

**NEIGHBOURHOOD CHARACTERISTICS AS A MEDIATOR IN THE
RELATIONSHIP BETWEEN HOUSEHOLD INCOME AND CHILD HEALTH**

By

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1 Introduction

The positive relationship between income and health is well-documented and established. Even in countries with universal public health care systems, income disparities can contribute to health inequities. Jimenez-Rubio et al (2008) found that income-related inequities in health in Canada are mostly due to within-area inequities, or gaps between rich and poor individuals. Case et al. (2002) argue that these inequities in health due to income have their origins in childhood. They argue that the intergenerational prevalence of socioeconomic status may begin through the effect of parents' income on child health. Children also provide an interesting sample in which to study the income-health relationship as the reverse causation problem of the impact of health on labour income that is found in adults is mostly removed.

However, although this "income gradient" has been researched extensively, the transmission mechanisms that translate higher income into better health remain unclear (Currie and Stabile 2003). Exploring this relationship in detail is important for policy-makers to be able to create policies that attempt to reduce the income-health gradient. Neighbourhood characteristics are one area of potential exploration that is often overlooked in the literature, though interest is growing. Neighbourhoods could affect child health through the physical, social or institutional characteristics of the environment.

This paper seeks to explore neighbourhood characteristics as a possible mechanism in the income-child health relationship. Using the National Longitudinal Study of Children and Youth (NLSCY), I analyze whether the inclusion of neighbourhood characteristics into the income-child health axis reduces the importance of income on health. My results suggest that neighbourhood characteristics, especially safety, are important determinants of child health. The

addition of these indicators decreases the importance of income. In addition, these effects seem to be stronger for older children.

The rest of the paper proceeds as follows: Section 2 provides a background on the relationship between income and child health, as well as some insight as to how neighbourhood characteristics could enter into the relationship; Section 3 describes the NLSCY and summarizes the main variables used; Section 4 describes the methodology of this study; Section 5 and 6 provide results and discussion; Section 7 concludes.

2 Background

The positive relationship between income and health has long been well established. Though these findings hold across various countries and health care systems, there is debate over the direction of the causality (Adams et al. 2003, Adler et al. 1994). For example, there is uncertainty over whether the income-health relationship can be attributed more to the likelihood of low-income individuals to be unhealthy, or to the likelihood of adults in poor health to work less. Research has also found that this relationship has its roots in childhood, especially as the income-health gradient has been found to be stronger in older children (Case et al. 2002, Currie and Stabile 2003). In addition, studying child health is important for research on the income-health gradient as a whole, since the reverse causation from health to income that is problematic in studying adults is removed.

An important study in the literature is Case et al.'s (2002) seminal work that thoroughly examined the gradient of household income and child health thoroughly using various datasets for the United States. Using parent-reported subjective child health as their dependent variable and ordered probit regressions, they find strong evidence of a positive relationship between

income and health. Interestingly, they also find that the relationship strengthens with age. Their methodology has since been replicated and built upon by researchers in other Western countries (Currie and Stabile 2003, Khanam et al. 2009, Reinhold and Jorges 2012, Chen et al. 2006, Currie et al. 2007, Apouey and Geoffard 2013, Propper et al. 2007), and their results have been confirmed for the most part, even in countries with publicly-funded health care systems with universal coverage for children.

Most relevant for this study is Currie and Stabile's (2003) research looking at Canadian children using the first three cycles of the NLSCY. Though they include parents' education to study socioeconomic status as a whole compared to only income, they follow the same methodology as Case et al. (2002). Currie and Stabile (2003) similarly find that the gradient steepens with age. However, while Case et al. (2002) find that higher income "protects" children from the negative consequences of health conditions, Currie and Stabile (2003) find that the mechanism underlying income's protective effect in Canada is that higher household income decreases the arrival rate of health "shocks". In comparison to the United States, it seems that both higher and lower income children in Canada respond to health shocks in relatively the same way, but lower income children are just subject to *more* shocks.

Despite relatively numerous studies examining the income-child health relationship, few have been able to establish whether this relationship is solely between income and health, or whether the relationship is caused spuriously by a third unobserved factor. Allin and Stabile (2012) have since expanded on Currie and Stabile (2003) by using eight cycles of the NLSCY, and expanding the set of explanatory variables. In particular, they include measures for maternal health, as a study conducted using a UK dataset by Propper et al (2007) found that the gradient disappears for children aged 0 to 7 when maternal health is included. Allin and Stabile (2012)

found that including maternal health slightly reduces the effect of income on subjective child health, though it remains significant. They also examined whether access to health care was a mechanism that drove the income-child health relationship. Interestingly, they found that health care use, especially contact with a physician or medication use, gave household income a greater protective effect. They hypothesize that this might be evidence that higher income households are more likely to use preventative measures whereas lower income households are more likely to rely on only curative practices. In any case, health care use was not found to be a significant mediator of the income-child health relationship.

Kuehnle (2014) also attempts to expand on the literature by exploring potential transmission mechanisms that mediate the relationship between income and child health. One of the most influential mechanisms they found was housing quality. In addition, in a recent study, Bilger and Carrieri (2013) look at Italian data to assess the effect of neighbourhood problems on adult health. They find the living in a neighbourhood with a large amount of problems (such as pollution and crime) is strongly damaging to health. This effect was found to be even stronger than the effect of income. Similar results have also been found for children. Jacob et al. (2013) found evidence suggesting that moving families out of public housing and into less distressed neighbourhoods decreased child mortality rates, especially for girls. Contoyannis and Li (2011) found evidence that neighbourhood characteristics amplify the relationship between income and child health.

