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ORIGINAL RESEARCH

Does social capital flatten the social gradient in early childhood development? An ecological study of two provinces in Canada

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Abstract

Social capital is thought to buffer the negative effects of low income on health and thereby flatten the social gradient. Child development research on social capital has suggested that social networks of adults and children in a neighborhood may play a protective role in children's outcomes. Yet little is known about how this relationship applies to diverse developmental outcomes in early childhood. This study examines whether the presence of role model adults and the willingness of neighbors to help keep children safe moderates the relationship between neighborhood income and five developmental outcomes for children in kindergarten: (1) physical health and well-being, (2) social competence, (3) emotional maturity, (4) language and cognitive development, and (5) communication and general knowledge. We linked neighborhood-level data on child development from two Canadian provinces, British Columbia (BC, n = 100) and Ontario (n = 482), to neighborhood-level data on social capital from the Ontario Kindergarten Parent Survey, and the BC Social Capital Study; and income data from the 2006 Canadian Census. Multiple regression analyses were conducted to examine the main and interaction effects of social capital and income in relation to child development outcomes. In Ontario, higher levels of social capital were associated with better child outcomes on all five developmental domains. Similar trends were observed in BC. Higher levels of social capital flattened the income gradient in language and cognitive development in both provinces, and social competence in Ontario. Implications for research and practice are discussed.

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1 Introduction

The existence of a socioeconomic gradient in children's developmental outcomes is well established (Marmot et al., 1991). At the neighborhood level, differences in the average income have been estimated to account for between 45 and 50% of the variance in early childhood development (Hertzman, 2010), with children from poorer neighborhoods faring worse on a variety of outcomes, including behavioral adjustment, literacy and numeracy, motor functioning, and social skills and communication skills (Keating & Hertzman, 1999). The remainder of this variance may be accounted for by various other neighborhood factors, including social capital. Because development during the early years is predictive of success and good health in adulthood (Heckman, 2006; Jones et al., 2015), it is imperative to examine how such factors may be leveraged to mitigate the negative impacts of poverty on young children and families. This study examines whether social capital is one such protective factor or buffer (Uphoff et al., 2013).

Social capital has been variously defined in the theoretical literature. It has referred to the resources associated with the belonging to a social network (Bourdieu, 1986; Carpiano, 2006), the social organization that is achieved by social connection (J. S. Coleman, 1988), and the features of social organization (i.e., trust, norms, and networks) that facilitate collective action (Putnam, 1993). Defining social capital according to the formal and informal relationships between adults and children in a community, Coleman (1990) and Sampson (1999) elaborated on how social capital at the neighborhood level could benefit children. Neighborhoods in which parents share similar behavioral and attitudinal norms may facilitate parents' use of community resources to monitor and care for children, even in circumstances when family economic resources are scarce (Brooks-Gunn et al., 1993; Kohen et al., 1998). Frequent contact among residents in a neighborhood may mean that children have more role-models, sources of social support, and opportunities to learn prosocial behaviors. Relationships between local children and adults may also include adults employed in the area who do not necessarily live in the neighborhood, but who may nonetheless be role-models for children (Froiland et al., 2014; Leventhal & Brooks-Gunn, 2000; Sampson et al., 1999). Social and structural issues that occur alongside neighborhood poverty (e.g., population turnover, stigma, and ethnic minority and immigrant concentration), however, may interfere with the formation of collective norms and behaviours (Browning & Cagney, 2002; Sampson et al., 1999; Shaw & McKay, 1942). This "social disorganization" or inability for communities to realize common values and maintain social controls may negatively affect the well-being of residents and their children (Kohen et al., 2008; Sampson et al., 1999).

Across various studies, the evidence has tended to support a positive effect of social capital on children's development (Bubier et al., 2009; Froiland et al., 2014; Lima et al., 2010; Meisels, 1999; Minh et al., 2017; O'Campo et al., 2010; Odgers et al., 2009). There are, however, a number of gaps in the evidence. First, there is a dearth of studies examining whether social capital moderates the relationship between socioeconomic status and a variety of developmental outcomes. In their review, Vyncke et al. (2013) found only four studies, two of which were done in the USA, one in the UK, and the other in the Netherlands, that examined social capital as a moderator of the relationship between socioeconomic status and child and adolescent outcomes. Only two of these found a protective effect of social capital for children living in poor neighborhoods; both studies examined children's behavioral problems (Caughy et al., 2008; Odgers et al., 2009). While studies on adolescents published since have found significant protective effects on emotional outcomes, such

as life satisfaction (Buijs et al., 2016) and mental health (Nielsen et al., 2015), it is not clear whether the same effects would be observed in young children. One study examining children's life satisfaction and self-esteem found no moderating effects (Drukker et al., 2006). Second, the majority of the existing evidence comes from the USA and the UK. As such, it is unclear whether these effects generalize to other contexts where demographic, cultural, and policy differences may differently shape its relationship to childhood development. Third, perhaps due to the wide range of definitions of social capital, existing empirical studies vary on measures of social capital (Minh et al., 2017; Vyncke et al., 2013). Studies have used, for example, measures of greater community involvement with children (Caughy et al., 2008; Lima et al., 2010); social connections between children and adults in the community; and a higher likelihood of neighbors to intervene when children get into trouble (Sampson et al., 1997). Effect estimates are therefore difficult to compare across existing studies and testing of theoretical frameworks requires additional empirical evidence.

