Childhood neighborhoods and health in adulthood: A life-course and nearest neighbor approach for Sweden 1939-2015

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2021

Document Version:
Other version

Abstract for Population Association of America conference 2021

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1. Introduction

How do childhood neighborhoods affect health in adulthood? Childhood and adult socioeconomic risk factors have been linked to adverse health in later life. Research on the weathering hypothesis has provided evidence that racial disparities in a wide array of health outcomes are caused by differences in residence patterns across deprived and more affluent neighborhoods (Forde et al. 2019). At the same time, little is still known on how neighborhood social class in childhood affects health across the life course, as many studies take a cross-sectional approach so that causal pathways remain unclear (Forde et al. 2019). In this paper, we study the association between socio-spatial neighborhood conditions throughout childhood, social class in the family of origin and own social class in adulthood, and a range of health outcomes later in life. Our main research question is: What are the long-term implications of the close-by childhood neighbors for physical health, net of one's own socioeconomic background?

There is an established relationship between socioeconomic class and health outcomes, which includes childhood socioeconomic class next to adulthood socioeconomic class (Cohen 2010; Conroy et al. 2010). In addition to family socioeconomic class, neighborhoods of origin's socioeconomic class affects self-reported health in adulthood (Vartanian & Houser, 2010). That applies both to relatively advantaged neighborhoods – with higher social status than the child – and absolutely advantaged neighborhoods, which are relatively affluent places. Objective measures of health in early adulthood are also affected; for instance, a higher prevalence of diabetes has been found among middle-aged individuals who grew up in disadvantaged neighborhoods (Kivimäki et al. 2018). These results suggest that it is likely that childhood neighborhoods have a lasting effect on health outcomes in adulthood. However, longitudinal studies of health in relation to children's neighborhoods are rare.

To measure childhood conditions, we utilize unique longitudinal micro-data that contains economic and demographic information of the full population of the Swedish industrial town Landskrona, 1939-1967. Approximately 77,000 individuals have been geocoded at address-level (Hedefalk & Dribe, 2020). Hence, we obtain accurate locations of everyone's nearest neighbors and measure their socioeconomic characteristics, as well as each move across the city. Therefore, we can measure continuous social as well as spatial neighborhood properties at the micro-level, based on children's nearest same-age neighbors and the close-by physical environment. Furthermore, detailed information on parental occupations is included, so that we can reconstruct changes in social class in childhood in a detailed manner. We use Swedish national registers (1968-2015) to measure later-life outcomes, which are linked to the indicators of childhood conditions (1939-1967) in Landskrona. Follow-up is nationwide so that selective out-migration is accounted for. Later-life health outcomes are measured using a range of indicators, including information about hospital admission for different diagnoses as well as for the risk of premature death.

We contribute by using detailed information with regard to health indicators, individualized neighborhoods in childhood, and rich controls at the individual, family, and geographic level. Furthermore, previous research has addressed how neighborhoods affect health of individuals and health of children at the start of life (see, e.g., Arcaya et al. 2016; Duncan and Kawachi 2018), but has not yet addressed the long-term health consequences for children growing up in varied contexts. We analyze the relatively socially unsegregated Sweden, which have implications for many similar societies in Western Europe as well as for more segregated contexts, where effects of neighborhood disadvantage are likely to be stronger.

2. Data and methods

We use historical register data for the city of Landskrona (population 25,000-30,000) from the Scanian Economic Demographic Database (SEDD) (Bengtsson et al., 2018) in combination with national register data.

We have geocoded 98% of the person-time for the ~77,000 individuals in the historical dataset at the address level, providing the full residential histories of the individuals living in the city (c.f. Hedefalk & Dribe (2020)). These address points are linked to the buildings in the city, and we have created an object lifeline representation of ~90% of the buildings and streets in Landskrona.

First, we quantify individual and neighborhood variables for children ages 0-16 between 1939 and 1967. By doing so, we are able to account for variations in the neighborhood influence at different ages. The hospital admissions, death records, and class of these individuals are later followed up in the national registers, 1968-2015 (until 2010 for the death records). When analyzing early death, children growing up in Landskrona from 1939 to 1967, and born before 1957, are followed from age 18 until age 60 or death, regardless of where they live within Sweden (total sample: 12,286). For the hospital admissions, we also select those that were children in Landskrona (1939-1967), and follow them from age 35 to 50 (total sample 10,150). We start the follow-up in 1974, as about 80% of the counties in Sweden had then started to report hospital admissions. We remove individuals from the analysis who have resided in a county without complete hospital records. We estimate logistic regression models to analyze the association between childhood neighborhood class and: (1) the likelihood of dying before age 61; and (2) the likelihood of being hospitalized once between age 35 and 50.

