The differential association of socioeconomic vulnerabilities and neglect-related child protection involvement across geographies: Multilevel structural equation modeling

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ABSTRACT

Background/Purpose: This paper explores the use of social geographic data and multilevel latent modeling to make initial predictions on geographic variation in child protection involvement for reasons of neglect, resulting in novel findings regarding the relationship between poverty and neglect in low-density geographies in the province of Quebec, Canada.

Method: This study used multilevel structural equation modeling, which combines both structural equation modeling and multilevel modeling, to test how a latent construct of socioeconomic vulnerability – across 10,650 small area geographies and 166 community health and social service regions in Quebec – is connected to child protection intervention for neglect in child population density quintiles across these geographies. Small area geographies and health and social service regions in this study are defined and discretely organized using full six digit postal codes and larger community regions provincially defined according to the public social and health services administered by the province. Full alphanumeric postal codes allow for more granular analysis than studies using only the first three digits. The rate of substantiated neglect cases is calculated per 1000 children aged 0–9 years, for the years 2006 to 2016, inclusively. The socioeconomic data for each of the small area geographies and health and social service regions was drawn from the 2011 Canadian National Household Survey and then matched to provincial administrative child protection data using full alphanumeric postal codes allowing for more granular analysis than studies using only the first three digits. Model fit evaluations (comparative fit index and Tucker-Lewis index) were conducted and results suggested acceptable model fit.

Results: Overall results suggest a consistent association between socioeconomic vulnerability and the increased likelihood of child protection involvement for reasons of neglect. However, latent socioeconomic factors were most associated with neglect cases in the lowest density small area geographies, suggesting that increased vulnerability to investigation for neglect is related to a sparse geographic spread of the child population.

Conclusions/Implications: The association between socioeconomic vulnerability and neglect is not surprising, but the fact that this relationship varies in strength according to child population density is a novel finding. The finding of greatest association between socioeconomic vulnerability and neglect in the lowest density small area geographies suggests that more research should be done to explore the ways that population density may relate to the likelihood of exceptional involvement by child protection authorities for neglect. Implications of this study for policymaking intended to prevent neglect, particularly related to chronic need, include the importance of

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taking a tailored approach to preventative service provision in small area geographies with lower child population densities, considering the challenges families face in more remote areas in accessing appropriate supports.

1. Introduction

In North America, substantiated child neglect cases involve intervention by child protection authorities due to a variety of unmet material, relational, or supervisory needs (e.g., Garbarino & Collins, 1999; Korbin et al., 2000; Newton, 2017), according to varied legislative definitions of neglect across jurisdictions (Kobulsky, Dubowitz, & Xu, 2019). A large majority of child protection cases in Canada relate to chronic need rather than "urgent" safety concerns (Trocmé et al., 2014), indicating ongoing unmet needs in these families. Poverty at individual and neighbourhood levels is shown to correlate with child protection involvement for families in many jurisdictions (e.g., Bywaters et al., 2016; Esposito et al., 2017; Lefebvre, Fallon, Van Wert, & Filippelli, 2017; Maguire-Jack & Font, 2017; Webb, Bywaters, Scourfield, McCartan et al., 2020). Specifically, poverty is demonstrably linked to higher risk of neglect-related involvement with child protection (Berger, 2007; Bywaters et al., 2016; Fluke et al., 2008; Lloyd & Kepple, 2017; Sedlak et al., 2010; Slack et al., 2011; Trocmé et al., 2013). Poor families are also more likely to experience recurrent involvement with child protection systems (Cheng & Lo, 2015; Connell et al., 2007) and neglect-driven out-of-home placement (Walsh, 2010) than more socioeconomically stable families. However, socioeconomic factors are shown to differentially interact with ethnoracial factors to explain child protection involvement across geographic areas (Webb, Bywaters, Scourfield, Davidson, & Bunting, 2020). Risk of neglect is highest for younger children (e.g., Clément, Bérubé, & Chamberland, 2016; Wildeman et al., 2014). Neglect cases are also shown to be the most common reason for recurrence of child protection involvement (Brooks-Gunn, Schneider, Waldfogel, 2013; Drake & Pandey, 1996; Esposito et al., 2021; Jonson-Reid et al., 2019; Lefebvre et al., 2017; Slack et al., 2011). These patterns of neglect- and poverty-driven child protection involvement are reflected in recent analyses conducted in the Canadian province of Quebec, which is the focus of the present study. More specifically, this study examines the relationship between poverty and neglect across different geographic regions in Quebec.

Families face a higher risk of neglect-driven child protection involvement for many reasons including caregiver-level challenges and social factors, which can be compounded by economic hardship (Chambers & Potter, 2009; Gaudin et al., 1993; Frame, 2001; Lefebvre et al., 2017; Schumacher et al., 2001). The presence of positive supports around families – both informal social connections and formal social services – is demonstrated to reduce families' involvement with child protection systems (e.g., Coulton et al., 2007; Maguire-Jack & Show-alter, 2016; Molnar et al., 2016). Informal social networks including friends and neighbours can provide "affective and instrumental support" to parents and can reduce risk of child protection involvement for reasons of neglect in particular (Zolotor & Runyan, 2006, p. 1125; see also Fluke et al., 2018; Maguire-Jack & Showalter, 2016). Conversely, a lack of supports, such as scant or unaffordable child care options, is shown to make some families more vulnerable to child protection involvement (e.g., DePanfilis & Zuravin, 1999; Merritt, 2009). Higher involvement with child protection systems is explained in some studies to be a last-resort mechanism for getting families needed support where services have not been available or accessible. Where needs are high and both formal and informal supports are inaccessible or absent, struggling families become more vulnerable to involvement with child protection for reasons of neglect.