The mixed evidence on whether social capital buffers the effect of low-income has important implications given that many health interventions either implicitly or explicitly seek to directly strengthen social capital (e.g., support groups), or act through social capital as a means to improve health for those who may be economically disadvantaged (e.g., improve neighborhood walkability) (Villalonga-Olives et al., 2018). Evidence that speaks to how and to what extent social capital mitigates the effects of low-income across a variety of developmental outcomes is likely to contribute to knowledge about the effectiveness of such interventions in children. This paper therefore seeks to address the above knowledge gaps.

Through an ecological study of social capital within two large and diverse provinces in Canada, Ontario and British Columbia (BC), we examine: (1) the extent to which social capital is associated with early child development outcomes (physical health and wellbeing, social competence, emotional maturity, language and cognitive development, and communication and general knowledge); (2) whether it moderates the relationship between neighborhood income and early child development; and, (3) whether its effects are replicated across both provinces in this study. Higher levels of social capital are likely to be associated with lower rates of poor developmental outcomes in early childhood, and expected to flatten the social gradient in children's outcomes. In other words, the social gradient would be less steep for neighborhoods with higher levels of social capital.

2 Methods

2.1 Data sources

Our data came from the *Canadian Neighbourhoods and Early Child Development Study* (CanNECD) (Guhn et al., 2016). The CanNECD Study contains neighborhood-level data aggregated from population-based surveys of early childhood development for 12 out of all 13 Canadian provinces/territories, and linked with census and Canadian tax-filer data on socioeconomic indicators. For this study, we used the early childhood development data about children around age 5, collected under government mandate between 2007 and 2009 in the province of Ontario, and between 2009 and 2012 in BC (Guhn et al., 2016; Janus et al., 2018). In both provinces, all publicly-funded school districts were included. Participating jurisdictions collected data from all kindergarten teachers during February of the

kindergarten year (Janus et al., 2007). These data were then aggregated to the neighborhood level and linked to the 2005 tax-filer data and the 2006 Canadian Census data (which corresponds to household income in the year 2005). These years were chosen as they contained the closest available census data that preceded the early childhood collection data.

A detailed description of the development of a neighborhood definition has been published in Guhn et al. (2016). Briefly, we created custom-defined neighborhood boundaries that used census dissemination areas as "building blocks". Following guidelines for measurement reliability set by Forer et al. (2013, 2019), adjacent dissemination areas were combined where necessary to ensure that all neighborhoods had data on early childhood development from between 50 and 400 individual children. Neighborhood boundaries were validated through consultation with representatives from government, community organizations, and academic groups (Guhn et al., 2016).

For the present study, we linked the CanNECD data on early childhood development to data on social capital available for two of the largest provinces in Canada—Ontario and BC. Specifically, we used data from the (1) the Kindergarten Parent Survey (KPS) in Ontario; and (2) the British Columbia Social Capital Study conducted in BC (Fig. 1).

Kindergarten Parent Survey (KPS) The KPS was sent to parents of students attending kindergarten and returned on a voluntary basis to the Offord Centre for Child Studies at McMaster University. Data for the KPS were collected from 29 communities in ON in 2011/12, which included 583 neighborhoods out of a possible 796 using the boundaries in the CanNECD database (73%). The decision to participate in the KPS was made at the community level and while no clear pattern of participation could be discerned, it is worth noting that the sample did not include the largest city in Ontario. In the communities with full school board participation, the response rates ranged from 31 to 68% in the respective communities. The remaining 213 neighborhoods that did not participate in the KPS were
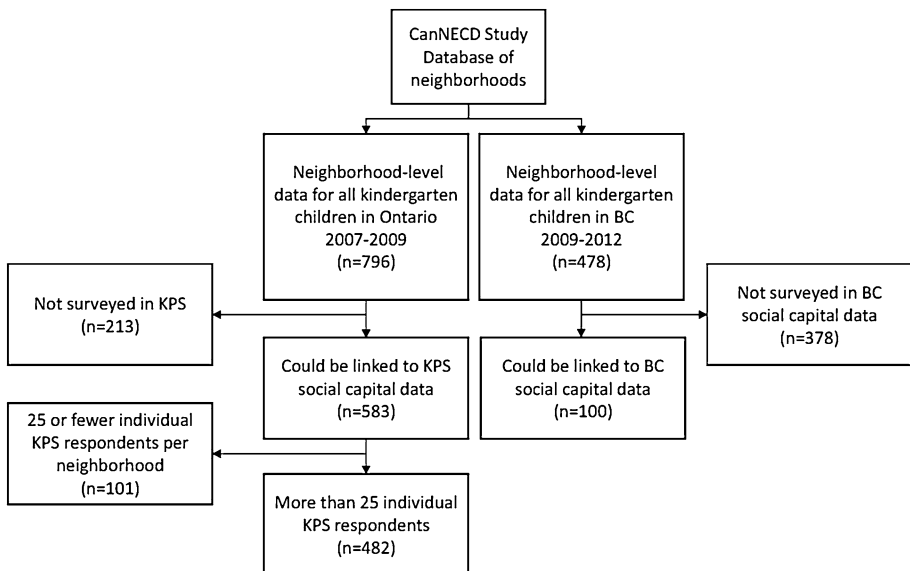
Fig. 1 Exclusion and inclusion criteria for the Canadian Neighbourhoods and Early Childhood Development (CanNECD) Study database of neighborhoods in British Columbia and Ontario. *KPS* Kindergarten Parent Survey; *BC* British Columbia