There are many possible channels that could explain this relationship. One of the most obvious is the purely physical environment of the neighbourhood. Disadvantaged neighbourhoods may experience a higher environmental health risk due to more pollution and lower housing quality. Neidell (2004) found that the effect of air pollution was greater for

children of lower socioeconomic status. In addition, housing dampness has been connected to respiratory issues. Therefore, if poorer families are unable to afford to move to less polluted areas, then child health could suffer (Peat et al., 2007; Andriessen et al., 1998).

The institutional environment of the neighbourhood may contribute to health outcomes as well. Disadvantaged neighbourhoods may experience a lower quality or quantity of health care services and other health-related amenities in their neighbourhood such as parks, gyms or grocery stores that sell fresh fruits and vegetables (Jacob et al. 2013). In addition, crime might be disproportionately greater in disadvantaged neighbourhoods. Various studies have found that neighbourhood crime can have a large effect residents' health. Crime may negatively affect health through physical harm leading to increased mortality and injury rates (Soares 2006), or indirectly, through its impact on physical activity (Janke et al. 2016) and mental health (Dustmann and Fasani 2016).

Social aspects of the neighbourhood could also affect health. In studying the Move to Opportunity (MTO) program, in which randomly selected low-income households were offered housing vouchers to live in higher income neighbourhoods, Kling et al. (2007) found convincing evidence of neighbourhood effects on obesity. In addition, those who moved out of the distressed neighbourhoods experienced reduced psychological distress and an increase in exercise and nutrition, with teenage girls being especially affected. However, they found the opposite affects among teenage boys. Browning and Cagney (2003) found the "collective efficacy" of a neighbourhood to be a significant positive predictor of health. Similarly, Kawachi et al. (1997) found that neighbourhoods with lower levels of social capital, trust and social cohesion are associated with increased mortality. Kawachi et al. (1997) posit that this may be because societies with little social trust may invest less into social institutions as they internalize less of

the positive externalities that these institutions bestow on society. Thus, there could be a feedback effect of social characteristics into the institutional characteristics of the neighbourhood that effect health.

For younger children, one would expect that the physical or institutional environment would have the strongest effects on health, as the child would not yet have much independent interaction with the neighbourhood (Jacob et al. 2013). It is also important to note that at a young age, the child's parents' behaviours, which are likely influenced by the environment, would be the most important in determining the child's health. On the other hand, as children become older and more autonomous in their actions, their own behaviour is increasingly important in determining their health (Jacob et al. 2013). As they have more independent interactions with their environment, one would expect social characteristics of their neighbourhood to have a stronger effect.

Currie and Stabile (2003) note the need for future research to further delve into the transmission mechanisms that drive the income – child health. With convincing research arguing the importance of neighbourhood effects on health, I will explore this as a potential mediator in the income-health relationship. In addition, most of the above studies look at American data and I am unaware of any studies that use Canadian data in this specific context. My data, described below, allows me to investigate whether neighbourhood characteristics can explain some of the effect of income on child health.

3 Data

This study will use the National Longitudinal Study of Children and Youth (NLSCY). The NLSCY is a longitudinal study that followed Canadian children from 1994/1995 to

2008/2009 in 8 cycles conducted every two years by Statistics Canada. Its purpose is to follow children from birth to early adulthood and collect information on factors that influence their development. Detailed information on the health and wellbeing of participant children is collected. Each cycle has both longitudinal and cross-sectional components. Initially, the survey began in 1994/95 with 22,831 children aged 0 to 11 years, with additional cohorts of children aged 0 to 1 added in each survey cycle. The majority of children were sampled from Canada's Labour Force Survey (LFS). It is important to note that since the LFS excludes those living on Indian reserve or Crown lands, residents of institutions, full-time members of the Canadian Armed Forces and residents of some remote regions of Canada, these populations are also not represented in the NLSCY. This study utilizes cycles 5 to 8 of the NLSCY.

For the majority of the survey questions used in this analysis, the person most knowledgeable (PMK) about the child is identified and answers questions on behalf of children aged 0 to 17. Older children living independently answer questions for themselves, but I have excluded them here for the purposes of this study.

Following previous literature, my main dependent variable is parent-reported (subjective) general child health. General health is rated by the PMK with 5 possible responses: excellent, very good, good, fair and poor. In line with many other studies, including those that have used the NLSCY (Allin and Stabile 2012, Currie and Stabile 2003), I have collapsed the "fair", "poor" and "very poor" categories into an indicator variable. Due to restrictions of the survey, and the difficulty in evaluating and comparing the health of children in their first year of life, I have restricted my sample to children aged 1 to 15.

In order to further check the robustness of the relationship between income and child health, I also reanalyze my model using the presence of chronic conditions as the dependent

variable. In the NLSCY, PMKs were asked how many chronic conditions the child had, which I recoded into a dummy variable equalling 1 if the child one or more chronic conditions. The chronic conditions included in this definition are asthma, allergies, bronchitis, heart conditions, epilepsy, cerebral palsy, kidney problems or disease, mental or learning disabilities, and psychological disorders.

For my main independent variable, household income, I use the natural logarithm of current income¹. All income figures are converted to 2002 prices using annual consumer price indices. In the few cases where income is imputed, this was controlled for with a dummy variable.

In order to examine whether neighbourhood effects mediate the relationship between income and child health, I look at 3 different indicators to evaluate the neighbourhood. The first measure is the PMK's answer to the question of how they feel about their neighbourhood as a place to bring up children. This question is answered categorically from 1 (Excellent) to 5 (very poor). I have recoded this answer to be a dummy variable equal to 1 if the PMK answered very poor or poor. This measure stands as a general indicator of the subjective quality of the neighbourhood.