Because studies show that numerous factors beyond the household are important for measuring risk of involvement with child protection systems, the use of social geographic analysis can help explain how and why neglect cases emerge in certain geographies and not others

(Freisthler, 2004; Freisthler, Merritt, & LaScala, 2006; Freisthler et al., 2007; Hillier, 2007; Radke & Mu, 2000; Robertson & Weir, 1998). For example, Paulsen (2003) examined the structural characteristics of neighbourhoods where neglect is concentrated in Charlotte, North Carolina, finding that neglect was most densely concentrated within a few localized pockets located close together, compared with less dense pockets of other forms of maltreatment that were more widely dispersed over the city. Lery (2009) found that neighbourhood-level childcare burden, impoverishment, and residential instability correlated with higher risk of out-of-home placement in California, measured at three different geographic scales (census blocks, census tracts, and ZIP codes). Specifically, for families involved with the youth protection system in Quebec (the jurisdictional focus of the present study), neighbourhood area socioeconomic disadvantages are associated with higher rates of out-of-home placements (Esposito et al., 2017a) and lower rates of subsequent family reunification (Esposito et al., 2014; Esposito et al., 2017b). Studies at these geographic scales allow us to capture information that is not readily available at the child and family level, illustrating both clustering of vulnerabilities and factors relevant to allocation of services.

While many relevant aspects of the neighbourhoods and contexts around families can be difficult to conceptualize and measure, others are more easily documented through objectively measured indicators. Several studies have found that population density rates can have a differential impact on child maltreatment reporting, open cases, socio-economic needs, and related services (e.g., Beatriz et al., 2018; Molnar et al., 2016; Sedlak et al., 2010). This may be explained by the nature of the challenges families face in accessing services to meet their needs, which can be different depending on population density. Families in more rural areas – less densely populated geographies – can face unique challenges related to the interaction between specific needs and a lack of available supports such as addiction treatment (e.g., Brown, Goodin, & Talbert, 2018), and specialized medical services (Hanlon, Burstein, Masters, & Zhang, 2012; Holzer, Goldsmith, & Ciarlo, 2000; Van Spijker et al., 2019). The structural factors in rural areas creating families' need for services (e.g., lack of public transit, and poor mobile phone and internet service) may create barriers to accessing them even when they do exist (Child Welfare Information Gateway, 2018; McCoy et al., 2016). Lower population density has been found to be associated with higher levels of racial disparity in maltreatment rates in some U.S. counties (e.g., Maguire-Jack et al., 2015). The aim of this study is to examine how the relationship between poverty and neglect cases may vary across areas of Quebec with different population density. In undertaking this study, our hope is that the results can inform more granular research questions related to population density and child protection involvement driven by a relationship between poverty and neglect.

In contrast to supportive health and social services, child protection intervention occurs *exceptionally* – when concerns regarding abuse or neglect are reported. Neglect, which is conceptually, practically, and legally distinct from abuse (e.g., Garbarino & Collins, 1999), often arises when formal or informal supports fail to scaffold families. It has been described as an act of "omission," in which gaps in basic needs eventually lead to a child protection report (Garbarino & Collins, 1999, p. 2). Many recent studies suggest that addressing chronic needs could reduce neglect-driven child protection involvement (Rothwell et al., 2014; Trocmé et al., 2014). Generally, supportive services are more readily available in more densely populated areas and less available in more remote and rural areas with lower population density (e.g., Belanger & Stone, 2008; Zimbelman, 2018). Accordingly, in this study we rely on child population density to as a pseudo-indicator of support service availability and accessibility. In the absence of strong indicators of

service accessibility in available data for the province of Quebec, this variable serves as a proxy for the level of support that may be available to families.

Neglect presents a complex challenge to child protection authorities whose agency mandates and funding tend not to extend to the socio-economic problems that may make families vulnerable to investigation (Bae et al., 2007, 2009, 2010; Casanueva et al., 2015; Connell et al., 2007; Jenkins et al., 2018; Morris, et al. 2018; Putnam-Hornstein et al., 2015). When workers plan interventions for families investigated for neglect, they may be unable to help reduce these underlying socioeconomic vulnerabilities due to a general lack of local, accessible resources (Duva & Metzger, 2010). While the link between poverty and neglect is well documented, there is inadequate understanding of the nature of this relationship (e.g., Carter & Myers, 2007; Frame, 2001; Hearn, 2011), nor is there an understanding of how population density relates to these factors, limiting the extent to which policy interventions may be designed to appropriately address it.

