954. "A Theory of Social Comparison Processes." *Human Relations* 7(2):117-40.
- Gibbs, J. P., and Walter T. Martin. 1964. *Status integration and suicide : a sociological study*. Eugene, Or: University of Oregon Books.
- Hassan, R., and G. Tan. 1989. "Suicide trends in Australia, 1901-1985: an analysis of sex differentials." *Suicide Life Threat Behav* 19(4):362-80.
- Hawton, K., L. Harriss, K. Hodder, S. Simkin, and D. Gunnell. 2001. "The influence of the economic and social environment on deliberate self-harm and suicide: an ecological and person-based study." *Psychological Medicine* 31(5):827-36.

Author, Date

- Heikkinen, M., H. Aro, and J. Lönnqvist. 1994. "Recent life events, social support and suicide." *Acta psychiatrica Scandinavica. Supplementum* 377:65-72.
- Henry, A.F., and J.F. Short. 1954. *Suicide and Homicide : Some Economic, Sociological and Psychological Aspects of Aggression*. New York ; London: Free Press of Glencoe.
- Hjern, A., and P. Allebeck. 2002. "Suicide in first- and second-generation immigrants in Sweden: a comparative study." *Social Psychiatry and Psychiatric Epidemiology* 37(9):423-9.
- Johansson, Leena Maria, Jan Sundquist, Sven-Erik Johansson, B. O. Bergman, Jan Qvist, and Lil Träskman-Bendz. 1997. "Suicide among foreign-born minorities and native Swedes: An epidemiological follow-up study of a defined population." *Social Science & Medicine* 44(2):181-87.
- Johnson, B.D. 1965. "Durkheim's one cause of suicide." *American Sociological Review* 30(6):875-86.
- Karlsen, S., and J. Y. Nazroo. 2002. "Relation between racial discrimination, social class, and health among ethnic minority groups." *American Journal of Public Health* 92(4):624-31.
- Kawachi, I., B. P. Kennedy, K. Lochner, and D. Prothrow-Stith. 1997. "Social capital, income inequality, and mortality." *Am J Public Health* 87(9):1491-8.
- Kliewer, E. V., and R. H. Ward. 1988. "Convergence of Immigrant Suicide Rates to Those in the Destination Country." *American Journal of Epidemiology* 127(3):640-53.
- Lester, B. Y. 2001. "Learnings from Durkheim and beyond: the economy and suicide." *Suicide Life Threat Behav* 31(1):15-31.
- Linehan, M. M., S.L. Rizvi, S.S. Welch, and B. Page. 2000. "Psychiatric aspects of suicidal behaviour: personality disorders." Pp. 385-404 in *The International Handbook of Suicide and Attempted Suicide*, edited by K Hawton and K Van Heeringen. Chichester: John Wiley & Sons.
- Author, Date.
- Author, Date.
- Lonnqvist, J. 2000. "Psychiatric Aspects of Suicidal Behaviour: Depression." Pp. 107-20 in *The International Handbook of Suicide and Attempted Suicide*

edited by K Hawton and K van Heeringen. Chichester: John Wiley & Sons.

- Luo, F. J., C. S. Florence, M. Quispe-Agnoli, L. J. Ouyang, and A. E. Crosby. 2011. "Impact of Business Cycles on US Suicide Rates, 1928-2007." *American Journal of Public Health* 101(6):1139-46.
- Luttmer, E. F. P. 2005. "Neighbors as negatives: Relative earnings and well-being." *Quarterly Journal of Economics* 120(3):963-1002.
- Lynch, J. W., G. D. Smith, G. A. Kaplan, and J. S. House. 2000. "Income inequality and mortality: importance to health of individual income, psychosocial environment, or material conditions." *BMJ* 320(7243):1200-4.
- Maimon, D., and D. C. Kuhl. 2008. "Social Control and Youth Suicidality: Situating Durkheim's Ideas in a Multilevel Framework." *American Sociological Review* 73(6):921-43.
- Mäkinen, I. H. 1997. "Are there social correlates to suicide?" *Social Science and Medicine* 44(12):1919-29.
- Marsh, H. W. 1987. "The Big-Fish Little-Pond Effect on Academic Self-Concept." *Journal of Educational Psychology* 79(3):280-95.
- Marshall, J. R., and R. W. Hodge. 1981. "Durkheim and Pierce on Suicide and Economic-Change." *Social Science Research* 10(2):101-14.
- Martikainen, P, N Mäki, and J Blomgren. 2004. "The Effects of Area and Individual Social Characteristics on Suicide Risk: A Multilevel Study of Relative Contribution and Effect Modification." *European Journal of Population* 20:323-50.
- McPherson, M., L. Smith-Lovin, and J. M. Cook. 2001. "Birds of a feather: Homophily in social networks." *Annual Review of Sociology* 27:415-44.
- Merton, R. K., and A. S. Rossi. 1950. "Contributions to the Theory of Reference Group Behavior." in *Continuities in Social Research*, edited by R. K. Merton and P. F. Lazarsfeld. New York: Free Press.
- Messner, S. F. 1989. "Economic Discrimination and Societal Homicide Rates - Further Evidence on the Cost of Inequality." *American Sociological Review* 54(4):597-611.

