ORIGINAL PAPER

Area-Level Variation in Children's Unmet Need for Community-Based Mental Health Services: Findings from the 2014 Ontario Child Health Study

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Abstract

There is limited empirical evidence documenting the magnitude and correlates of area-level variability in unmet need for children's mental health services. Research is needed that identifies area-level characteristics that can inform strategies for reducing unmet need in the population. The study purpose is to: (1) estimate area-level variation in children's unmet need for mental health services (using Service Areas as defined by the Ontario Ministry of Children and Youth Services), and (2) identify area-level service arrangements, and geographic and population characteristics associated with unmet need. Using individual-level general population data, area-level government administrative data and Census data from Ontario, Canada, we use multilevel regression models to analyze unmet need for mental health services among children (level 1) nested within Service Areas (level 2). The study finds that 1.64% of the reliable variance in unmet need for mental health services is attributable to between-area differences. Across areas, we find that Service Areas with more agencies had a lower likelihood of unmet need for mental health services. Compared to other Service Areas, Toronto had much lower likelihood of unmet need compared to the rest of Ontario. Rural areas, areas with unsatisfactory public transport, and areas with higher levels of socio-economic disadvantage had a higher likelihood of unmet need for mental health services. These findings identify challenges in service provision that researchers, policymakers and administrators in children's mental health services need to better understand. Policy implications and potential Service Area strategies that could address equitable access to mental health services are discussed.

Keywords Mental health · Services · Children and youth · Unmet need · Multilevel modelling · Area-level variation

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Childhood mental disorders contribute to substantial individual and social burden (Waddell et al. 2017) and are the leading cause of child disability worldwide (Erskine et al. 2015). Children's mental health services are designed to

deliver mental health treatment that can address mental disorders and other mental health challenges in children and youth (herein child/ren). To be effective interventions, these services must be delivered to those children with a mental health need. Evidence suggests that not all children with a mental health need receive services. In Canada, 13% of children aged 4 to 17 years have mental disorders but only 31% of these children are receiving specialized mental health services (Waddell et al. 2014; Georgiades et al. 2019).

The extent to which children's mental health needs are being met provides an indication of responsiveness of the mental health system to population need, which has been identified as an intrinsic goal of health care systems (World Health Organization 2000). A health system that is able to respond to the needs of its users serves a number of overarching population health policy principles including health equity, accountability and efficiency (Bhattacharya and Bhatt 2017). Failing to address the mental health needs of children can result in negative outcomes at both the individual and service system level. Individuals may experience declines in functioning, increases in problem severity or the development of chronic mental health problems (Berwick and Hackbarth 2012). In turn, complications from untreated mental health problems can create additional system burden through ongoing reliance on services or even hospital admission, an extremely expensive way to provide mental health care (Marshall et al. 2011). Unmet need is a form of inefficiency that has economic implications (Mental Health Commission of Canada 2017). Given the individual and service system implications, unmet need for mental health services represents a significant challenge to those service providers, funders and policymakers involved with administering children's mental health services. Understanding area-level variation in unmet need and identifying potential area-level correlates of unmet need using areas that correspond to administrative boundaries will enable policymakers and administrators to begin to understand and address the challenge.

The existing evidence about area-level variation in children's unmet need for mental health services is limited to one study: an ecological analysis of children's mental health care from the United States (US; Sturm et al. 2003). There is one Canadian study of adults that focuses on area-level variation in mental health risk and service use in Toronto (Law and Perlman 2018). Other studies of children's unmet need for mental health services focus on individual-level determinants (Kataoka et al. 2002; Jensen et al. 2011) or on vulnerable groups such as children with special health care needs (Inkelas et al. 2007; Fulda et al. 2013). Sturm and colleagues (2003) examine use of mental health services, need for mental health services, unmet need and need among service users. The authors defined a mental health need as 'assessed need' based on elevated scores on six items from the Child Behaviour Checklist (Achenbach 2001) and defined 'unmet need' as children with an assessed need who had not received mental health services in the past 12 months. They found no differences in unmet need by income group (despite an income gradient in service use and need) but there were racial/ethnic group differences between Hispanic and white children (OR: 2.33). Policy decisions about mental health services could be made very generally at the state/province level (e.g. overall allocations, state policy on service eligibility, pathways etc.) but services are often arranged within jurisdictions at smaller levels of geography within states/provinces. The study by Sturm et al. (2003) is of limited use from a policy perspective as it does not include state-level factors related to service arrangements and the units of geography (states) do not align with administrative boundaries within states that are used for service governance, planning, management and provision.