While there has been increasing interest in social interventions aimed at improving conditions of socioeconomically disadvantaged communities, rigorous studies using population-based data to understand the nature of localized child protection involvement are limited (Lefebvre et al., 2017). Understanding how local access to preventative supports relates to family needs may be crucial for reducing child protection involvement, particularly for neglect reasons. Further exploration of how and why some families face increased chances of neglect-related child protection involvement is needed to develop localized policy aimed at mitigating this risk. In particular, it is important to go beyond a rural–urban dichotomy in geographic studies in order to study population density in a more granular way (e.g., Fassio et al., 2013). Distinguishing among areas of varying population density is necessary for precision in understanding local challenges and needs, which may in turn inform more effective allocation of resources to address them (Albert & Barth, 1996). For example, some remote incorporated communities have a dense population but are far from other dense areas and would not be considered "urban" so it is important to note these distinctions. For example, if we had relied on an "urban–rural" dichotomy, we would not capture semi-urban or semi-rural areas. Arguably, had more granular data been available, more precision than we have in the present study would provide even more precise results.

Responding to the limited knowledge in this area, this study describes the creation of a population-based composite index of child-based socioeconomic vulnerabilities in Quebec, and the point at which this index supports intial predictions of localized variations in child protection service involvement for reasons of neglect. Outside of Montreal and Quebec city, the province of Quebec is quite rural, with small cities acting as local hubs in the regions outside the two large municipalities.[1] In the past there have been challenges to delivering services in more remote regions related to delayed follow-up to child protection reports, exacerbated by understaffing (CBC News, 2019). Remote Indigenous populations are subject to a complicated set of provincially- and federally-funded health and social services which are chronically under-funded (e.g., Barrera, 2020). Children removed from their families in these communities are often also removed from the communities themselves due to a lack of local services or approved foster homes (e.g., The Jordan's Principle Working Group, 2015). While Quebec has highly subsidized daycare (MacDonald, 2018), child tax benefits beyond those

offered federally (Retraite Québec, 2020), and paid parental leave policies (Commission des normes, de l'équité, de la santé et de la sécurité du travail, 2020), access to services and assistance from benefits can vary widely from family to family and region to region.

This study aims to add to a wide body of methodological approaches to measure factors relevant to health and social service accessibility (e. g., Bauer & Groneberg, 2016; Jack, 2011; Wu & Tseng, 2018), and in so doing to contribute findings on poorly understood and under-acknowledged structural neighborhood factors associated with neglect. While complex spatial indicators of service accessibility have not been measured in Quebec, analyses using the measure of population density used in this study could undergird such a measure in the future. By analyzing a latent construct of socioeconomic vulnerability with levels of neglect cases and child population density in different regions of Quebec, it is possible to examine both clustering of risk and opportunities for hyper-localized preventative health and social services to minimize child protection involvement for families. Because administrative child protection data does not capture any measure of poverty and income measures are often missing, use of this latent construct allows us to consider multiple facets of family vulnerabilities beyond parental capacity (a common lens through which neglect is framed in legislation), as well as adjust for relative socioeconomic vulnerability across social geographies (e.g., Spicker, 2007). Studying interactions between population density and structural disadvantage can provide an opportunity to design subsequent studies of allocation and sustainability of child and family support services, particularly in more remote or less densely populated areas, and where poverty can compound a lack of services more profoundly. We propose that measuring variation in characteristics across highly localized geographies (Coulton, Korbin, Su, & Chow, 1995; Coulton, Crampton, Irwin, Spilsbury, & Korbin, 2007; Freisthler, Merritt, & LaScala, 2006) may help researchers, practitioners, and policymakers understand the nuanced factors that shape a family's immediate environment that can create or mitigate risk of neglect-driven child protection involvement.

2. Method

Small area geographies and health and social service regions in this study are defined and discretely organized using provincial and municipal boundaries relating to the organization and delivery of government services. Specifically, we examined administrative child protection data across 10,650 small area geographies using full six digit postal codes within Quebec's 166 community health and social service regions, which are used to delineate public health and social service delivery areas across the province in local community health centers (*Centre locale de services communautaires;* CLSC). Using multilevel structural equation modeling (MSEM), which combines structural equation modeling (SEM) and multilevel modeling (MLM), we used a latent construct of socioeconomic vulnerability to examine child protection involvement for reasons of neglect across small area geographies in Quebec.

The administrative child protection data in Quebec, drawn from the 166 socio-health regions in the province, were defined by community identification codes and included full alphanumeric postal codes (e.g., X1X 1X1). The postal codes were used to link the administrative data to socioeconomic data from Quebec's 10,650 census dissemination areas (DA). The DA is children's immediate living environment at the time of the substanted maltreatment concern and reflects the smallest unit of census population data available, representing between 400 and 700 individuals. In a city, a DA might be as granular as a large apartment building, townhouse complex, city block, or cul-de-sac, while in a rural area the DA might be much larger. Socioeconomic data at the DA-level included variables which were used to build the latent socioeconomic vulnerability construct. The latent socioeconomic vulnerability construct is a model of the relationship among five observed variables of economic and social constructs (Bartholomew, Knott, & Moustaki,

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2011). This construct was developed based on prior development of a material and social deprivation index in Quebec (Pampalon et al., 2012) which used census data from all DAs in the province and has since been validated through principal component analysis and used in studies of child and family services in the province (Esposito, Roy, Chabot, & Trocmé, 2017). In this study, we adapted the index to include census data regarding individual income, family income, household income, unemployment, and parents' education level.