The second measure is derived from a weighted average of two questions regarding the safety of the neighbourhood². This weighted Neighbourhood Safety Score was coded from 1 to 6, with 6 indicating the safest neighbourhoods, and 1 indicating the least safe neighbourhoods. I recoded this variable as an indicator variable equal to 1 if the neighbourhood scored 4 or lower.

¹ Similar results were noted when using income averaged over all available cycles.

² The questions are:

- a. Is the neighbourhood safe?
- b. Is it safe for children to play outside?

The last measure is the Neighbours Score, which is a weighted value of five questions used to determine the cohesiveness of the community in which the child lives³.

This variable has been coded from 0 to 15, with 15 indicating the highest degree of neighbourhood cohesiveness. This score will be used as a proxy for the social cohesiveness of the neighbourhood. I also recoded this score as a dummy variable, and it equals 1 if the neighbourhood scored 5 or lower.

Table 1 shows the means of the main variables in question.

4 Methodology

In line with previous literature, child health can be modeled through a production function where households maximize their utility subject to budget and time constraints. The reduced form can be written as the empirical formulation:

$$H_{it} = \alpha Y_{it} + \beta X_{it} + \epsilon_{it} \quad (1)$$

Where H_{it} is a dummy indicating either the subjective PMK-reported health status or the presence of chronic conditions in child i , Y_{it} is the natural logarithm of the household income, and X_{it} is a vector of all other exogenous variables that may effect the child's health in year t . In this base case specification, the exogenous control variables I use are: the logarithm of the number of members in the household, the gender of the child, the age of the child, a dummy if the PMK is female, a dummy if the child lives in an urban area, a set of dummies controlling for

³ Answers to the following statements were used to make up the Neighbours Score:

- a. If there is a problem around here, the neighbours get together to deal with it.
- b. There are adults in the neighbourhood that children can look up to.
- c. People around here are willing to help their neighbours.
- d. You can count on adults in this neighbourhood to watch out that children are safe and don't get in trouble.
- e. When I'm away from home, I know that my neighbours will keep their eyes open for possible trouble.

the province the child lives in, a set of dummies controlling for the year, the mother's and father's ages at the child's birth, a dummy indicating if the biological father is present in the household, a dummy indicating if the child primarily speaks one of Canada's official languages (English or French) at home, a dummy indicating if the child was born in Canada, a dummy indicating if the PMK owns the dwelling that the child resides in, a set of dummies for PMK and spouses' education, an indicator of PMK and spouses' employment status, and indicators for the PMK and spouse's subjective health score.

Following past literature, I run probit regressions on four pooled waves of the NLSCY to empirically estimate this model. I first run the model with all ages together, and then separate by age group. To account for repeated observations in the pooled data, I cluster the standard errors on the child.

In addition, as is pointed out in the literature (Currie 2009, Currie and Stabile 2003) there is a need to more closely examine the transmission mechanisms that translate higher income into better health. As argued earlier, a potential transmission mechanism that mediates the income-child health relationship could be neighbourhood characteristics. To more closely examine this, I estimate the following regression:

$$H_{it} = \alpha Y_i + \beta X_{it} + \gamma N_{it} + \epsilon_{it} \quad (2)$$

Where N_{it} is an indicator for either social cohesiveness, subjective neighbourhood quality, or neighbourhood safety, as described in the previous section. I also run the model including all three of these neighbourhood measures together.

One possible source of bias within this model is the potential for neighbourhood choice to be endogenous. Bilger and Carrieri (2013) explore the effects of neighbourhood on adult health and attempt to address this problem of endogeneity of neighbourhood choice by instrumenting

neighbourhood problems for the degree of urbanization of the place of residence. They find neighbourhood problems are unlikely to be endogenous. When I repeated their methodology by instrumenting for the degree of urbanization, I also find that each of my neighbourhood indicators can safely be treated as exogenous. However, the degree of urbanization was found to be a very weak instrument, so these results should be treated with caution. My analysis differs from many studies examining neighbourhood effects and health in that I am looking at child outcomes. For the most part, children do not choose where they live, so the problem of self-selection into certain neighbourhoods may be less of an issue directly.

However, a child's presence in a certain neighbourhood may be indicative of unobserved parental behaviour or preferences that are correlated with child health. It may be the case that those with parents with the same behaviour or preferences happen to cluster into the same neighbourhoods, so what looks like neighbourhood effects on health is actually just a misinterpretation of unobserved individual characteristics of the residents. If any unobserved factors exist, then the neighbourhood effect is overstated. However, I attempt to control for factors that the literature shows are the main determinants of neighbourhood choice (Bayoh et al. 2006). These include many of the PMK's characteristics such as their age, education level, work status, language spoken at home to their child and whether the parents own the dwelling the child resides in. The inclusion of these control variables may remove some of the potential bias of unobserved characteristics.

In addition, there could be reverse causation present if parents move to certain areas due to their child's health. A reason for this could be that they require a treatment only available in a certain area, or the parents deem it healthier for their child to live in one neighbourhood over another. This could give rise to a situation where child health actually causes neighbourhood

choice. However, when running the model again excluding families that moved, I obtained very similar estimates. Thus, I kept families that move within Canada.⁴ Reverse causation could also be present if child health impacts parents' income decisions.

Lastly, a lack of objective measures for child health may bias the results as one PMK's view of "poor" health may be different from another's, leading my results to be either understated or overstated. There are differing views on the issue of conducting research using subjective measures of health. Some argue that while parents may lack certain medical knowledge to be able to objectively assess their child's health in relation to other children, doctors actually have very limited information about the children they examine compared to their parents (Case et al. 2002). In addition, as much of the previous literature relies on subjective health reports as the dependent variable in their models, the use of this indicator is useful for comparative purposes. On the other hand, studies have found that parents of low income and high income can have differing views of what constitutes "conditions requiring medical attention" (Currie 2008). In addition, if the PMK is in poor health themselves, they may be more likely to record their child as being in poor health (Khanam et al. 2009). To alleviate this problem, I have controlled for self-reported PMK health status as an indicator variable equal to one if the PMK reports themselves to be in less than fair health. In addition, to provide a comparison to subjective health estimates, I repeat all specifications using the presence of chronic conditions as the dependent variable.