The absence of evidence on associations between area-level influences and children's unmet need for mental health service reflects the lack of individual-level studies with sufficient clustering of individuals within areas and a sufficient number of areas to conduct multilevel modelling. Instead, researchers opt for ecological study designs, such as that used by Sturm et al. (2003). In these designs, the unit of analysis is the geographic area and variables of interest are aggregate summary statistics at the area level. These designs are subject to criticism due to challenges in statistical inference and interpretation caused by the ecological fallacy whereby area-level associations are mistakenly interpreted as representing individual-level associations. These studies are also limited by a shortage of accurate and appropriate area-level variables (Holley 1998). Administrative health databases, such as those used in the study of Toronto adults (Law and Perlman 2018), provide broad geographic coverage but exclude those with a mental health need who are not accessing services, leading to an incomplete picture.

To study area-level variation in unmet need, we must define children's mental health need and mental health service use. While a consensus on the appropriate definition of need in children's mental health does not exist, Bradshaw (1972; 2005) proposes six need types: normative (presence of mental disorder); felt (subjective perception of a mental health problem); expressed (demand for mental health service); comparative (population inequities in mental health); medical (treatable disease) and social (restoring quality of life). There is evidence to suggest that perceptions of a mental health need (felt need) are more closely associated with service demands than the presence of a diagnosed mental health disorder (normative need; Wichstrøm et al. 2014) so we use both to classify need in the current study.

Children's Mental Health Services in Ontario, CA

The provision of children's mental health services in Ontario is complex (Boydell et al. 2009). At the time the study was conducted, community-based services were primarily the responsibility of the Ontario Ministry of Children and Youth Services (MCYS) with the majority of treatment services addressing children's mental health need being provided by MCYS-funded community-based agencies. MCYS was also responsible for youth justice and child welfare services, and services supporting Indigenous children and youth. Other providers of children's mental health services included: (1) the Ministry of Health and Long-Term Care in primary care and hospital settings, (2) the Ministry of Education in schools, and (3) private practitioners as well as advocacy, charity and self-help groups, although these providers account for only a small to modest amount of the treatment services that children receive in Ontario. There has been no attempt to coordinate care from these various providers, and the distribution of resources to mental health services across sectors is unknown (Duncan et al. 2018a). As a result, the focus in this study is on services provided by MCYS given that: (1) MCYS policy decisions are made independently of other sectors; (2) MCYS-funded agencies are the only group of organizations with a targeted mandate to provide treatment services to address the mental health needs of children throughout Ontario; (3) we can identify MCYS-funded agencies across the province and isolate service contacts within these agencies; and (4) administrative data is available, including expenditure data, that is tied directly to individual agencies and service provision. In particular, children's mental health services in this study refer to community-based, MCYS-funded mental health services designed to address the mental health needs of children aged 0 to 17 in Ontario. What follows is a description of how services are administered, arranged and funded—important context that frames the research objective.