- Mueller, A. S., and S. Abrutyn. 2015. "Suicidal disclosures among friends: using social network data to understand suicide contagion." *J Health Soc Behav* 56(1):131-48.
- Mueller, A. S., S. Abrutyn, and C. Stockton. 2015. "Can Social Ties be Harmful? Examining the Spread of Suicide in Early Adulthood." *Sociol Perspect* 58(2):204-22.
- Neeleman, J., and S. Wessely. 1999. "Ethnic minority suicide: a small area geographical study in south London." *Psychological Medicine* 29(2):429-36.
- Overholser, J. C., D. M. Adams, K. L. Lehnert, and D. C. Brinkman. 1995. "Self-esteem deficits and suicidal tendencies among adolescents." *J Am Acad Child Adolesc Psychiatry* 34(7):919-28.
- Pescosolido, Bernice A., and S. Georgianna. 1989. "Durkheim, Suicide, and Religion: Toward a Network Theory of Suicide." *American Sociological Review* 54(1):33-48.
- Platt, S. 1984. "Unemployment and suicidal behaviour: a review of the literature." *Soc Sci Med* 19(2):93-115.
- Platt, S., and N. Kreitman. 1990. "Long term trends in parasuicide and unemployment in Edinburgh, 1968-87." *Social Psychiatry and Psychiatric Epidemiology* 25(1):56-61.
- Pope, W. 1976. *Durkheim's Suicide : A Classic Analyzed*. Chicago ; London: University of Chicago Press.
- Pope, Whitney, and Nick Danigelis. 1981. "Sociology's "One Law"." *Social Forces* 60(2):495-516.
- Rehkopf, D. H., and S. L. Buka. 2006. "The association between suicide and the socio-economic characteristics of geographical areas: a systematic review." *Psychological Medicine* 36(2):145-57.
- Robinson, W. S. 1950. "Ecological correlations and the behavior of individuals." *American Sociological Review* 15(3):351-7.
- Rodgers, G. B. 2002. "Income and inequality as detriments of mortality: An. international cross-section analysis." *Population Studies* 33:343-51.
- Sainsbury, P., J. Jenkins, and A. Levey. 1980. "The social correlates of suicide in Europe." Pp. 38-53 in *The Suicide Syndrome*, edited by E. Farmer and S. Hirsch. London: Croom Helm.

- Sampson, R. J., J. D. Morenoff, and T. Gannon-Rowley. 2002. "Assessing 'neighborhood effects': Social processes and new directions in research." *Annual Review of Sociology* 28:443.
- Shneidman, E.S. 1987. "A Psychological Approach to Suicide." in *The master lectures, Vol. 6*. Washington, DC, US: American Psychological Association.
- Stack, S. 1987a. "Celebrities and suicide: a taxonomy and analysis, 1948-1983." *American Sociological Review* 52(3):401-12.
- . 1987b. "The Effect of Female Participation in the Labor Force on Suicide: A Time Series Analysis, 1948-1980." *Sociological Forum* 2(2):257-77.
- . 2000a. "Suicide: A 15-yr review of the sociological literature part I: Cultural and economic factors." *Suicide and Life Threatening Behavior* 30(2):145-62.
- . 2000b. "Suicide: A 15-yr review of the sociological literature part II: Modernization and social integration perspectives." *Suicide and Life Threatening Behavior* 30(2):163-76.
- Stack, Steven, and Augustine J. Kposowa. 2011. "Religion and Suicide Acceptability: A Cross-National Analysis." *Journal for the Scientific Study of Religion* 50(2):289-306.
- Taylor, Steve. 1994. "Suicide and social theory." Pp. 1-10 in *Emile Durkheim : Le Suicide, One Hundred Years Later*, edited by David Lester. Philadelphia: Charles Press.
- Thorlindsson, T., and T. Bjarnason. 1998. "Modeling Durkheim on the micro level: A study of youth suicidality." *American Sociological Review* 63(1):94-110.
- Tsai, Alexander C., and Andrew V. Papachristos. 2015. "From social networks to health: Durkheim after the turn of the millennium." *Social Science & Medicine* 125(0):1-7.
- van Tubergen, Frank, Manfred te Grotenhuis, and Wout Ultee. 2005. "Denomination, Religious Context, and Suicide: Neo-Durkheimian Multilevel Explanations Tested with Individual and Contextual Data." *American Journal of Sociology* 111(3):797.
- Wadsworth, T., and C. E. Kubrin. 2007. "Hispanic suicide in U.S. metropolitan areas: Examining the effects of immigration, assimilation, affluence, and disadvantage." *American Journal of Sociology* 112(6):1848-85.