excluded from the sample. Out of 57,259 children for whom there were early childhood data in the CanNECD database, 25,555 (44.6%) also had data on the KPS, as provided by their parents or legal guardians. To minimize sampling error within neighborhoods, we followed prior research using aggregate measures of social capital to further exclude the 101 neighborhoods that had 25 or fewer respondents on the KPS (Martin & Newman, 2014), resulting in a final sample of 482 neighborhoods.

BC Social Capital Study. Neighborhoods in the 2009 BC Social Capital Study were selected according to a sampling framework described elsewhere (Kershaw et al., 2009) that aimed to produce a representative sample of developmental vulnerability at the neighborhood level in the province, with over-representation of rural neighborhoods. It used a sample of 100 neighborhoods (out of 478 in the CanNECD database) in BC. From each neighborhood, data on neighborhood social capital were collected using a phone survey from at least around 40 residents (min = 38, max = 56), for a total of 4540 individual respondents. Unlike with the KPS, having a child of a specific age at home was not a criterion for inclusion. Individual respondents were selected using random digit dialing and were eligible to participate if they were older than 19 years of age.

2.2 Measures

2.2.1 Early childhood development

Children's developmental outcomes were assessed with the Early Development Instrument (EDI) (Janus & Offord, 2007), a 103-item checklist completed by kindergarten teachers on every child in their classroom during the second half of the school year. In Canada, that is the year preceding Grade 1. The EDI has been used widely in population-level research on child development outcomes, with over 200 publications to date (Bibliography of the EDI, 2021), including numerous studies that specifically evaluated different aspects of validity (e.g., cross-cultural validity Brinkman et al., 2017; Duku et al., 2015), multilevel construct validity (Barry Forer & Zumbo, 2011), convergent and discriminant validity (Hymel et al., 2011)). The EDI measures five outcomes representing different domains of development: (1) physical health and well-being, (2) social competence, (3) emotional maturity, (4) language and cognitive development, and (5) communication skills. It has been validated for use in children aged 4 through 6 years of age. Based on the scores, children were categorized as either vulnerable or not in each one of the outcomes using validated pre-determined national 10th percentile values from a normative dataset (Janus & Duku, 2007). The percent of vulnerable children in a neighborhood was then used to represent neighborhood-level vulnerability for each of the five developmental outcomes.

2.2.2 Social capital

For the purposes of this study, we created a composite social capital variable from two questions common to the surveys in both provinces related to the presence of role model adults and the willingness of neighbors to help keep children safe. These two questions come from a broader list of five items developed by Sampson et al. (1999) relating to social connections and supports between children and adults (whether or not they are parents) in the neighborhood. Coleman (1988) first theorized that relationships between children, parents and other adults in a community, which he termed *intergenerational closure,* could influence children's outcomes. Studies have examined the relationship

between intergenerational closure and older children's educational outcomes (Carbonaro, 1998; Glanville et al., 2008; Hemmerechts et al., 2018). The first question was worded identically in Ontario and BC ("*There are adults in my neighborhood that children can look up to*"). The second question was very similarly worded in the two provinces ("*You can count on adults in my neighborhood to watch out that children are safe and don't get into trouble*" in Ontario, "*Adults in this local area can be counted on to watch out that children are safe and don't get into trouble*" in BC).

Individuals who responded to the KPS were asked to rate their agreement to each item on a 3-point scale (ranging from '*True*', '*Sometimes true*', to '*Not true*'). Individuals who responded to the BC Social Capital Study survey were asked to rate their agreement on a 5-point scale (ranging from '*Agree*' to '*Disagree*'). To be able to compare between provinces, we rescaled the individual responses from the BC Social Capital Survey to a scale ranging from 1 to 3. In following with other studies (Buijs et al., 2016; Odgers et al., 2009), individual level data on both surveys were aggregated up to the neighborhood level; the mean score on each item in the neighborhood was used. Last, we standardized the scores for each item by subtracting the provincial sample mean of each item from the value and dividing by the standard deviation. We summed the standardized scores to create a combined social capital score.

2.2.3 Neighborhood income

Neighborhood income was defined by the median family income based on the 2006 Census. Median income is frequently used to examine neighborhood poverty and affluence (van Vuuren et al., 2014).

2.2.4 Covariates

As covariates, we identified concepts that have been used in previous studies to reflect *neighborhood structural disadvantage.* Previous research has found that measures of neighborhood structural disadvantage that are related to neighborhood income level, both predict children's developmental outcomes (see van Vuuren et al., 2014 for a review), and influence social ties between neighbors in ways that support or undermine the community's capacity work towards shared goals, or regulate residents' behaviors (Sampson et al., 2002). We assessed four indicators: (i) Education: the percentage of those 25–64 with no high school diploma, (ii) Ethnic concentration: the percentage of individuals whose mother-tongues were neither English nor French (Canada's two official languages), (iii) Family structure: the percentage of individuals who were separated or divorced, and (iv) Residential instability: the percentage of individual non-migrant movers over 12 months (an indicator of residential stability). The percent of the population between the ages 0–4, a variable indicating the age distribution of the neighborhood, was additionally included as a potential confounder for the association between social capital and vulnerability rates in developmental health.