The Ontario Ministry of Children and Youth Services (MCYS) was responsible for providing services around the province until August 2018 (Government of Ontario 2015a). Services include targeted prevention, brief services, counselling, therapy, family capacity building, specialized consultations, crisis support and intensive treatment. MCYS provides policies on the minimum expectations of, and definitions for, these core services and other key processes, and is responsible for the development and implementation of policies, programs and services, provider funding and oversight (Duncan et al. 2018a). For the purposes of MCYS service administration, Ontario is organized into five MCYS administrative

regions (West, Central, East, North, and Toronto). Regions comprise 33 Service Areas, which are geo-political areas that are geographically bounded in one or more Statistics Canada Census Divisions—larger than neighbourhoods but smaller than states/provinces. Census Divisions can encompass several neighbouring municipal jurisdictions but are the most stable administrative geographic areas next to provinces (Statistics Canada 2015). Each Service Area is headed by a Lead Agency who has overarching responsibility for planning and delivering children's mental health services within the Service Area. Lead Agencies must ensure that services are provided across the service array according to community needs and they coordinate with individual service provider agencies within the Service Area. Lead Agencies also provide services within the Service Area but have no special service or triage role. MCYS contracts with and directly funds the approximately 250 individual service provider agencies across the province who provide services free of charge to children and families. Lead Agencies assist with service contracts and budget negotiations but funding does not flow through them. How funding decisions are made is unclear and there is evidence indicating that expenditures are not well aligned with levels of need in the province (Duncan et al. 2019). It is not clear that any Service Area characteristics are taken into account in planning or funding activities. As a condition of funding, agencies must fully account for their expenditures and regularly report on key performance indicators to both Lead Agencies and MCYS (Government of Ontario 2015b).

Area-level Influences on Children's Unmet Need for Mental Health Services

The lack of evidence on this topic means that potential area-level factors associated with unmet need for mental health services at the child level are not well understood and appropriate theoretical models are unavailable. Work has been done to understand individual-level factors associated with access to services, contextual influences on individual service seeking behaviours (Khan and Bhardwaj 1994; Andersen et al. 2002; Ryvicker 2018) and the organizational context of children's mental health services (Glisson 2002). Existing models do not fully articulate what is an individual characteristic and what is a system characteristic that exerts an influence on individual behaviours. The focus of our study is the service system-level, not the individual- or agency-level. There is an absence of theoretical models that hypothesize how area-level characteristics of the service system might be associated with children's unmet need at the area-level. To develop this line of inquiry, we identify Service Area characteristics that might be associated with

unmet need by considering: (a) how MCYS Service Areas are funded and arranged; and (b) known patterns in the spatial ecology of mental illness and service demand (Holley, 1998). In this study, our primary focus is on Service Area service arrangements that are related to specific funding or organizational policy decisions that could be modified to address unmet need. These factors can be thought of as policy levers or 'control knobs' that could be adjusted by Ontario government policymakers to motivate health service reform (Roberts et al. 2003). Our secondary focus is on geographic and population characteristics of Service Areas that might be associated with children's unmet need for mental health services. These characteristics may represent important influences on unmet need that should be better understood but are less amenable to being addressed through MCYS policy changes. They may represent political, economic or ideological challenges that can only be addressed through a significant political and economic investment into coordinated, cross-sectoral policy approaches. Nonetheless, identifying Service Area-level geographic and population characteristics that are associated with unmet need flags challenges for policy makers and agency management to study and address. Communicating these challenges to service agency management in these areas might motivate providers to consider changes to service delivery.

Service Arrangements

Given the policies and responsibilities of MCYS in Ontario (Government of Ontario 2015a), we hypothesize that dollar per capita children's mental health service expenditures and the number of service provider agencies in the Service Area will impact how well services reach those with a mental health need. If lower Service Area-level per capita expenditures are associated with an increased likelihood of unmet need, policymakers might formally evaluate funding policy in relation to service targeting or incorporate data on unmet need into funding decision processes to ensure that funding responds to area-level variation in need as well as changes in need over time.