Modeling showed how the latent construct of socioeconomic vulnerability is associated with higher rates per thousand of child protection involvement for reasons of neglect. We hypothesized that the density of child population by size of the CLSC territory—and concomitant resource gaps within territories—differentially influences neighbourhood factors in rates (per thousand) of child protection involvement for reasons of neglect (see Fig. 1).

3. Analytic model

The rate of child protection involvement for reasons of neglect was the dependent variable in this study. Rates per 1000 children aged 0 to 9 years by neighbourhood dissemination area were calculated from 2006 to 2016, when there was a substantiated allegation of neglect leading to ongoing child protection involvement for reasons of a) physical, material, or health neglect, b) emotional neglect, c) school neglect, or d) parent high-risk lifestyle. These neglect definitions reflect the way in which these data are coded in the administrative system: category (a) includes three neglect types which were grouped conceptually as they all relate to socioeconomic vulnerability and sometimes overlap. The decision to focus on children aged 0–9 years old was made based on previous findings that neglect is shown to disproportionately impact younger children: had we included all children (0–17), granular focus on the risk of neglect would have diluted our analysis (Esposito et al., 2017a). The average provincial rate of child protection involvement for reasons of neglect over a 10-year period across neighbourhood dissemination areas was 13.25 (SD 28.4) per 1000 children aged 0 to 9 years, with a variation in rates across neighbourhood dissemination areas ranging from a low of 0.9474 to a high of 218.18. The measurement and structural model were estimated using Mplus 7. The analytic model does not accommodate time variation as the census data are cross sectional and collected only every five years.

The latent construct of socioeconomic vulnerability was modeled at the neighbourhood level with first-level indicators drawn from the 2011 Canadian National Household Survey: median income of individuals 15 years and over, median family income, median household income, the average population aged 15 years and over that are inactive or unemployed and the average population aged 15 years and over that do not possess a secondary school diploma. Using individual, household, and family income levels acknowledges that family members do not always live in the same household, and households are not always comprised of family members. Accordingly, these three measures give a more holistic picture of the income that may be available to support children and the people around them.

The three income indicators were transformed prior to normalizing using logarithm base 10 by subtracting each median income by the maximum provincial value so that each unit increase represents an increase in income vulnerability which was subsequently standardized using logarithm base 10 allowing for a normal distrution across Quebec on all income measures. Lastly, we measured child population density at the community level as the number of children aged 0–17 years per square kilometer. The child population density variables were derived using child population data provided by the Ministère de la Santé et des Services Sociaux (Quebec's health and social services ministry) and geographic size drawn from ArcGIS shape files for the province of Quebec. Using the latent covariate approach, a two-level regression model was specified (following Hox, Maas, & Brinkhuis, 2010), as:

$$Y_W = \wedge_W \eta_W + \varepsilon_W$$

$$\mu_B = \mu + \wedge_B \eta_B + \varepsilon_B \tag{1}$$

where μ_B were the random intercepts for covariates Y_W. The first modeled within dissemination area variation whereas the second equation modeled between-CLSC variation. By combining the two equations, we obtained.

$$Y_{ij} = \mu + \wedge_W \eta_W + \wedge_B \eta_B + \varepsilon_B + \varepsilon_W \tag{2}$$

In equation (2), μ represented group level means, $\wedge_W$ was the factor matrix at the dissemination-level, $\wedge_B$ was the factor matrix at the between CLSC level, and ε_W and ε_B represented residual errors at the dissemination and the broader CLSC level. The structure of the final equation followed a simple random effects intercept regression model with fixed first-level regression coefficients.

Last, a confirmatory factor analysis with oblique rotations of the five indicators that made up the latent construct of socioeconomic vulnerability in the multilevel regression model was used to combine all measures into a single construct, yielding a standardized socioeconomic score for each of the 10,650 small area geographies within the 166 health and social service communities in the province. The index produced a Kaiser-Meyer-Olkin sample adequacy score of 0.912; a Bartlett's
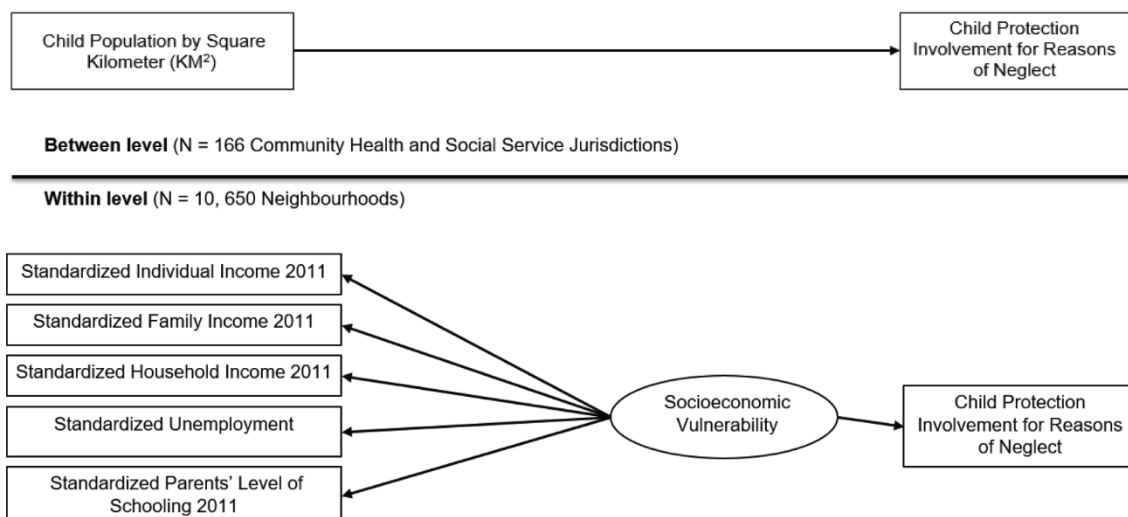