2.3 Analyses

We analyzed the datasets for BC and Ontario separately, using identical analytical techniques, given that the social capital data were collected with different target groups (a paper survey with parents of kindergarten children in Ontario; a phone survey with randomly selected adults in BC). First, we described the characteristics of the samples to assess potential selection bias, and to examine the comparability of the BC and Ontario samples. Group differences were examined using t-tests. Second, to examine the unadjusted association between each variable of interest, we estimated bivariate correlations using Pearson's correlation coefficient. Third, to examine the main and interaction effects by social capital on children's development we separately regressed each of the five developmental outcomes on neighborhood median income, social capital, and the study covariates. The baseline model (Model 1) contained only neighborhood median income to characterize the social gradient in each developmental outcome by income. Due to the potential non-linearity of the relationship between income and early childhood development (Case et al., 2008; Ecob & Davey Smith, 1999; Willms, 2003), we tested addition of the log-transformation of the neighborhood income variable in the model. Model 2 additionally included social capital to examine how social capital independently predicts each developmental outcome. In Model 3, we added the neighborhood structural characteristics to examine whether coefficients for neighborhood income and social capital were either no longer significant, substantially attenuated, increased or changed direction of association. Finally, we added an interaction between neighborhood income and social capital (Model 4). We assessed each model for collinearity by examining variance inflation factors (VIF ≥ 5) (Vittinghoff, 2005). A variance inflation factor (VIF) quantifies how much the variance of a model coefficient is inflated by the correlation with other independent variables in the model. Neighborhood income and social capital were centred in each model. All analyses were conducted using the *stats* package in R version 3.4.2 (R Core Team & contributors worldwide, 2017).

3 Results

3.1 Study sample and characteristics

There were some differences in the characteristics of the neighborhoods that were included in the Ontario sample and those that were excluded. Included neighborhoods had fewer non-official Canadian language speakers (-17.0%, $t = 16.8$, $df = 480.37$, $p < 0.0001$), a higher percentage of lone parents below the low-income measure (3.12%, $t = -3.77$, $df = 778$, $p < 0.001$), a higher proportion of separated or divorced individuals (0.7%, $t = -3.49$, $df = 794$, $p < 0.001$), a higher proportion of adults with less than high-school education (1.6%, $t = -3.24$, $df = 794$, $p < 0.01$), and a lower proportion of non-migrant movers in the past year (-2.6%, $t = 8.79$, $df = 576$, $p < 0.0001$).

By contrast, in the BC sample, there were no statistically significant differences between included and excluded neighborhoods on a number of socioeconomic variables including income, the percentage of individuals below low-income, the proportion with less than high school education, non-official language speakers, or marital status.

Table 1 Study variables for the Ontario and British Columbia neighborhoods in the sample

	Ontario (n = 482)				British Columbia (n = 100)				p (t-test)
	Min	Max	Mean	SD	Min	Max	Mean	SD	
Neighborhood variables									
Median family income, all economic families, 2006 ($CAD)	37,970	128,641	74,722	15,704	37,268	104,206	62,053	14,248	0.00
Percent whose mother tongue is not English or French, 2006	0.32	73.60	16.07	14.44	2.13	75.57	23.27	20.09	0.00
Percent separated or divorced, 2006	3.42	19.17	10.49	2.91	5.01	18.67	11.55	3.39	0.01
Percent of those 25–64 with no high school diploma, 2006	1.60	45.61	14.53	6.39	2.13	75.57	14.78	6.67	0.76
Percent of non-migrant movers in the past year, 2006	0.98	19.52	6.98	3.73	5.01	18.67	9.31	3.46	0.00
Percent lone parents, 2006			14.29	5.16	1.48	33.17	14.87	4.65	0.27
Percent population age 0–4	2.49	12.89		1.68	2.87	18.58	5.27	1.51	0.07
Social capital									
Role model adults*	1.03	1.95	1.61	0.17	1.23	1.76	1.52	0.10	0.00
Neighbors keep children safe*	0.98	1.94	1.50	0.16	1.04	1.73	1.43	0.12	0.00
Developmental vulnerability as measured by the EDI									
Percent vulnerable on physical health and well-being	1.03	35.29	11.77	5.89	0.00	32.08	12.26	7.17	0.54
Percent vulnerable on social competence	0.97	34.62	10.76	4.90	0.00	37.93	12.69	7.10	0.01
Percent vulnerable on emotional maturity	0.94	31.48	12.25	5.05	0.00	37.93	12.33	6.95	0.95
Percent vulnerable on language and cognitive development	0.61	29.63	6.74	4.08	0.00	31.65	10.08	7.01	0.00
Percent vulnerable on communication skills and general knowledge	0.00	40.74	12.43	5.31	1.85	36.49	13.16	7.55	0.38

EDI Early Development Instrument; *SD* standard deviation; *$CAD* Canadian dollars. *Scaled to value of 1–3, higher = better average rating

Table 1 shows the demographic composition, social capital, and degree of developmental vulnerability for the neighborhoods in the Ontario and BC samples. The descriptive results show that there are significant differences in the characteristics of neighborhoods between provinces. While the two provinces had comparable vulnerability rates across three developmental domains (physical health and well-being, emotional maturity, and communication skills and general knowledge), on average, neighborhoods in Ontario had lower vulnerability rates in the language and cognitive development and social competence domains. Neighborhoods in Ontario also had a higher median family income, fewer non-official Canadian language speakers, fewer separated/divorced individuals, and less residential instability on average compared with BC (see Table 1).