Although, MCYS provides policy direction on core service definitions and processes, it does not dictate how many service agencies within Service Areas should provide services. In some Service Areas, one or two large agencies will provide a wide array of services while in others, more numerous small agencies will provide different types of core services. If the number of service agencies within a Service Area is negatively or positively associated with unmet need for mental health services, then this could indicate that service access might be improved by recommending Service Areas consolidate or diversify the number of agencies that are providing services. Area-level wait times and problems with intake, referral and triage processes could

also be important factors associated with unmet need but unfortunately, reliable wait time data nor data on intake and referral processes were available for the study period.

Geographic and Population Characteristics

Area-level variation in children's unmet need for mental health services may reflect physical differences in Service Areas. Urban–rural health inequities are well-documented in the US (Kelleher and Gardner 2017) and Canada where rural areas experience both health and service disadvantages (Pong et al. 2006; Mitura and Bollman 2004, Nagarajan 2004). Ontario includes both highly urban (Toronto is the 7th largest city in North America) and highly rural (Northern Ontario constitutes 88% of Ontario's land but only 6% of the province's population (Wikipedia Contributors 2019)). We might expect rural and remote areas to be similarly disadvantaged in levels of unmet need due to service access barriers such as the travel distance to and between services (Arcury et al. 2005). Other physical aspects of the Service Area environment, such as poor public transportation may lead to forms of social exclusion that represent barriers to access that operate in both rural and urban areas (Stanley and Lucas 2008). Although MCYS policy cannot change the urban/rural composition of the province or improve public transport options, if Service Areas in rural areas or with poor public transportation are associated with higher levels of unmet need, service or access solutions could be identified that might reduce or remove access barriers.

In the US, the link between area-level economic disadvantage and poor individual health outcomes is well-established (Pickett and Pearl 2001; Wilson 2012). In their US analysis of geographic variation in mental health need and service use, Sturm and colleagues (2003) found that families with lower incomes had more service visits and higher levels of need although they did not find an effect specific to unmet need. Although there are important differences between Canada and the US, variation in unmet need may be indicative of mental health need or service inequities relating to underlying socio-economic differences between Service Areas. For example, the inverse care law states that the availability of good services tends to vary inversely with served population needs (Hart 1971; Watt 2002). If Service Area socio-economic disadvantage is associated with children's unmet need, this provides further evidence of the negative impact of SES disadvantage on children and makes the need for governments to address SES disadvantage even more urgent.

Study Objectives

The objectives of this study were to describe the extent to which children's unmet need for MCYS-funded

community-based mental health services varies by MCYS Service Area and to identify service arrangement, geographic and population characteristics of Service Areas that are associated with children's unmet need for mental health services. To do this we address the following research questions: (1) What proportion of children have unmet need for MCYS-funded community-based mental health services? (2) Does the proportion of children with unmet need for MCYS-funded community-based mental health services vary by Service Area? (3) Are higher Service Area dollar per capita expenditures on children's community-based mental health services or greater numbers of agencies within a Service Area associated with lower unmet need? (4) Are rural Service Areas, Service Areas with poor public transportation or higher levels of socio-economic disadvantage associated with higher unmet need? This study is the first that we are aware of to use individual-level data in a multilevel analysis of children's unmet need for community-based mental health services. In identifying the extent to which there is Service Area-level variation in children's unmet need for mental health services and examining service arrangements, geographic and population characteristics associated with unmet need, this study can help governments and policy makers frame service delivery policy development to support equitable access to community-based mental health services for children in need.

Method

Data

This study combines individual-level data from the 2014 Ontario Child Health Study (OCHS; Boyle et al. 2019; Statistics Canada 2017a) with aggregate Service Area-level data from: (a) administrative records from the Ontario Ministry of Children and Youth Services, (b) household survey responses from the 2014 OCHS; and (c) the 2016 Canadian Census Profile (Statistics Canada 2018). The 2014 OCHS is a province-wide, cross-sectional, epidemiological study of children's mental health. A probability sample of 6537 households (50.8% response) participated, with 10,802 children aged 4 to 17. Using the 2014 Canadian Child Tax Benefit file as the sampling frame, households were selected based on a complex three-stage survey design that involved cluster sampling of residential areas and stratification by residency (urban, rural) and income (areas and households cross-classified by three levels of income). Data were collected during home visits by trained Statistics Canada interviewers from the person most knowledgeable (PMK) about the child and by computer-assisted interviews from children aged 12 to 17. Data collection occurred from October 2014 to October 2015. Detailed accounts of the survey design,

content, training, and data collection are available elsewhere (Boyle et al. 2019; Statistics Canada 2017b).