Fig. 1. Conceptual model of predictors of socioeconomic vulnerability. The oval represents latent variable and rectangles represent directly measurable variables.

test of sphericity of P <.000 and a sum of squared loadings of 78.34, all confirming the robust creation of a socioeconomic vulnerability index used to predict the increased probability of child protection involvement for neglect. A series of linear regressions was used to understand how the relationship between socioeconomic vulnerability and child protection involvement for neglect varied by quintiles of child population density per square kilometer (see Fig. 2 in the following section). To evaluate model fit, the comparative fit index (CFI) and the Tucker-Lewis index (TLI) were estimated to account for the total variance in the model; CFI values of the null and final model were greater than 0.93 and TLI were greater than 0.90, suggesting desirable model fit.

4. Results

Results of our analysis illustrated significant relationships among socioeconomic variables, child population density, and neglect-related child protection involvement in Quebec. First, results from the multi-level structural equation model revealed that at the neighbourhood measures of individual-, family-, and household-income, unemployment, and lack of high school were all significantly related to the latent construct of socioeconomic vulnerability (Table 1).

We found a highly significant link between the neighbourhood latent construct of socioeconomic vulnerability and child protection involvement for reasons of neglect. There was also a significant association between the density of children per square kilometer and child protection involvement for reasons of neglect, reducing the residual variance estimate by 36.5%: as the density of child population decreased, the rates of child protection involvement for reasons of neglect increased (see Fig. 2). The average rate of child protection involvement for reasons of neglect in the least child populated small area geographies was 27.1 per thousand, which is 4.4 times greater than the average rate (6.1 per thousand children) in the most densely populated small area geographies in the province (Fig. 2).

Importantly, as population density decreased, the linear relationship between the latent socioeconomic vulnerability construct and the likelihood of neglect-related child protection involvement became stronger (Table 2).

Table 2 (below) illustrates variations in the strength of the relationship between neglect and socioeconomic vulnerability, showing the strongest association in the least populated small area geographies

which was confirmed in the structural equation multilevel modeling estimate (Table 1). The adjusted explained variance between socioeconomic vulnerability and child protection involvement for reasons of neglect ranges from a high of 21.7% in the least populated small area geographies to a low of 2.7% in the most densely populated small area geographies. The decreasing coefficient estimates are also directly related to the reduction in R^2.

5. Discussion

The results of this study illustrate highly localized intersections of poverty- and neglect-related child protection intervention that vary by child population density. Our results confirm past findings that a variety of social and economic factors increase risk of child protection involvement for reasons of neglect (Dubowitz, Pitts, & Black, 2004; Garbarino & Collins, 1999; Korbin et al., 2000; Lacharité, 2014). This is not surprising given "neglect" can entail a wide range of social and economic gaps around families (e.g., Garbarino & Collins, 1999). However, our finding that child population density may modify this relationship is, to our knowledge, novel. Following previous findings that external factors can influence child protection decision making (Fluke et al., 2014; Graham et al., 2015; Stoddart et al., 2018), our finding that lower density areas may exacerbate the risk of poverty-driven neglect suggests that more precise understanding of the geographic factors around families is needed.