Similarly, the lack of objective neighbourhood indicators may also be a source of bias in my results. For example, living in a neighbourhood where crime is high may desensitize those living in it, leading them to rate safety as higher than someone on the outside looking in (Ellen and

⁴ Families that move outside of the country are then excluded from the NLSCY.

Turner 1997). The NLSCY partially combats this, as both the neighbourhood safety score and social cohesion score include the interviewer's answer in weighting the scores. Therefore, the only fully subjective measure is my indicator of neighbourhood quality.

Lastly, the lack of an objective definition of what constitutes a "neighbourhood" may bias my results as "neighbourhood" may mean a different thing to each PMK. Whether the PMK recognizes their street, social circle or city as their "neighbourhood" may lead to either an upward or downward bias on my results. In addition, a weakness of my research is that I am not able to identify children that live in the same neighbourhood.

5 Results

Table 2 shows the estimates for the specification including subjective child health as the dependent variable. 2A shows the estimates for equation 1, my base case, which only includes income. For all ages, an increase in income decreases the likelihood that the PMK reports the child to be in fair health or lower. As in Currie and Stabile (2003) and Allin and Stabile (2012), the effect appears to be largest for the oldest group, though the coefficient has a large standard error. However, this is as expected since this group has the smallest sample size.

Neighbourhood social cohesion shows a mixed effect on health, as is seen in 2B. Surprisingly, a low cohesion score decreases the likelihood of being in poor health for children aged 1 to 4. Conversely, the coefficient for the group aged 10 to 15 shows a very large positive effect. However, all of the coefficients exhibit large standard errors. Neighbourhood social cohesiveness may be a mediator in the income-child health relationship, as the income coefficients slightly diminish with the inclusion of the social cohesion indicator. Income becomes statistically insignificant in the model for children aged 10 to 15.

The specification adding the indicator for subjective neighbourhood quality is shown in Table 2C. Like social cohesion, subjective neighbourhood quality has a mixed effect on child health, with a strong positive effect on 5 to 9 year olds, and a weak negative effect on 10 to 15 year olds. The addition of subjective neighbourhood quality decreases the effect of income slightly for all specifications except for the oldest age group.

Table 2D shows the model specification including the neighbourhood safety indicator. Residing in an unsafe neighbourhood has a large positive effect on the likelihood of reporting a child in less than fair health. In addition, the coefficients on income are decreased compared to the base case of income only (Table 2A), and become insignificant for children aged 10 to 15. Again, this effect increases as the child ages, which is consistent with the literature.

Table 2E reports estimates when all three of the neighbourhood indicators are included in the model. The effect of income on child health decreases for all age groups, with the largest effect being seen in the oldest group, where the coefficient becomes insignificant. For the measure of social cohesiveness, the mixed effect persists from what was seen in Table 2B. Again, the effect is actually negative for children aged 1 to 4. The effect is also much lower than the specification in 2B except for the oldest age group, which brings into question whether social cohesiveness is picked up by other coefficients in this specification. The significance of neighbourhood quality in determining child health is also decreased in Table 2E, and also still shows mixed results. The indicator for neighbourhood safety continues to be significant in the relationship with subjective child health, though the coefficients also slightly diminish compared to 2D for the most part. The effect remains greatest in children 5 years and older.

To further test the robustness of the above estimates, all of the specifications were repeated with an indicator for the presence of chronic conditions as the dependent variable. Table 3A

shows the results of the base case including only income. Income is found to have a much weaker relationship with chronic conditions than with overall subjective child health. It is not found to be as significant in the relationship except for children aged 5 to 9.

Table 2B shows the estimates when the indicator for social cohesion is included. Interestingly, low social cohesion has a strong positive effect on chronic conditions in children aged 1 to 4, whereas a weak negative effect was seen on the subjective health of children of the same age. Again, the income coefficients are also slightly decreased. Subjective neighbourhood quality (Table 3C) has little significance on the likelihood of the child having a chronic condition compared to the specification in 2C. The inclusion of subjective neighbourhood quality has a mixed effect on the income coefficients.

Living in an unsafe neighbourhood has a strong effect on whether a child has a chronic condition, as it did on subjective health (Table 2D). The income coefficients also decrease with the addition of the neighbourhood safety indicator. Finally, when all neighbourhood indicators are included in the specification (Table 3E), it can be seen that neighbourhood safety remains significant in determining the likelihood of the child contracting a chronic condition, whereas the importance of social cohesion and neighbourhood quality diminish. The coefficients for social cohesion decrease, and are not significant for the all ages specification anymore. In addition, similar to the specification shown in 2C, subjective neighbourhood quality is not an important determinant for chronic conditions. The effect of income decreases dramatically for all ages.

6 Discussion

The safety of the neighbourhood seems to be the most consistently important neighbourhood indicator that affects health, especially for older children. It has the strongest effect on both

subjective child health and the presence of chronic conditions (Tables 2D and 3D). The effect of income is also diminished when neighbourhood safety is included into the model. There are a number of explanations for this effect. Firstly, neighbourhood safety issues may cause poor mental health due to heightened anxiety and fear (Cornaglia et al. 2014, Dustmann and Fasani 2015). Adults may feel the brunt of this effect, but it could trickle down to children.