Social class in childhood (class origin) is based on father's occupation (coded in HISCO and classified in HISCLASS, see Van Leeuwen & Maas, 2011). We define three classes: high class (non-manual workers), mid-class (skilled workers), and low class (low/unskilled workers and farmers). We select the highest social class obtained in childhood (ages 0-16). Class attainment in adulthood is measured as the highest social class attained.

For neighborhood class we use people's individualized neighborhoods and employ the k-nearest neighbor approach with geographic weights, based on their address and building of residence, rather than arbitrary administrative borders. This approach, which is rarely possible to use due to data limitations, measure more realistic neighborhood conditions and helps us avoid some serious biases in the estimates (Kwan 2012). The details of the method is fully described in Hedefalk and Dribe (2020). The main approach is to construct annual matrices containing the shortest Euclidean distances between each child and age group, and their k-nearest neighbors of the same age, ±1 y.

The final dataset contains yearly snapshot information on each individual's neighbors for the period 1939 to 1967. From these matrices, we first create individual neighborhoods from the k-nearest neighbors, and thereafter we construct the geographically weighted (GW) neighborhood class variable. We categorize the neighborhood class for each individual and age (0-16) as: (1) high class, a 13-neighborhood[1] with a GW share of at least 50% high-class neighbors, and less than 25% low-class neighbors; (2) low class, a 13-neighborhood with a GW share of at least 50% low-class neighbors, and less than 25% high-class neighbors; and (3) mid-class, a 13-neighborhood that is not classified as high class or low class. Finally, the average neighborhood class throughout childhood (0-16) is selected.

Figure 1 shows an example of individualized neighborhoods in which we estimate the social characteristics from the nearest neighbors at one specific point in time. The figure shows the 13 nearest neighbors j and their class c, of the same age +/-1 year to individual i. The share of the neighbors' classes, which are 5 high-class, 4 mid-class, and 4 low-class, are geographically weighted using a Gaussian distance function. The closest three neighbors, all of different classes, reside only a few meters from the individual, indicating the fine scale of the longitudinal data.

3. Preliminary results

Table 1 displays the preliminary results from the logistic regressions and shows estimates of class origin, neighborhood class and class attainment in adulthood on the risk of death between age 18 and 60. Model 1 indicates a higher risk of death for men and women from low- and mid-class origins (manual workers) compared to non-manual origins (high class). Growing up in a low/mid-class neighborhood is also associated with considerably higher risks of premature death, as shown in Model

[1] Neighborhood consisting of the 13 nearest neighbors

2. The estimates are similar for men and women. When including both class origin and neighborhood class (model 3) the similarities of the estimates indicate that origin and neighborhood are independently associated with adult mortality. Finally, when adding also class attainment in adulthood (Model 4) the patterns do not change much for women, whereas the origin association disappears for men. As expected, manual workers have higher mortality in adulthood than non-manual workers for both men and women, but the associations are stronger for men.

Figure 2 shows more detailed estimates for class origin and neighborhood class by age of the child. It is based on separate regressions for each individual age and class origin/neighborhood class, only distinguishing between high class and low class. Overall the rather independent associations of class origin and neighboring class are evident in all panels, but especially in the models for class origin (the top panels). It is also clear that the associations for both class origin and neighborhood class are stronger for younger children, especially for girls, and that the strength of the associations are similar for class origin and neighborhood class.

These results suggests that the class structure of childhood neighborhoods have a long-term association with health and translates into higher risks of death before age 60. Moreover, the associations are not strongly dependent on class origin or class attainment in adulthood.

Table 2 shows estimates for the risk of being hospitalized at least once between ages 35 and 50. For class origin (Model 1), there is only a week association with hospitalization, and only for low-class men is the estimate statistically significant at the 10% level (OR=1.13, p=0.09). For women, high neighborhood class is associated with higher risk of hospitalization, whereas the opposite holds for men. Including both class origin and neighborhood class in the same model (Model 3), does not change the estimates to any considerably extent, which indicates relatively independent associations as was also the case for mortality. Finally, when including class attainment in adulthood (Model 4), the association with class origin for men is attenuated, whereas the association with neighborhood class is left virtually unchanged.

Thus, whereas both class origin and class attainment in adulthood seem to be similarly related to the risk of hospitalization as they were for mortality, the association for neighborhood class is much weaker for hospitalization than for mortality; for women even in an opposite direction. Naturally, being admitted once to a hospital may not be a realistic indicator of adult health. Therefore, in the final version of the paper we will also analyze the associations with the number of hospitalizations as well utilizing information on diagnoses.