Limitations of our analysis should be noted before we elaborate our discussion. In particular, prior studies have indicated differences in child protection involvement across certain racial or ethnic groups—particularly Indigenous and black families—within given geographic areas (Kim, Drake, & Jonson-Reid, 2020; Webb et al., 2020b). Findings on race and child welfare decision making suggest that factors beyond race (such as socioeconomic and geographic factors) are also in part explanatory. Disproportionate representation of black and Indigenous children in child protection has been explained by a constellation of factors related to environmental risk and caseworker and agency decision making (e.g., Dettlaff et al., 2011; Fallon et al., 2015; Fluke et al., 2010). In this study, it was not possible to conduct analysis at the level of ethnic group membership due to inadequate data at the level of geographic analysis used in this study. Given this limitation, our findings should be interpreted with the understanding that certain low
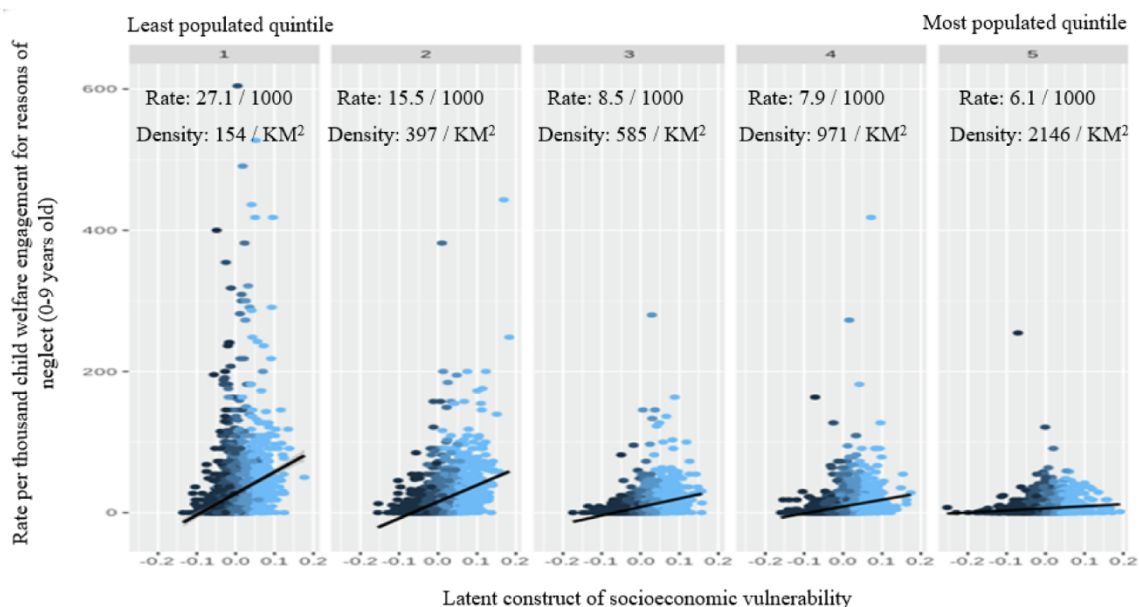

Fig. 2. Relationship between socioeconomic vulnerability and the rate of child protection involvement for neglect for children aged 0 to 9 years by child population density per square kilometer.

Table 1
Multilevel structural equation modeling of child protection involvement for reasons of neglect for children aged 0 to 9 years.

	Null model				Final Model			
Level 1								
(N = 10,650 small area geographies)	Beta	SE	t	P	Beta	SE	T	P
Individual measures on latent construct of socioeconomic vulnerability:								
Lack of high school diploma (ref)	1	–	–	–	1	–	–	–
Unemployment parents	1.168	0.056	20.77	0.000	1.168	0.056	20.76	0.000
Individual income	1.746	0.101	17.32	0.000	1.746	0.101	17.32	0.000
Family income	2.021	0.114	17.79	0.000	2.021	0.114	17.79	0.000
Household income	2.476	0.138	17.88	0.000	2.476	0.138	17.88	0.000
Latent construct of socioeconomic vulnerability on neglect	113.48	9.08	12.49	0.000	114.43	9.14	12.51	0.000
Level 2								
(N = 166 health and social service communities)					**Final Model**			
Average child population by square kilometer (KM^2) (2006 to 2016)								
					−1.439	0.217	−6.64	0.000
Residual Variance	**Null model**				**Final Model**			
Residual variance estimate (V^0 Null model and V^1 Final model)	610				387			
Yes Variance explained ((V^0 – V^1)/ V^0)100					36.5%			

Table 2
Linear regression of socioeconomic vulnerability on the rate of child protection involvement for neglect for children aged 0 to 9 years by child population density quintiles.

	Beta	SE	t	P	Adjusted R^2
Child population density in small area geographies (N = 10,650)					
Quintile 1 (Least populated quintile – 154 children per KM^2)	230.55	8.53	27.02	0.000	0.217
Quintile 2 (397 children per KM^2)	186.91	7.81	23.92	0.000	0.207
Quintile 3 (585 children per KM^2)	96.53	5.23	18.43	0.000	0.144
Quintile 4 (971 children per KM^2)	86.48	5.64	15.33	0.000	0.098
Quintile 5 (Most populated quintile – 2146 children per KM^2)	26.25	3.46	7.57	0.000	0.027

population density small area geographies in Quebec are the home to First Nations or Inuit communities whose representation in in child protection systems for reasons of neglect is 6.7 times greater than non-Indigenous children and demonstrated to be associated with many structural socioeconomic factors of disadvantage (e.g., de la Sablonnière-Griffin et al., 2016). The lack of available data regarding specific services (e.g., health, social services, etc) at the level of granularity of census dissemination areas limited the specificity of our analysis. We should also note that population density should not be interpreted as a pseudoindicator for family supports: if a small remote, dispersed community is close and has strong social cohesion, our theory of population density being a risk factor would not hold as well. This is particularly important when considering diversity within populations — some families, even in densely populated areas, may be isolated from both formal and informal supports. For example, families without social connections or familiarity with available services, such as recent immigrants or minorities in the population, may be close to many services but not have the knowledge or comfort to access them.