In addition, one of the questions in the NLSCY asked to parents is whether the neighbourhood is safe for children to play outside. Research shows that physical activity (i.e. walking) decreases in response to news about violent crimes in the area (Janke et al. 2016). If parents believe their neighbourhood is too unsafe to let their children play outside, children's health could suffer due to a decrease in physical activity. This effect should be stronger for older children, as those aged 1 to 4 are not typically allowed to play outside on their own anyway. This could explain why the effect of neighbourhood safety is so much lower for younger children when looking at subjective child health. In addition, for older children, since risky behaviours in youth and the crime rate of a neighbourhood are related (Case and Katz 1991), living in a neighbourhood with more crime could lead to youth partaking in more risky behaviours (such as smoking, drinking or using drugs) which can contribute to poor health.

It is important to note that my analysis relies on parents' belief about the safety of their neighbourhood, not the actual crime rates. If parents' take longer to update their beliefs about the safety of their neighbourhood after a change in the crime rate, or if they have distorted views about the crime in their neighbourhood, then the effect of neighbourhood safety could be either under or overestimated.

The other neighbourhood indicators show more ambiguous effects. Social cohesion was found to have an overall mixed effect on child health. It is interesting to note that the sign of the

coefficient is negative for children aged 1 to 4 when subjective health is the dependent variable (Table 2B), while it is positive and significant when chronic conditions is the dependent variable (Table 3B). Oddly, the opposite is the case for children aged 5 to 9: the coefficient is positive and significant when subjective overall health is the dependent variable, and negative with large standard errors when chronic conditions is the dependent variable.

There are various reasons for these mixed results. For one, an increase in social cohesion in the neighbourhood could lead to more social interactions between parents. This means that there is an increase in “social resources” relative to other neighbourhoods (Deri 2005). A result of this could be that more information is dispersed amongst parents about child health. The saying “it takes a village” rings true in this case: neighbours become a resource from which parents can ask for help with raising their children.

However, it could also mean that negative health behaviours are solidified in the neighbourhood (Case and Katz 1991, Jones 1994, Clark and Loheac 2006). For example, social interaction plays a role in the choice to quit smoking (Jones 1994). Peer effects are also involved in teenagers’ decisions to partake in risky behaviours.

Lastly, I might also see mixed results for social cohesion as this indicator might primarily effect psychological disorders, for which parents may view differently than physical disorders when being questioned about their children’s health (Cutler and Lleras-Muney 2010).

Subjective neighbourhood quality is significant in the model of subjective child health as is seen in Table 2C, though it shows an almost negligible the presence of chronic conditions (Table 3C). A reason for this could be that PMKs who report their neighbourhood quality is low may be more likely to report their children’s health is low due to factors inherent in the PMK rather than the neighbourhood or their child’s health.

Another reason could be that this indicator includes too many confounding factors to be a reliable insight. The question this indicator relies on asks the PMK about the neighbourhood's rating as a place to raise children. The characteristics required of a place to be suitable to raise children in may be very different from parent to parent, so it is difficult to decipher what aspect of the environment the PMK is referring to when answering this question.

With respect to the results presented featuring all three neighbourhood indicators, most of the coefficients decrease in magnitude when either subjective child health (Table 2E) or chronic conditions is the dependent variable (Table 3E). It is possible that these indicators feed back into each other. For example, if a neighbourhood is viewed as less safe, there could be less trust between neighbours, which would mean the social cohesion score is low. It is noteworthy that the coefficients stay relatively the same for the 10 to 15 year age group. However, this group has a much smaller sample size than the others and thus is subject to more variability in the results.

Since the effect of income diminishes with the addition of almost every neighbourhood indicator, it can be hypothesized that either the neighbourhood characteristics themselves, or an effect captured within the neighbourhood indicators removes part of the effect of income on health. Thus, it is possible that neighbourhood effects mediate the income-child health relationship.

In addition, neighbourhood characteristics seem to have a stronger association with health in older children on average. A potential explanation for this is that older children have more independent interactions with their neighbourhoods than younger children, and thus the consequences of their outside environment are stronger. A path for future research would be to investigate the extent to which this is true for other data, especially as the 10 to 15 year age

group was my smallest sub-sample, and thus more susceptible bias from to outlying observations.

7 Conclusion

In summary, neighbourhood safety showed the most consistent effect on both subjective child health and chronic conditions, especially for older children. Social cohesion was found to have a significant but mixed effect on child health. The addition of neighbourhood indicators decreases the magnitude of the relationship between income and child health, especially when subjective child health is the health indicator. Future research could explore the extent to which social factors mediate the income-child health relationship. This research would benefit from richer data, and more objective measures of health and neighbourhood characteristics.

My findings have policy implications for all levels of government, but especially for local levels. Investments into social capital may have broader implications for the income-health relationship as a whole. Investments in increasing the safety of neighbourhoods could especially alleviate potential health issues associated with older children living in these areas.

One weakness of my study is the potential for neighbourhood to be endogenous in my model. In addition, the lack of objective data on neighbourhoods and child health means that the way parents perceive and report their children's health and neighbourhood conditions is likely to bias my results.