- Wagstaff, A., and E. van Doorslaer. 2000. "Income inequality and health: What does the literature tell us?" *Annual Review of Public Health* 21:543-67.
- Wilkinson, R. G. 1996. *Unhealthy societies : the afflictions of inequality*. London: Routledge.
- Wills, T. A. 1981. "Downward Comparison Principles in Social-Psychology." *Psychological Bulletin* 90(2):245-71.
- Wilson, William J. 1987. *The truly disadvantaged : the inner city, the underclass, and public policy*. Chicago: University of Chicago Press.
- Wood, J. V. 1989. "Theory and Research Concerning Social Comparisons of Personal Attributes." *Psychological Bulletin* 106(2):231-48.
- World Health Organization. 2014. "Preventing Suicide: A Global Imperative." Geneva: World Health Organization.

Table 1. Individual-level and neighborhood-level variables

Individual-level (N=1,383,009)			Neighborhood-level (N=578)		
	Mean	(S.D.)		Mean	(S.D.)
<i>Individual and neighborhood variables with cross-level interaction terms:</i>					
Logged disposable income ^a	0.95	(0.93)	Logged median disposable income of the neighborhood	1.12	(0.12)
Received unemployment benefits	0.09		% received unemployment benefits	8%	(3%)
Received social welfare benefits	0.10		% received welfare benefits	8%	(7%)
Being a single parent	0.06		% single parent	6%	(2%)
Born in an Eastern European country ^b	0.02		% born in Eastern European countries	2%	(1%)
Born in Finland	0.05		% born in Finland	6%	(3%)
Born in a Western European country ^c	0.03		% born in Western countries	3%	(2%)
Born in a Southern European country ^d	0.02		% born in Southern European countries	2%	(2%)
Born in a country in the Middle East ^e	0.04		% born in Middle East countries	3%	(5%)
<i>(B) Individual and neighborhood variables without cross-level interaction terms:</i>					
Calendar year	1994		Ln(Number of adults ages 16-65 years in the SAMS area)	7.46	(0.76)
Age at year t	37.86	(13.99)	Number of adults in the SAMS area ages 16-65 years per km ²	2886.64	(3574.64)
Female	0.50		Gini Coefficient ^g	0.26	(0.05)
Born in other non-European country ^f	0.05				

Note: The interactions between the individual-level variables in Panel A and their corresponding neighborhood-level variables are included in the main model (Table 2).

- a. In base amount. One base-amount equals approximately 33,000 Swedish Krona
- b. Estonia, Lithuania, Albania, Bulgaria, Romania, Czechoslovakia, Czech Republic, Slovakia, Hungary, Poland, Moldavia, Russia, Republic of Belarus and Ukraine
- c. Denmark, Norway, Iceland, Germany, Belgium, France, Luxemburg, the Netherlands, Austria, Great Britain, Ireland, Andorra, Lichtenstein, the Vatican, Switzerland, Monaco, Malta, San Marino, United States, Canada, Australia, New Zealand and other Oceania countries
- d. Italy, Spain, Portugal Greece Bosnia-Herzegovina, Croatia, Macedonia and Slovenia
- e. Egypt, Libya, Tunisia, Algeria, Morocco, Israel, Palestine, Syria, Lebanon, Jordan, Yemen (south), Yemen, United Arab Emirates, Kuwait, Bahrain, Qatar, Saudi Arabia, Iran, Iraq and Turkey
- f. Asian (including Japan), African, Central American and South American countries
- g. Range from 0 to 1. High values indicate high levels of inequality.