Taken together, our preliminary findings indicate that neighborhood class in childhood is associated with health in adulthood, independently of class origin and class attainment. Childhood and adulthood environments are correlated, which may explain part of the relationship between early-life conditions and adult outcomes (Preston, 1998). However, we here establish that childhood neighborhood conditions have an effect over and above these correlated social characteristics. Further, we find that class origin is related to health and survival in adulthood, but is mediated through class attainment in adulthood. This underlines that contextual effects on health affect health independently from individual class and that place over the life course deserves attention in life-course epidemiology. Possible pathways work through education, life style factors, health benefits of neighborhoods where relatively higher-class children are concentrated (i.e. green space, absence of traffic and roads, better-quality housing), and stress factors in the neighborhood.

In the final version of the paper, we will include women's records in the medical birth registers, and include the birthweights of their children. For women who had children, birthweights provide us with an indication about women's health in a period of life for which health and survival are generally favorable and as such, for which little indications are available with regard to the effects of early life conditions (Quaranta et al. unpublished manuscript). Using a wider array of health outcomes, we will be better able to pinpoint the later-life health consequences of growing up in low-class neighborhoods and possibly establish pathways that contribute to worse health in adulthood for low-status children. Moreover, we will fully utilize the social and spatial information at micro-level to estimate cumulative and time-varying socio-spatial neighborhood effects throughout childhood, as well as conducting more realistic methods and models. For example, we have time-varying information on roads and buildings, which allow us to include accurate information on the physical environment in the neighborhood.

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Table 1: Association between neighborhood conditions in childhood and death between age 18-60, Landskrona and Sweden, 1939 to 2010. Neighborhood class represent the average class for all children between 0 and 16, class origin represent the highest class measured between 0 and 16, and class adult represent the highest class measured before age 61. Left panel: women. Right panel: men

Variables	Women								Men							
	Model 1		Model 2		Model 3		Model 4		Model 1		Model 2		Model 3		Model 4	
	OR	P>z	OR	P>z	OR	P>z	OR	P>z	OR	P>z	OR	P>z	OR	P>z	OR	P>z
Class Origin																
High	1.00	RC			1.00	RC	1.00	RC	1.00	RC			1.00	RC	1.00	RC
Mid	1.23	0.14			1.32	0.03	1.25	0.09	1.23	0.05			1.14	0.21	0.97	0.78
Low	1.36	0.02			1.19	0.21	1.08	0.59	1.17	0.12			1.19	0.10	0.99	0.94
Neigh Class																
High			1.00	RC	1.00	RC	1.00	RC			1.00	RC	1.00	RC	1.00	RC
Mid			1.42	0.05	1.36	0.09	1.32	0.12			1.43	0.01	1.39	0.02	1.33	0.04
Low			1.43	0.07	1.34	0.15	1.30	0.20			1.36	0.04	1.30	0.09	1.20	0.25
Class Adult																
High							1.00	RC							1.00	RC
Mid							1.85	0.00							2.06	0.00
Low							1.41	0.01							2.85	0.00
Birth year	1.00	0.94	1.00	0.92	1.00	0.82	1.00	0.72	0.99	0.00	0.99	0.01	0.99	0.01	0.99	0.04
LR chi^2	6.08		4.59		9.25		22.51		16.68		19.71		22.77		127.25	
Prob<chi^2	0.11		0.20		0.10		0.00		0.00		0.00		0.00		0.00	
Individuals	5968								6318							

Table 2: Association between neighborhood conditions in childhood and being at hospital once between ages 35 and 50, Landskrona and Sweden, 1939 to 2016. Neighborhood class represent the average class for all children between 0 and 16, class origin represent the highest class measured between 0 and 16, and class adult represent the highest class measured between age 35 and 50. Left panel: women. Right panel: men