3.2 Main associations between social capital, neighborhood income, and early childhood development

The results of the bivariate analysis highlighted associations between neighborhood median income, social capital, and early childhood development. Specifically, there was a positive relationship between neighbourhood median income and neighborhood social capital in both Ontario (r: 0.11 and 0.25, respectively) and BC (r: 0.26 and 0.34). There were also significant positive associations between social capital and early childhood development outcomes, though the specific outcome for which associations were found differed between two provinces. The two indicators of social capital—the presence of role model adults, and the willingness of adults to keep children safe—were related to lower rates of vulnerability in all developmental outcomes in Ontario (r: -0.18 to -0.41), and in three out of five outcomes in BC: (1) social competence (r: -0.23 and -0.29, respectively), (2) language and cognitive development (r: -0.26 and -0.32), and (3) communication and general knowledge (r: -0.32 and -0.39).

The results of the multivariable regression for Ontario and BC are shown on five panels (one for each outcome) in Table 2. In these models, VIF values were all below 5, suggesting that multicollinearity was not a concern for these analyses. Partial F-tests and residual plots suggested that the models had a higher level of fit when median income was log-transformed as compared to the untransformed variable (results not shown), indicating progressively flattening slopes in the association between neighborhood median income and rates of developmental vulnerability as income increases. We therefore reported only results of models with using the transformed income variable.

The results of the multivariable regression showed first, that there is a social gradient in vulnerability across all developmental outcomes for both BC and Ontario such that lower neighborhood income was related to higher rates of developmental vulnerability (Table 2). Second, results showed that the association between social capital and developmental vulnerability varied between provinces and among outcomes (Table 2). In Ontario, social capital explained an additional proportion of variance in all five developmental outcomes, as indicated by the increase in the adjusted R-squared value. Specifically, higher levels of social capital were related to lower rates of vulnerability in all outcomes. After adjusting for the remaining covariates, the coefficient for social capital increased in models for four of the five developmental outcomes, physical health and wellbeing ($\beta = -1.98$; $t(473) = -6.16$, $p < 0.0001$), social competence ($\beta = -1.97$; $t(473) = -6.76$, $p < 0.0001$), emotional maturity ($\beta = -1.01$; $t(473) = -3.31$, $p = 0.001$), and language and cognitive development outcomes ($\beta = -0.86$; $t(473) = -3.28$, $p = 0.001$); and, decreased in the model for communication skills and general knowledge ($\beta = -1.32$; $t(473) = -4.12$, $p < 0.001$).

Table 2 Multivariable regression of EDI developmental vulnerability rates in British Columbia (BC) and Ontario

	BC								Ontario							
	Model 1		Model 2		Model 3		Model 4		Model 1		Model 2		Model 3		Model 4	
Physical health and wellbeing	b	SE	b	SE	b	SE	b	SE	b	SE	b	SE	b	SE	b	SE
Log-median income (per $1000)	−9.81*	3.12	−8.77*	3.33	1.89	5.36	2.25	5.30	−15.23*	1.07	−13.98*	1.05	−4.29*	1.98	−4.64*	1.99
Social capital			−0.70	0.78	−1.61+	0.94	−1.26	0.95			−1.38*	0.23	−1.98*	0.31	−1.93*	0.31
% non-official language speakers					−0.02	0.06	−0.02	0.06					−0.08*	0.03	−0.07*	0.03
% separated/ divorced					0.51	0.37	0.55	0.37					0.50*	0.14	0.47*	0.14
% no high school graduation					0.31*	0.15	0.31*	0.15					0.13*	0.05	0.12*	0.05
% non-migrant movers					0.16	0.25	0.13	0.25					0.06	0.08	0.03	0.08
% population under 5					0.35	0.66	0.33	0.65					0.09	0.15	0.08	0.15
interaction income/social capital							5.99+	3.34							1.58+	0.96
Adjusted R-squared	0.083		0.081		0.193		0.212		0.295		0.344		0.416		0.418	
Social competence																
Log-median income (per $1000)	−11.42*	3.03	−9.50*	3.20	2.38	5.28	2.56	5.28	−10.15*	0.96	−8.87*	0.93	−3.60*	1.79	−4.03*	1.79
Social capital			−1.29+	0.75	−1.60+	0.92	−1.42	0.94			−1.43	0.20	−1.97*	0.28	−1.91*	0.28
% non-official language speakers					0.07	0.06	0.06	0.06					−0.07*	0.02	−0.06*	0.02
% separated/divorced					0.97*	0.37	0.99*	0.37					0.27*	0.13	0.23+	0.13
% no high school graduation					0.14	0.15	0.14	0.15					0.02	0.05	0.01	0.05
% non-migrant movers					0.14	0.25	0.12	0.25					0.04	0.07	0.00	0.07
% population under 5					−0.11	0.65	−0.12	0.65					−0.07	0.14	−0.09	0.14
interaction income/social capital							3.03	3.33							1.89*	0.86