8 References

- Adams P, Hurd M, McFadden D, Marril A, Ribero T. 2003. Healthy, wealthy and wise? Tests for direct causal paths between health status and socio-economic status. *Journal of Econometrics* 112: 3–56.
- Adler, N.E., Boyce, T., Chesney, M.A., Cohen, S., Folkman, S., Kahn, R.L., Syme, S.L., 1994. Socioeconomic status and health: the challenge of the gradient. *American Psychologist* 49 (1), 15–24.
- Allin, S., Stabile, M., 2012. Socioeconomic status and child health: what is the role of health care, health conditions, injuries and maternal health? *Health Economics, Policy and Law* 7 (2), 227–242.
- Almond, Douglas, and Currie, Janet. 2011. “Killing Me Softly: The Fetal Origins Hypothesis.” *The Journal of Economic Perspectives* 25(3): 153-172.
- Almond, Douglas, 2006. “Is the 1918 Influenza Pandemic Over? Long-term Effects of In Utero Influenza Exposure in the Post-1940 U.S. Population,” *Journal of Political Economy*, 114: 672-712.
- Almond, Douglas, and Currie, Janet. 2011. “Killing Me Softly: The Fetal Origins Hypothesis.” *The Journal of Economic Perspectives* 25(3): 153-172.
- Almond, Douglas, and Hoynes, Hilary W. and Schanzenbach, Diane Whitmore. 2008. "Inside the War on Poverty: The Impact of Food Stamps on Birth Outcomes," NBER Working Papers 14306, National Bureau of Economic Research, Inc.
- Anderson, R., Sorlie, P., Backlund, E., Johnson, N., Kaplan, G.A., 1997. Mortality effects of community economic status. *Epidemiology* 8, 42–47.
- Andriessen, J., Brunekreef, B., Roemer, W., et al., 1998. Home dampness and respiratory health status in European children. *Clin. Exp. Allergy* 28 (10), 1191–1200.
- Apouey, B., Geoffard, P.-Y., 2013. Family income and child health in the UK. *J. Health Econ.* 32 (4), 715–727.
- Barker, D.J.P., 1995. “Fetal origins of coronary heart disease.” *British Medical Journal* 311 (6998), 171–174.
- Barker, D. J. 1992. “Fetal Growth and Adult Disease.” *British Journal of Obstetrics and Gynaecology* 99.
- Bayoh, I., Irwin, E.G.G., Haab, T.C., 2006. Determinants of residential location choice: how important are local public goods in attracting homeowners to central city locations? *Journal of Regional Science* 46 (1), 97–120.

Bilger, M., Carrieri, V., 2013. Health in the cities: when the neighborhood matters more than income. *J. Health Econ.* 32 (1), 1–11.

Canadian Institute for Health Information. National Health Expenditure Trends, 1975 to 2016. Ottawa, ON: CIHI; 2016.< https://www.cihi.ca/sites/default/files/document/nhex-trends-narrative-report_2016_en.pdf>

Case, A., Lubotsky, D., Paxson, C., 2002. Economic status and health in childhood: the origins of the gradient. *Am. Econ. Rev.* 92 (5), 1308–1334.^[1]_[SEP]

Case, Anne and Fertig, Angela and Paxson, Christina, 2005. "The lasting impact of childhood health and circumstance," *Journal of Health Economics*, Elsevier, vol. 24(2), pages 365-389.

Chappie, M., Lester, L., 1982. The health effects of air pollution: a reanalysis. *Journal of Urban Economics* 12, 346–376.

Chen, E., Martin, A.D., Matthews, K.A., 2006. Socioeconomic status and health: do gradients differ within childhood and adolescence? *Soc. Sci. Med.* 62 (9), 2161–2170.^[1]_[SEP]

Christakis, N.A., Fowler, J.H., 2008. The collective dynamics of smoking in a large social network. *New England Journal of Medicine* 358, 2249–2258.

Christakis, N.A., Fowler, J.H., 2007. The spread of obesity in a large social network over 32 years. *New England Journal of Medicine* 357, 370–379.

Cornaglia, F., Feldman, N.E., Leigh, A., 2014. Crime and mental well-being. *J. Hum. Res.* 49 (1), 110–140.

Contoyannis, Paul and Dooley, Martin, 2010. "The role of child health and economic status in educational, health, and labour market outcomes in young adulthood," *Canadian Journal of Economics*, Canadian Economics Association, vol. 43(1), pages 323-346.

Contoyannis, P. and J. Li (2011), 'The evolution of health outcomes from childhood to adolescence', *Journal of Health Economics*, 30(1): 11–32.^[1]_[SEP]

Currie, A., Shields, M.A., Price, S.W., 2007. The child health/family income gradient: evidence from England. *J. Health Econ.* 26 (2), 213–232.^[1]_[SEP]

Currie, J., 2009. Healthy, wealthy, and wise: socioeconomic status, poor health in childhood, and human capital development. *J. Econ. Lit.* 47 (1), 87–122.^[1]_[SEP]

Currie, J., Stabile, M., 2003. Socioeconomic status and child health: why is the relationship stronger for older children? *Am. Econ. Rev.* 93 (5), 1813–1823.