The findings of this study point to many more research questions that merit further study. We understand our results to indicate that the nature and context of poverty—and how these impact families and caregiving—may vary depending on population density as well as other factors within the population. Accordingly, it seems important for future studies to incorporate a complex understanding of poverty in both rural (Norris, Zajicek, & Murphy-Erby, 2010) and urban settings into analysis

of families' likelihood of neglect-driven child protection involvement. Policy attending to family poverty ought not to be limited to simply poverty alleviation where poverty is most concentrated (e.g., urban centers); indeed, rural families' involvement with child protection is more likely to be experienced in tandem with financial stress than is the case for urban families (Mattingly & Walsh, 2010). The findings raise additional hypotheses related to the possibility that, on the whole, services may be less available, accessible, or appropriate in less densely populated areas. However, the gaps that may lead families to become involved with child protection systems for reasons of neglect are varied and may be shaped through locally distinct experiences of socioeconomic challenges. Individual family situations must be studied within context to understand what supports might be needed and how they might be provided within a particular environment. For example, the implications of being a married couple versus a single parent in a rural area may be quite different from an urban setting due to differences in reliance on support from outside of the household and the possibility of accessing those supports (e.g., Nelson, 2007). Transportation may be a much bigger barrier for families living more rurally to easily access work, childcare, groceries, and health services (e.g., Child Welfare Information Gateway, 2018). Income may fluctuate in more agricultural, rural areas due to seasonal work (e.g., Chambers, 1982) and in urban areas perhaps less so. As our findings regarding population density show, socioeconomic factors may not be an adequate indication of risk of neglect when studied without considering geographic and social context (e.g., Webb, Bywaters, Scourfield, Davidson, & Bunting, 2020). We hope that the findings of the present study prompt further quantitative and qualitative studies examining risk of child protection involvement in rural, semi-rural, suburban, and urban environments for different populations. Studies examining neglect according to density of formal social services, grocery stores, daycares, health clinics, and other resources could complement our findings related to child population density and deepen contextualized conclusions regarding both the risk of neglect and policy responses to mitigate it.

The findings of this study follow recent papers in suggesting that more research is needed to illustrate where, when, and for whom socioeconomic disparities in child protection involvement arise for different populations (e.g., Bywaters et al., 2019). Particularly for Indigenous communities, many of whom live in remote areas far from many services (Quebec secretariat aux affaires Autochtones, 2015), social geographic analysis incorporating population density may shed light on child protection involvement. It is important to state, however, that our findings should not be taken as conflating less densely populated areas with Indigenous communities. In Quebec, Indigenous communities are much more likely to experience child protection intervention for neglect, related in part to structural inequalities such as

higher rates of poverty (e.g., de la Sablonnière-Griffin et al., 2016). A lack of prevention services in Indigenous communities, which tend to have higher rates of socioeconomic challenges and substance use challenges (e.g., National Collaborating Centre for Aboriginal Health, 2010), is repeatedly suggested to relate to this disproportionality (The Jordan's Principle Working Group, 2015). While the data available to use for this study does not allow for direct analysis of prevention services, much recent advocacy and legislation is based on documented, consistent findings of a lack of preventative services for Indigenous communities across Canada combined with a need for communities to govern their own child protection systems (e.g., Bill C-92, 2019; The Jordan's Principle Working Group, 2015; Truth and Reconciliation Commission of Canada, 2015).

Conceptualizing neglect according to unmet needs rather than caregiver capacity or intent incorporates attention to the role of the environment and policy atmosphere shaping family opportunity (e.g., Dubowitz, Black, Starr, & Zuravin, 1993; Garbarino & Collins, 1999). Because more rurally located families may have less access to family support services, they may more frequently rely on informal supports to meet child care or other needs (Anderson & Mikesell, 2019). Where informal supports are not sufficient, however, formal supports can help fill this gap – whether through direct family services, income supports, health care (including mental health and addiction treatment), or child care (e.g., Macdonald, 2018). Researchers have proposed that preventative interventions aimed at structural factors disadvantaging families can mitigate risk for families in socioeconomically vulnerable areas (e. g., Davidson et al., 2017; Featherstone et al., 2019; Morris et al., 2018; Webb, Bywaters, Scourfield, McCartan et al., 2020), thus improving outcomes and reducing overall spending on services over time (Mason & Bywaters, 2016; Trocmé et al., 2014; Webb & Bywaters, 2018). Because, as our results illustrate, families experiencing intervention by the child protection system may have varied challenges depending on the density of where they live, more research related to preventative approaches to demonstrated local needs can inform policy development.

Our findings contribute to recent research pointing to the need for decisionmakers to better understand how local population density may interact with demonstrated socioeconomic needs of families and their risk of child protection involvement. Recent studies in England examining the relationship(s) between poverty and child protection involvement have conceptualized service availability in terms of demand (e.g., families' socioeconomic needs and risks) and supply (service policy and provision) across various geographies (Bywaters, 2019; Bywaters et al., 2015; Bywaters et al., 2018). These studies have found that the supply of child protection intervention, and socioeconomic inequalities where services are implemented can be inversely related to the locally demonstrated "deprivation" or need, meaning that similar demand elicits different supply depending on local contexts (Bywaters, 2019; Bywaters et al., 2015, 2018; Webb et al. 2020a; Webb et a., 2020b). Further, a recent study noted that services received by families involved with child protection may not be appropriate for the needs the families themselves identify as most crucial (Armstrong et al., 2019), indicating that an adequate supply of services will depend on unique needs within particular communities and families. Where families who may need more support receive less than others, policies targeted to specific areas of vulnerability may be appropriate to reduce barriers to needed forms of support for particular groups (Victora et al., 2018). Specifically, for marginalized groups with histories of state-sponsored oppression and family separation (e.g., Indigenous people and African-Americans), even when health and social services are proximal to vulnerable families, mistrust can be a barrier to accessing services meant to prevent child protection involvement (e.g., Maguire-Jack et al., 2018), reiterating the importance of publicly-funded services that are designed flexibly and in consultation with (or, simply, by) these groups, according to locally identified needs. Geographic units of analysis have proven to be an effective research element to inform grounded policy shifts in other health and social service domains (e.g., Agarwal et al.,