Table 2 (continued)

	BC								Ontario							
	Model 1		Model 2		Model 3		Model 4		Model 1		Model 2		Model 3		Model 4	
	b	SE	b	SE	b	SE	b	SE	b	SE	b	SE	b	SE	b	SE
Physical health and wellbeing																
Adjusted R-squared	0.118		0.135		0.202		0.200		0.188		0.264		0.314		0.319	
Emotional maturity																
Log-median income (per $1000)	−11.71*	2.94	−11.05*	3.15	−4.87	5.35	−4.59	5.32	−10.44*	0.99	−9.79*	0.99	−3.06	1.89	−3.19+	1.90
Social capital			−0.44	0.74	−0.90	0.94	−0.63	0.95			−0.71*	0.22	−1.01*	0.30	−0.99*	0.30
% non-official language speakers					0.00	0.06	0.00	0.06					−0.03	0.02	−0.03	0.02
% separated/ divorced					0.60	0.37	0.64+	0.37					0.55*	0.14	0.54*	0.14
% no high school graduation					0.03	0.15	0.03	0.15					0.00	0.05	0.00	0.05
% non-migrant movers					0.07	0.25	0.04	0.25					−0.01	0.07	−0.02	0.08
% population under 5					0.33	0.66	0.31	0.65					−0.17	0.14	−0.17	0.14
interaction income/ social capital							4.73	3.36							0.58	0.91
Adjusted R-squared	0.130		0.125		0.145		0.154		0.188		0.204		0.280		0.279	
Language and cognitive development																
Log-median income (per $1000)	−12.49*	2.94	−10.42*	3.09	0.42	4.96	0.80	4.88	−9.60*	0.77	−8.92*	0.77	−2.63+	1.49	−3.34*	1.47
Social capital			−1.39+	0.72	−2.16*	0.87	−1.80*	0.87			−0.76*	0.17	−0.86*	0.23	−0.76*	0.23
% non-official language speakers					0.00	0.06	−0.01	0.06					−0.02	0.02	−0.01	0.02
% separated/ divorced					0.42	0.35	0.46	0.34					0.33*	0.11	0.27*	0.11
% no high school graduation					0.35*	0.14	0.36*	0.14					0.11*	0.04	0.10*	0.04
% non-migrant movers					0.38	0.23	0.34	0.23					0.06	0.06	0.01	0.06
% population under 5					−0.77	0.61	−0.79	0.60					0.02	0.11	−0.01	0.11

Table 2 (continued)

	BC								Ontario							
	Model 1		Model 2		Model 3		Model 4		Model 1		Model 2		Model 3		Model 4	
	b	SE	b	SE	b	SE	b	SE	b	SE	b	SE	b	SE	b	SE
Physical health and wellbeing																
interaction income/ social capital							6.37*	3.08							3.17*	0.70
Adjusted R-squared		0.147		0.170		0.275		0.300		0.244		0.274		0.316		0.343
Communication skills and general knowledge																
Log-median income (per $1000)	−17.66*	2.95	−15.02*	3.07	−10.32*	5.11	−10.29	5.14	−9.44*	1.07	−7.73*	1.01	−0.05	1.97	−0.31	1.98
Social capital			−1.77*	0.72	−1.15	0.89	−1.12	0.92			−1.91*	0.22	−1.32*	0.31	−1.28*	0.31
% non-official language speakers					0.05	0.06	0.05	0.06					0.05+	0.02	0.05*	0.03
% separated/ divorced					−0.14	0.36	−0.14	0.36					0.30*	0.14	0.28*	0.14
% no high school graduation					0.25+	0.14	0.25+	0.14					0.22*	0.05	0.22*	0.05
% non-migrant movers					0.40	0.24	0.40	0.24					0.21*	0.08	0.19*	0.08
% population under 5					−0.31	0.63	−0.31	0.63					−0.13	0.15	−0.14	0.15
interaction income/social capital							0.46	3.24							1.18	0.95
Adjusted R-squared		0.261		0.297		0.339		0.332		0.138		0.253		0.297		0.297

BC (n = 100) and Ontario (n = 482). +$p < .10$; *$p < .05$

In BC, by contrast, social capital was only significantly associated with language and cognitive development after adjusting for all covariates ($\beta=-2.16$; $t(91)=-2.06$, $p=0.04$). There was some evidence of a negative relationship between social capital and two outcomes—physical health and wellbeing and social competence—but coefficients were not significant at an alpha of 0.05. We observed an association with children's communication skills and general knowledge but this effect was attenuated after adjustment.