- Curtis, Lori, Martin Dooley and Shelley Phipps (2004) "Child Well-Being and Neighbourhood Quality: Evidence from the Canadian National Longitudinal Survey of Children and Youth" *Social Science and Medicine*, 58(10):1917-1927.
- Diez-Roux, A., Nieto, F., Muntaner, C., Tyroler, H.A., Comstock, G.W., Shahar, E., Cooper, L.S., Watson, R.L., Szklo, M., 1997. Neighborhood environments and coronary heart disease: a multilevel analysis. *American Journal of Epidemiology* 146, 48–63. [\[L\]](#) [\[S\]](#) [\[EP\]](#)
- Dustmann, C. and Fasani, F. (2016), The Effect of Local Area Crime on Mental Health. *Econ J*, 126: 978–1017. doi:10.1111/eoj.12205
- Ettner, S.L., 1996. New evidence on the relationship between income and health. *J. Health Econ.* 15 (1), 67–85. [\[L\]](#) [\[S\]](#) [\[EP\]](#)
- Figlio, David N. and Guryan, Jonathan and Krzysztof Karbownik, Krzysztof and Roth, Jeffrey. 2014. "The Effects of Poor Neonatal Health on Children's Cognitive Development." *American Economic Review* 104 (12):3921–55. [\[L\]](#) [\[S\]](#) [\[EP\]](#)
- Gini, G., Pozzoli, T., 2009. Association between bullying and psychosomatic problems: a meta-analysis. *Pediatrics* 123 (3), 1059–1065. [\[L\]](#) [\[S\]](#) [\[EP\]](#)
- Grossman, Michael, 1972. "On the Concept of Health Capital and the Demand for Health," *Journal of Political Economy*, University of Chicago Press, vol. 80(2), pages 223-255, March-Apr.
- Ioannides, M.Y., Topa, G., 2010. Neighborhood effects: accomplishments and looking beyond them. *Journal of Regional Science* 50 (1), 343–362. [\[L\]](#) [\[S\]](#) [\[EP\]](#)
- Jacob, B.A., Ludwig, J., Miller, D.L., 2013. The effects of housing and neighborhood conditions on child mortality. *J. Health Econ.* 32 (1), 195–206. [\[L\]](#) [\[S\]](#) [\[EP\]](#)
- Jacobson, L., 2000. The family as producer of health—an extended Grossman model. *Journal of Health Economics* 19 (5), 611–637.
- Jimenez-Rubio, D., P. C. Smith and E. van Doorslaer, 2008. "Equity in health and health care in a decentralised context: evidence from Canada", *Health Economics*, 17: 377–392.
- Katz, L.F., Kling, J., Liebman, J.B., 2001. Moving to Opportunity in Boston: early results of a randomized mobility experiment. *Quarterly Journal of Economics* 116 (2), 607–654. [\[L\]](#) [\[S\]](#) [\[EP\]](#)
- Kawachi, I., Kennedy, B.P., Lochner, L., Prothrow-Stith, D., 1997. Social capital, income inequality, and mortality. *American Journal of Public Health* 87 (9), 1491–1498. [\[L\]](#) [\[S\]](#) [\[EP\]](#)
- Khanam, R., Nghiem, H.S., Connelly, L.B., 2009. Child health and the income gradient: evidence from Australia. *J. Health Econ.* 28 (4), 805–817.

- Kling, J.R., Liebman, J.B., Katz, L.F., 2007. Experimental analysis of neighborhood effects. *Econometrica*, Econometric Society 75 (1), 83–119.^[1]_{SEP}
- Kruk, K.E., 2012. Parental income and the dynamics of health inequality in early childhood evidence from the UK. *Health Econ.* 22 (10), 1199–1214.
- Kuehnle, Daniel, 2014. “The causal effect of family income on child health in the UK. *Journal of Health Economics.* 36, 139-150.
- Ludwig, J., Hirschfield, P., Duncan, G.J., 2001. Urban poverty and juvenile crime: evidence from a randomized housing-mobility experiment. *Quarterly Journal of Economics* 116 (2), 665–679.
- Macintyre, S., Maciver, S., Sooman, A., 1993. Area, class and health: should we be focusing on places or people? *Journal of Social Policy* 22, 213–234.
- Macintyre, S., Hiscock, R., Kearns, A., Ellaway, A., 2000. Housing tenure and health inequalities: a three-dimensional perspective on people, homes and neighborhoods. In: Graham, H. (Ed.), *Understanding Health Inequalities*. Open University Press, Buckingham, PA, pp. 129–142.
- Macintyre, S., & Ellaway, A. (2000). Neighbourhood cohesion and health in socially contrasting neighbourhoods: Implications for the social exclusion and public health agendas. *Health Bulletin*, 60(6), 450–456.
- Neidell, M.J., 2004. Air pollution, health, and socio-economic status: the effect of outdoor air quality on childhood asthma. *Journal of Health Economics* 23, 1209–1236.
- Peat, J., Dickerson, J., Li, J., 2007. Effects of damp and mould in the home on respiratory health: a review of the literature. *Allergy* 53 (2), 120–128.
- Propper, C., Rigg, J., Burgess, S., 2007. Child health: evidence on the roles of family income and maternal mental health from a UK birth cohort. *Health Econ.* 16 (11): 1245–1269.
- Reinhold, S., Jürges, H., 2012. Parental income and child health in Germany. *Health Econ.* 21 (5), 562–579.
- Soares, Rodrigo R. 2006. The welfare cost of violence across countries, *Journal of Health Economics.* 25 (5): 821-846
- Sundquist, K., Theobald, H., Yang, M., Li, X., Johansson, S.-E., Sundquist, J., 2006. Neighborhood violent crime and unemployment increase the risk of coronary heart disease: a multilevel study in an urban setting. *Soc. Sci. Med.* 62, 2061–2071.

Trogon, J.G., Nonnemaker, J., Pais, J., 2008. Peer effects in adolescent overweight. *Journal of Health Economics* 27 (5), 1388–1399.^[1]_[SEP]

Van Den Berg, Gerard J.; Lindeboom, Maarten; Portrait, France. Economic conditions early in life and individual mortality. *American Economic Review*. Mar; 2006 96(1):290–302.

Xu, Xin, 2013. The business cycle and health behaviours. *Social Science & Medicine*. 77: 126-136.