Variables	Women								Men							
	Model 1		Model 2		Model3		Model 4		Model 1		Model 2		Model 3		Model 4	
	OR	P>z	OR	P>z	OR	P>z	OR	P>z	OR	P>z	OR	P>z	OR	P>z		P>z
Class origin																
High	1.00	RC			1.00	RC	1.00	RC	1.00	RC			1.00	RC	1.00	RC
Mid	1.08	0.26			1.09	0.18	1.08	0.29	1.10	0.13			1.09	0.22	1.03	0.67
Low	1.08	0.27			1.10	0.19	1.06	0.41	1.13	0.09			1.10	0.19	1.03	0.69
Neigh Class																
High			1.00	RC	1.00	RC	1.00	RC			1.00	RC	1.00	RC	1.00	RC
Mid			0.88	0.07	0.86	0.04	0.86	0.04			1.13	0.08	1.11	0.14	1.10	0.20
Low			0.96	0.65	0.93	0.48	0.92	0.41			1.19	0.08	1.16	0.15	1.12	0.26
Class adult																
High							1.00	RC							1.00	RC
Mid							1.17	0.20							1.35	0.00
Low							1.18	0.02							1.72	0.00
Birth year	1.04	0.00	1.04	0.00	1.04	0.00	1.04	0.00	1.01	0.00	1.01	0.00	1.01	0.00	1.01	0.20
LR chi2	134.78		136.18		138.72		144.71		13.38		13.69		16.03		56.89	
Prob<chi2	0.00		0.00		0.00		0.00		0.00		0.00		0.01		0.00	
Individuals	4981								5169							

Figure 1: Example of an individual neighborhood for individual i, aged 8, containing the 13 nearest neighbors of ages 7-9 in Landskrona, 1959-12-31. The background map shows buildings, streets (white lines), and class origin. Note: some neighbors reside at the same address point (Source: Hedefalk & Dribe (2020)).

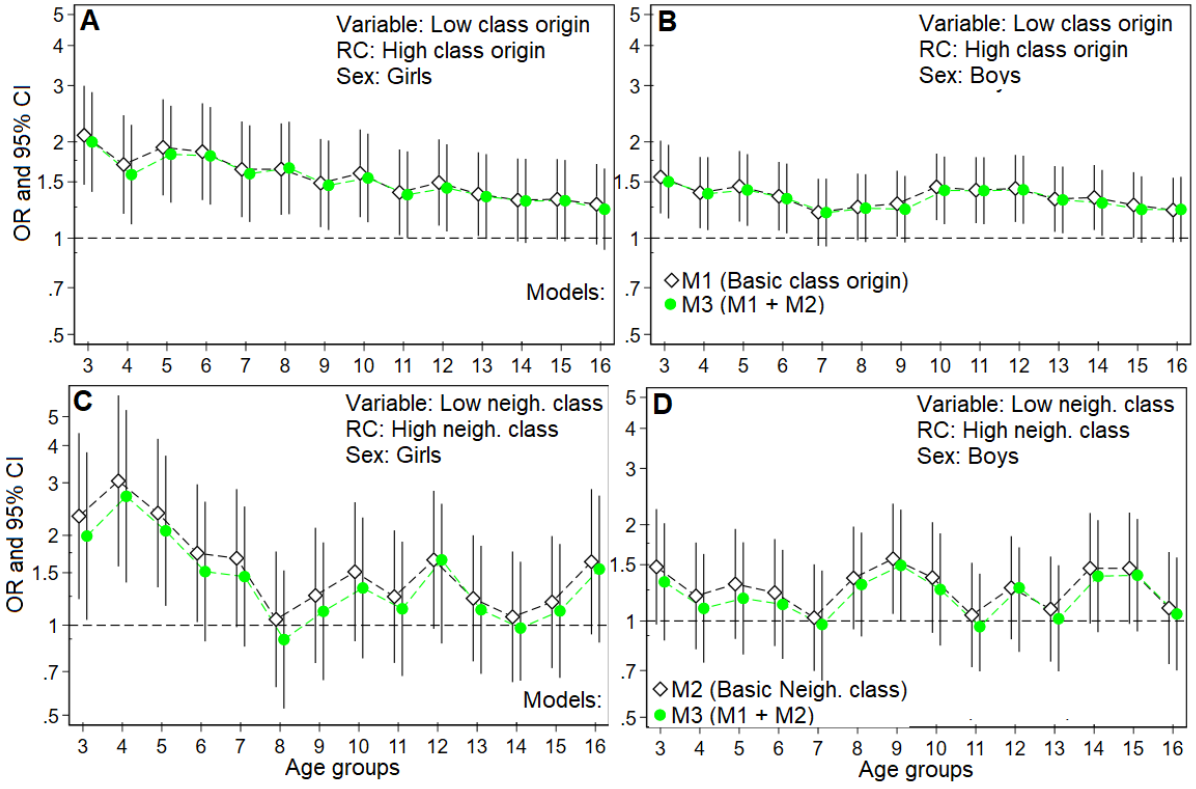

Figure 2: Association between neighborhood conditions in childhood and dying before age 61, Landskrona and Sweden, 1939 to 2015. Only the variables low-class origin and low neighborhood class are shown here (reference classes: high-class origin and high neighborhood class). (A) Low-class origin, girls; (B) low-class origin, boys; (C) low neighborhood class, girls; and (D) low neighborhood class, boys.