3.3 Social capital as a moderator for neighborhood income

There were similarities between provinces in the interaction between income and social capital (Table 2). The interaction term was only significantly associated with vulnerability in language and cognitive development in both Ontario ($\beta=3.17$; $t(473)=4.50$, $p=0.01$), and in BC ($\beta=6.37$; $t(91)=2.07$, $p=0.04$). As can be seen in Fig. 2, the slope of the effect of median income and vulnerability rates in this outcome decreased as social capital increased. However, results also showed differences between provinces. In Ontario but not in BC, we found that the interaction term was significantly related to social competence ($\beta=1.89$; $t(473)=2.19$, $p=0.03$) (Table 2).

4 Discussion

Our study contributes evidence of the potential for social capital to flatten the social gradient between neighborhood income and early childhood development. We used representative datasets from two comparable populations, holistic measures of early child development, multiple data sources for neighborhood level measures, and sufficiently large numbers of neighborhoods to examine interaction effects with adequate statistical power. Similar to previous studies, our study demonstrated a social gradient across all five developmental outcomes in early childhood. We also found evidence to support an independent effect of two measures of social capital, the presence of role model adults and willingness of neighbors to help keep children safe, on developmental outcomes. Higher social capital was predictive of better language and cognitive development in both provinces. We also
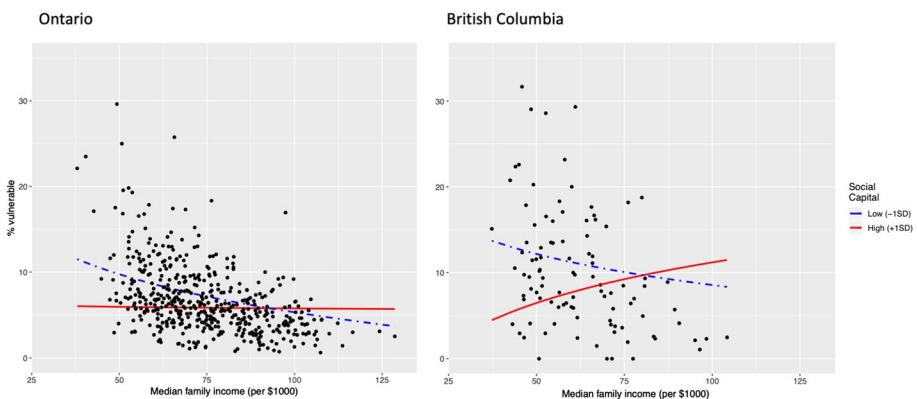
Fig. 2 Predicted rate of vulnerability in language and cognitive development by median family income (per $1000 increment) for different levels of social capital (one standard deviation [SD] above and below the mean), adjusted for neighborhood structural characteristics

found some evidence that social capital was positively associated with physical health and wellbeing and social competence across both provinces, though the effect was not significant at a 95% confidence level.

In addition, we found that in the areas of social competence (in Ontario) and in language and cognitive development (in both provinces), there was a significant interaction between social capital and neighborhood income such that the positive effect of social capital was stronger at lower-levels of income. These findings are consistent with research in the area of young children's behavioural problems (Odgers et al., 2009), showing that social capital has protective effects for children at the lower end of the socioeconomic spectrum.

However, our results did not support a general buffer effect of social capital against the negative impacts of low-income across all of the developmental outcomes that we investigated in the study. While we found a direct association between higher levels of social capital and lower rates of vulnerability in physical health, emotional maturity, and communication skills in Ontario, the interaction between social capital and neighborhood income was not statistically significant for these outcomes.

The current theoretical literature on social capital proposes an interplay between social capital and economic deprivation (Uphoff et al., 2013), but there are few hypotheses about why this protective effect may extend to some aspects of children's development but not others (Vyncke et al., 2013). Furthermore, few empirical studies have explicitly examined social capital and a variety of developmental outcomes. There is evidence, however, which suggests that social capital may operate on different outcomes through distinct mechanisms. In a smaller suburban at-risk sample in the USA, for example, Froiland et al. (2014) found that perceived neighborhood social networks had a positive indirect effect on home literacy and thus children's vocabulary skills. Meanwhile, Roosa et al. (2003) found that a poor neighborhood social environment impacted on children's undesirable behavioral and emotional outcomes by negatively influencing parents' perceptions of their neighborhoods as well as their parenting practices. Our findings would further suggest that while a higher level of social capital activates some mechanisms to protect against economic deprivation, such as greater home literacy, other intervening mechanisms may be less effective for flattening the gradient.

More research at the individual level is needed before definitive conclusions can be made about which developmental outcomes are most benefited by social capital and how. Nonetheless, the neighborhood level findings of this study add to the evidence of both the advantages as well as the limitations that social capital has for mitigating the effects of poverty. Social capital has potentially negative effects on behaviors and outcomes which may counterintuitively reinforce the effects of poverty (Portes & Landolt, 1996). It may impose demands for conformity (Arneil, 2006), for example, and lead to the reproduction of potentially unhealthy norms and behaviors (e.g., smoking; joining youth gangs) (Portes & Landolt, 1996). Others have found that buffer effects of social capital may be specific to certain points in the life course, with stronger effects for older than younger children, and may differ between developmental outcomes in early childhood (Riina et al., 2014). Poverty or structural disadvantage may have a greater influence on some areas of early childhood development, even where higher levels of social capital exist. Our findings suggest that the influence of income on physical, emotional, and communication domains of development may be less modifiable by social factors such as social capital. Solutions that address economic inequalities therefore remain important mechanisms for promoting equality in development as a whole.