Table 2. Results of multilevel model with individual-, neighborhood- and cross-level predictors

	O.R.	95% C.I.	Sig.
<u>Neighborhood-level</u>			
Logged median income	3.97*	(1.80-8.70)	<0.01
% Unemployment benefits	1.08*	(1.05-1.11)	<0.01
% Social welfare benefits	1.02	(1.00-1.04)	0.05
% Single parent	1.02	(0.98-1.05)	0.21
% born in Eastern Europe	1.02	(0.96-1.08)	0.45
% born in Finland	1.01	(0.98-1.03)	0.71
% born in Western Europe	1.01	(0.97-1.04)	0.71
% born in Southern Europe	1.05*	(1.01-1.09)	0.00
% born in the Middle East	1.01	(0.99-1.02)	0.47
% born in other non-European countries	0.98	(0.95-1.00)	0.09
Logged population	1.03	(0.94-1.11)	0.50
Population density per km ²	1.00	(1.00-1.00)	0.23
<u>Individual-level</u>			
Year	0.96*	(0.94-0.97)	<0.01
Female	0.56*	(0.50-0.60)	<0.01
Age	1.03*	(1.02-1.03)	<0.01
Logged personal income	0.98	(0.92-1.03)	0.35
Received unemployment benefits	1.00	(0.81-1.21)	0.94
Received social welfare benefits	4.34*	(3.82-4.92)	<0.01
Being a single parent	0.87	(0.71-1.05)	0.18
Born in:			
Eastern Europe	0.77	(0.54-1.09)	0.13
Finland	1.31*	(1.12-1.53)	<0.01
Western Europe	0.79	(0.61-1.03)	0.09
Southern Europe	0.69*	(0.48-0.99)	0.05
Middle East	0.31*	(0.21-0.46)	<0.01
Other non-European countries	0.33*	(0.25-0.45)	<0.01
<u>Cross-level</u>			
Logged personal income by logged neighborhood median income	0.74*	(0.55-0.97)	0.03
Received unemployment benefits by % received unemployment benefits	0.99	(0.94-1.04)	0.61
Received social welfare benefits by % received social welfare benefits	0.97*	(0.96-0.98)	<0.01
Single parent by % single parent	0.95	(0.89-1.02)	0.16
Born in Eastern Europe by % born in Eastern Europe	1.15	(0.93-1.40)	0.20
Born in Finland by % born in Finland	0.99	(0.95-1.03)	0.59
Born in Western Europe by % born in Western Europe	0.97	(0.83-1.13)	0.63
Born in Southern Europe by % born in Southern Europe	0.79*	(0.69-0.89)	<0.01
Born in the Middle East by % born in the Middle East	0.99	(0.97-1.02)	0.70

Number of neighborhoods=578; Number of individuals =1,383,009

*=p<0.05

Table 3. The effects of neighborhood median income, personal income, and income inequality

	I. Median income only	II. Median Income+ personal income	III. Median Income+ personal income + interaction	IV. Gini only	V. Gini + personal income	VI. Gini + personal income +median income	VII. Gini + income interactions
	O.R. Sig.	O.R. Sig.	O.R. Sig.	O.R. Sig.	O.R. Sig.	O.R. Sig.	O.R. Sig.
Logged median income	3.86* <0.01	3.95* <0.01	3.97* <0.01			3.32* <0.01	3.34* 0.01
Logged personal income		0.98 0.42	0.98 0.34		0.98 0.52	0.98 0.34	0.97 0.34
Income interaction			0.74* 0.03				0.74* 0.03
Gini coefficient				3.76* 0.01	3.83* 0.01	1.85 0.29	1.95 0.24

Number of neighborhoods=578; Number of individuals =1,383,009

*=p<0.05

All models control for the effects of the other variables listed in Table 1.