9 Tables

Table 1: Means of Key Variables

Variable	Mean (Standard Deviation)
Child Age	6.46 (0.016)
Subjective Child Health (=1 if child in less than fair health)	0.013 (0.1133)
Chronic Conditions (=1 if child has one or more chronic conditions)	0.2297 (0.4206)
Log Household Income	11.112 (0.6669)
Social Cohesion Score (= 1 if Neighbours Score is 5 or lower)	0.0262 (0.1597)
Subjective Neighbourhood Quality (=1 if neighbourhood reported as poor or very poor by PMK)	0.2297 (0.4206)
Neighbourhood Safety (= 1 if Neighbourhood Safety Score is 4 or lower)	0.0658 (0.2479)

Table 2: Subjective Child Health (=1 if health is fair, poor or very poor)

	All Ages	Ages 10 to 15	Ages 5 to 9	Ages 1 to 4
A. Base Case (Income Only)				
Log of Household Income	-0.1521*** (0.0406)	-0.2753* (0.1653)	-0.1393** (0.0632)	-0.1564*** (0.0561)
B. Social Cohesion				
Social Cohesion	0.2580 (0.1704)	1.2672** (0.5963)	0.5858** (0.2478)	-0.0971 (0.2821)
Log of Household Income	-0.1497*** (0.0405)	-0.2450 (0.1630)	-0.1356** (0.0634)	-0.1572*** (0.0561)
C. Subjective Neighbourhood Quality				
Subjective Neighbourhood Quality	0.3547*** (0.1107)	-0.0317 (0.5997)	0.5935*** (0.1732)	0.2426 (0.1480)
Log of Household Income	-0.1474*** (0.0406)	-0.2764* (0.1641)	-0.1342** (0.0635)	-0.1528*** (0.0562)
D. Neighbourhood Safety				
Neighbourhood Safety	0.2288*** (0.0686)	0.4556 (0.2987)	0.3650*** (0.1004)	0.0441 (0.1006)
Log of Household Income	-0.1446*** (0.0406)	-0.2708 (0.1700)	-0.1254** (0.0631)	-0.1548*** (0.0558)
E. All Neighbourhood Indicators				
Social Cohesion	0.0914 (0.1786)	1.6385** (0.6347)	0.3233 (0.2758)	-0.2008 (0.2929)
Subjective Neighbourhood Quality	0.2493** (0.1182)	-0.7547 (0.5521)	0.3878** (0.1884)	0.2680* (0.1580)
Neighbourhood Safety	0.1813** (0.0739)	0.5976** (0.2875)	0.2916*** (0.1082)	0.0013 (0.1035)
Log of Household Income	-0.1420*** (0.0406)	-0.2516 (0.1688)	-0.1218* (0.0633)	-0.1540*** (0.0559)
N	50,784	11,441	19,051	20,292

Standard errors in parenthesis. * denotes coefficient significant at the 10% level. ** denotes that a coefficient is significant at the 5% level. *** denotes that a coefficient is significant at the 1% level. Other variables included in the regression are: the logarithm of the number of members in the household, the gender of the child, the age of the child, a dummy if the PMK is female, a dummy if the child lives in an urban area, a set of dummies controlling for the provinces, the mother's and father's ages at birth, a dummy indicating if the biological father is present in the household, a dummy indicating if the child primarily speaks one of Canada's official languages (English or French) at home, a dummy indicating if the child was born in Canada, a dummy indicating if the PMK owns the dwelling that the child resides in, a set of dummies for parents' education, an indicator of parents' employment status, and indicators for the PMK and spouse's subjective health score.

Table 3: Chronic Conditions (=1 if child has one or more chronic conditions)

	All Ages	Ages 10 to 15	Ages 5 to 9	Ages 1 to 4
F. Base Case (Income Only)				
Log of Household Income	-0.0113 (0.0149)	0.0448 (0.0312)	-0.0420* (0.0223)	-0.0231 (0.0235)
G. Social Cohesion				
Social Cohesion	0.1640* (0.0877)	0.0493 (0.2764)	-0.0038 (0.1642)	0.3006*** (0.1075)
Log of Household Income	-0.0108 (0.0150)	0.0448 (0.0312)	-0.0420* (0.0223)	-0.0216 (0.0235)
H. Subjective Neighbourhood Quality				
Subjective Neighbourhood Quality	0.0403 (0.0592)	0.0957 (0.1653)	0.0338 (0.0995)	0.0591 (0.0795)
Log of Household Income	-0.0109 (0.0150)	0.0456 (0.0312)	-0.0418* (0.0223)	-0.0225 (0.0235)
I. Neighbourhood Safety				
Neighbourhood Safety	0.1039*** (0.0310)	0.0785 (0.1110)	0.0514 (0.0458)	0.1566*** (0.0432)
Log of Household Income	-0.0093 (0.0150)	0.0455 (0.0312)	-0.0408* (0.0224)	-0.0191 (0.0236)
J. All Neighbourhood Indicators				
Social Cohesion	0.1327 (0.0886)	0.0410 (0.2751)	-0.0285 (0.1632)	0.2540** (0.1106)
Subjective Neighbourhood Quality	-0.0170 (0.0611)	0.0792 (0.1655)	0.0161 (0.1006)	-0.0506 (0.0849)
Neighbourhood Safety	0.1003*** (0.0317)	0.0714 (0.1110)	0.0509 (0.0464)	0.1485*** (0.0447)
Log of Household Income	-0.0091 (0.0150)	0.0461 (0.0312)	-0.0407* (0.0224)	-0.0186 (0.0236)
N	50,784	11,441	19,051	20,292

Standard errors in parenthesis. * denotes coefficient significant at the 10% level. ** denotes that a coefficient is significant at the 5% level. *** denotes that a coefficient is significant at the 1% level. Other variables included in the regression are: the logarithm of the number of members in the household, the gender of the child, the age of the child, a dummy if the PMK is female, a dummy if the child lives in an urban area, a set of dummies controlling for the provinces, the mother's and father's ages at birth, a dummy indicating if the biological father is present in the household, a dummy indicating if the child primarily speaks one of Canada's official languages (English or French) at home, a dummy indicating if the child was born in Canada, a dummy indicating if the PMK owns the dwelling that the child resides in, a set of dummies for parents' education, an indicator of parents' employment status, and indicators for the PMK and spouse's subjective health score.