Worth noting are several provincial differences in our results. In Ontario, social capital was found to moderate the relationship between income and social competence, whereas in

BC the estimate was not observed to be statistically significant. One possibility is that such provincial variability may be explained by methodological differences. First, the sample of neighborhoods in BC was restricted to 100, due to budget limitations associated with the social capital data collection, limiting the statistical power of the analyses. Second, reporting bias may have been present if parents of kindergarten children, the sole respondents for social capital data in Ontario (thus likely within a certain age rage), perceived social capital differently than the general population, who represent the sample for the social capital data for BC. However, previous studies have not found there to be significant differences between the levels of social capital reported by parents and non-parents (Parker, 2010). Third, the sampling strategy differed between the two provinces. In BC, the demographics for the social capital survey data were representative for the overall population of BC. The Ontario sample included more than 70% of all neighborhoods in the province, but the sample was less ethnically diverse and more socio-economically disadvantaged than the overall Ontario population. More Canadian and international studies may be needed to understand to what extent differences in the socioeconomic, and socio-cultural composition of neighborhoods may be associated with differences in the association between social capital indicators and child development outcomes.

Aside from the difference in sampling between the neighborhoods, effect differences between contexts (in this case, provinces) raise the question of whether potential developmental effects of social capital are generalizable across broader social contexts and developmental outcomes. For example, Ontario and BC differ with regards to the availability of non-profit or public child care, and provincial spending on child care subsidies (Pasolli, 2015). Shiell et al. (2020) suggest a need to critically examine how effectively social capital should be expected to function within these different systems of redistribution. Neighborhood social capital may be less effective at supporting children's development in contexts where such social protections are comparably lacking. In order to test such a hypothesis, however, it would be necessary to examine neighborhoods effects within larger ecological systems impacting the development of children (Bronfenbrenner, 1979; Bronfenbrenner & Morris, 2007). For example, Singh et al. (2008) suggest that state-level policies may be crucial for explaining state-based differences in the prevalence of childhood obesity and its association with individual and neighborhood characteristics. Results from this study also mirror evidence of jurisdictional differences between the slope and strength the association between neighborhood SES and children's development in Canada (Barry Forer et al., 2019; Webb et al., 2017). Still, the broader macro-social determinants, particularly regional and provincial systems (e.g., the economy, social safety nets, the labor market, and the ways they produce or reinforce hierarchies of power) have rarely been taken into account in the social capital and child development research (Minh et al., 2017; Muntaner, 2004). Future research able to more systematically capture regional and provincial differences, in addition to neighborhood differences, may (1) help to explain provincial variation in outcomes and (2) offer greater insight into the *interacting* systems in which children develop.

This study has a number of limitations. First, our data are ecological, meaning that we cannot make inferences about the relationship between neighborhood poverty and child development at the individual level. Even though our sampling units were neighborhoods, it would have been useful to estimate family-level differences between participants and non-participants in the surveys that provided the social capital data, which we were not able to do. Future research should aim to replicate our findings using multilevel analytic techniques. Second, we were unable to distinguish selection effects from the causal effects of the neighborhood conditions, because we were limited to using cross-sectional data. Families with certain characteristics that influence child developmental health may

self-select into certain neighborhoods, thus producing the associations that we observed. We attempted to address this issue by using census data to control for potential compositional differences between neighborhoods. Third, our study uses administratively defined boundaries to assess neighborhood-level measures which may or may not reflect the contexts within which phenomena such as social capital occur. As such, this approach may introduce issues of measurement validity or may misclassify individuals' neighborhood-level exposures and outcomes. Future research may wish to examine if findings hold across a variety of neighborhood specifications, including subjective neighborhood boundaries or fuzzy neighborhood delimitations (Chaix et al., 2009). Fourth, our findings may be specific to the two dimensions of social capital that we investigated (i.e., the presence of role models, and the willingness of neighbors to help keep children safe). Due to the differences in the social capital measures collected across provinces, we did not have consistent data to capture the concept of social capital more broadly for this study (Sampson et al., 1999). Future research should attempt to replicate our findings using a wider breadth of social capital indicators. Finally, our findings may be vulnerable to selection bias as kindergarten attendance is not compulsory in either province in this study. However, given that majority of five-year old children in both provinces attended kindergarten during the study period (87.4% in BC and 88.9% in Ontario in 2008) (Beach et al., 2009), self-selection into kindergarten is not expected to substantially affect the results.

5 Conclusion

This study found differences in the protective role of social capital in children's development across domains and provincial contexts. While more research is needed to examine whether the patterns found in this study are also present across other child development outcomes, and to understand how macrosocial determinants shape developmental health inequalities, the findings do offer important insights for research and intervention regarding neighborhood-level indicators of social capital. This study supports the theory that high levels of social capital are related to better developmental health across early childhood development in general. Further, our findings suggest that social capital may buffer against economic deprivation, or in other words may help to flatten the gradient, for a number of outcomes in early childhood. However, our findings call into question whether this association may be generalizable across all aspects of development and social contexts. Together, our findings reinforce the critical role that efforts to stem social and economic disadvantage have, in addition to social capital interventions, within population intervention strategies to holistically address inequality in developmental health.

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