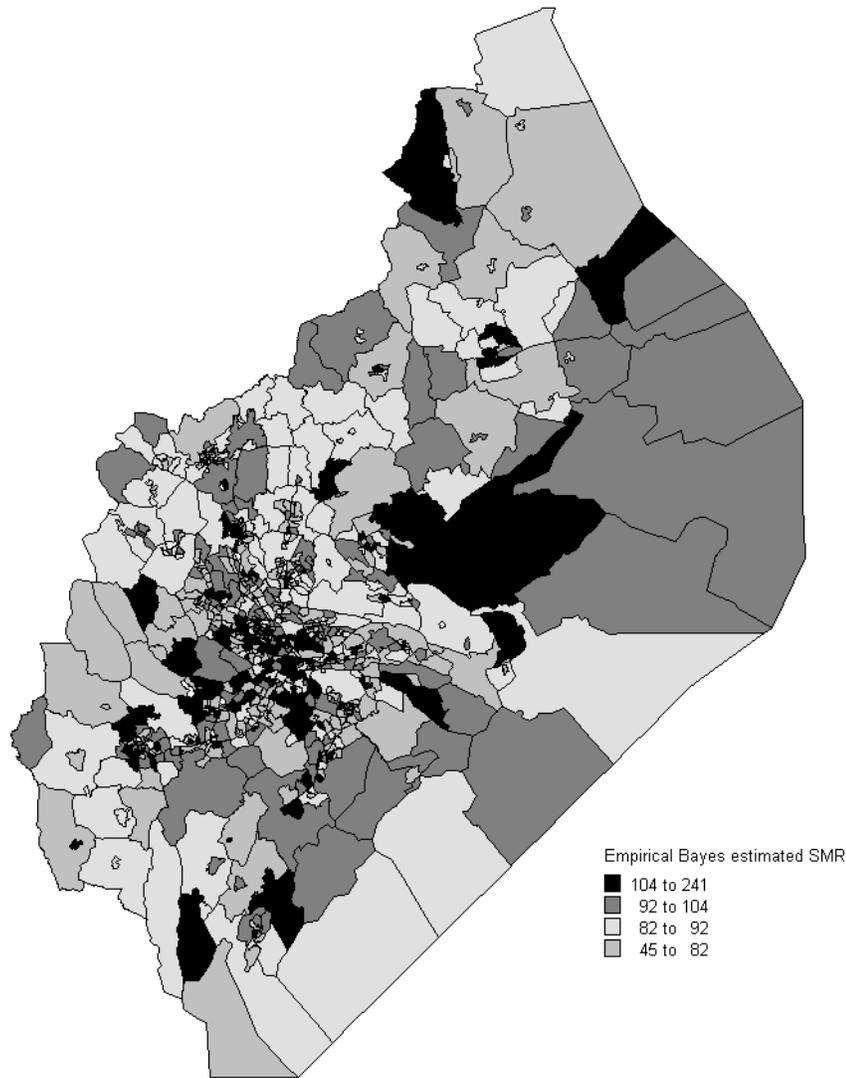


Figure 1. Empirical Bayes Estimated Standard Mortality Ratio in Stockholm Metropolitan Area, 1991-1999

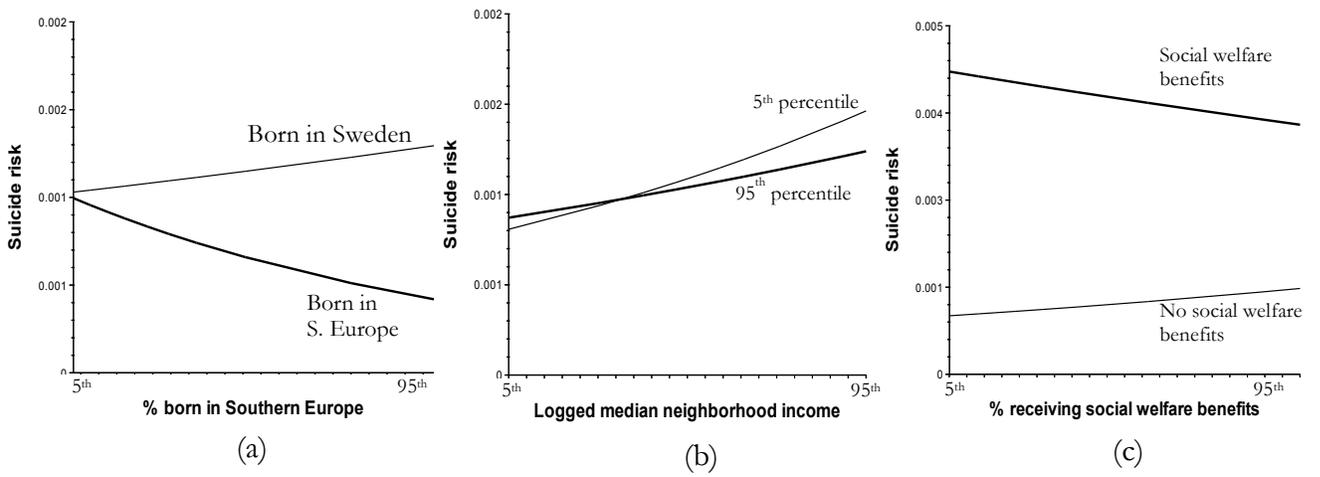


Figure 2. Interactions between individual and neighborhood attributes on suicide