2018; Goldman, 2018; Luo & Wang, 2003). While social geographic analysis has been used to identify geographic factors related to child protection-involved families in given localities, it is hard to know how well it is used to inform development and implementation of targeted services in areas identified as higher-risk for child protection involvement for reasons of neglect.

We urge more consideration of population density as it relates to service allocation analysis and decisionmaking such that its relationship to families' abilities to have their needs met can be more clearly understood. Population density must be understood in context rather than a stand-alone metric to indicate population needs. Policymakers aiming to reduce the number of neglect cases and improve responses to neglect ought to take several points into consideration. First, collaboration and consultation with local stakeholders in various geographic areas—including child protection-involved families themselves—must support evidence-based interventions to reduce neglect (Green et al., 2016) and validation of evidence on which new interventions are based. Second, practice settings ought to advocate and support flexible responses to families reported for neglect and embrace community-focused differential response (e.g., Delaye & Sinha, 2017) and other creative, family-driven interventions. This requires governments to fund and support community-based family services, particularly in rural and remote regions, and for formal child protection services to consult and collaborate with such services in an ongoing and collegial relationship.

Our results point to several implications for future research related to how accessibility is understood and studied, what population density can tell us (and what it may not), how neglect-specific research can inform more grounded policy improvements, and opportunities for complementary qualitative research to deepen interpretation of the present findings. While the present findings suggest the salience of population density among geographically delineated areas for poor families becoming involved with child protection because of neglect, more research is needed to understand why this relationship exists. For example, examining service "accessibility" according to metrics beyond geographic proximity could paint a more precise picture of family needs and how these gaps may be filled to prevent neglect. To illustrate this, while a family having a daycare nearby their home may suggest superficially that childcare is "accessible," the same family may in fact struggle to access this childcare for reasons that are not related to physical proximity. For example, they may not have the money to afford it (particularly in jurisdictions where daycare is not heavily subsidized), may not trust the provider to care well for their children, or may need overnight care to accommodate shift work. In addition, provincially developed child and family services in non-urban areas may have little relevance for Indigenous families in these regions whose cultural and family values are not reflected in intervention design. The way in which access to needed supports is understood in social geographic analysis may be limited by the inadequacy of available datasets to capture the diverse range of factors relevant for family wellbeing—a fundamental limitation of this study.

As it is becoming increasingly clear that "abuse" and "neglect" are qualitatively distinct and play out differently in families—particularly poor families (e.g., Semanchin Jones & Logan-Greene, 2016)—more neglect-specific work is needed. Decoupling these maltreatment types in research, as well as distinguishing among neglect sub-types (e.g., supervisory neglect, medical neglect, material neglect, etc.), can inform research findings that are more refined and appropriate for reducing risk factors for neglect according to local realities. Our findings for the province of Quebec could be further complemented by qualitative examinations such these to understand why population density might be relevant for poverty and neglect. In turn, more grounded understanding of these geographic patterns can inform more precise research questions and hypotheses regarding family needs and how they may be better met through prevention and child protection services (Galster, 2012; Noah, 2015; Petrović, Manley, & van Ham, 2018; Sharkey & Faber, 2014). While our study had a narrow focus on the relationship between poverty

and neglect, future studies looking more broadly at geographies and all types of child protection involvement could also include non-neglect maltreatment types, such as physical and sexual abuse.

The findings presented here reaffirm the relevance of socioeconomic vulnerability in understanding neglect-related child protection involvement. However, the novelty of this study is our finding that this relationship may be compounded for families living in more sparsely populated residential areas. This finding illustrates that poverty alone cannot characterize neglect risk: the context in which poverty and socioeconomic risks are experienced must also be acknowledged. Accordingly, poverty alleviation should not fall to child protection agencies or workers whose mandate, funding, and training are not designed to do so, particularly when poverty is not experienced similarly across families and geographies (Ridge, 2009). Given the geographic variation demonstrated in this study, future child protection research must become more attuned to the differing strengths and needs of families living in different geographies. This must be better understood before clear policy prescriptions can emerge. Further social geographic research must also specifically inquire about family experiences of neglect-related child protection involvement according to various definitions of access to formal services (including affordability, cultural relevance, and trust), as well as informal supports which cannot be easily measured using large quantitative datasets. Increased precision in research findings, accommodating differential characteristics in population and available services across small area geographies, can inform targeted intervention to reduce the risk of poor families being involved with child protection systems due to material needs that may be exacerbated by isolation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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