Concepts & Measures

Unmet Need for MCYS-Funded Community-Based Mental Health Services

Combining individual classifications of need with the presence/absence of community-based mental health agency service contact provided the basis for operationalizing the definition of unmet need. This was coded 1 = *child had a mental health need but no contact with MCYS-funded community-based mental health services;* and 0 = *child had (a) no mental health need and no contact with MCYS-funded community-based mental health services, or (b) a mental health need and contact with MCYS-funded community-based mental health services.* This variable serves as the dependent variable in all models.

Mental Health Need Children's mental health need was defined based on the presence of either normative (the presence of mental disorder) or felt need (subjective perceptions of a mental health need) in the previous six months, according to the PMK about the child. The PMK of one randomly selected child from each family (n = 6537) was interviewed using the Mini International Neuropsychiatric Interview for Children and Youth (MINI-KID; Sheehan et al. 2010; Duncan et al. 2018b, c). PMKs of all children (n = 10,802) were administered the OCHS Emotional Behavioural Scales (OCHS-EBS), a 52-item checklist that is self-reported by PMKs about children to assess mental health disorder symptoms over the past six months. The OCHS-EBS demonstrates satisfactory reliability and validity when used as either a dimensional (Duncan et al. 2018b, c) or categorical (Boyle et al. 2018) measure. To convert OCHS-EBS scale scores to binary classifications of disorder, first, the MINI-KID was used to estimate disorder prevalence. Second, scale score cut-offs that produced a prevalence matching the same disorder prevalence assessed by the MINI-KID interview were selected. These cut-offs were then applied to the OCHS-EBS scale scores. Children meeting criteria for one or more disorders in the past six months according to the PMK report binary classifications of the OCHS-EBS were classified with normative need (1 = *present*, 0 = *absent*).

Felt need was defined as positive responses to two sequenced questions that asked whether the PMK thought that, in the past six months, (a) the child had any emotional or behavioural problems, and (b) if yes, needed any professional help with these problems. Felt need was coded as 1 = *present* if the parent answered yes to both questions. Children with normative and/or felt need were coded as 1 = *having a mental health need*; while those with neither were coded as 0 = *no mental health need*.

Contact With MCYS-Funded Community-Based Mental Health Services This was based on PMK responses to the question 'In the past six months, did you, another family member or < child's name > see or talk to anyone from any mental health or addictions agency because of concerns about his/her mental health?'. In responding to this question, PMKs were asked if they had contact with specific, named, MCYS-funded mental health or addictions agencies in their Service Area (Reid et al. 2008). This was coded 1 if the PMK answered *yes*, and 0 if they answered *no*. Given our focus on MCYS Service Areas, we isolated MCYS-based service contact from agencies not funded by MCYS and other types of mental health service contact. Hospital, physician and school-based services are not MCYS-based services and were excluded in our definition of contact with mental health services.

Service Area Characteristics

1. Children's mental health service dollar per capita expenditures & number of children's mental health agencies. Our analysis focuses on the 33 Ontario MCYS Service Areas. Government administrative data for the 2015–16 fiscal year was used to assess: (a) dollar per capita expenditures on children's mental health services in Canadian dollars for children aged 0 to 17; and (b) the number of MCYS-funded children's mental health agencies providing services within each Service Area. Of the 33 Service Areas, Toronto was determined to be an extreme outlier with a much larger number of children's mental health agencies and total service expenditures. Because of this, a binary variable (1 = *Toronto*, 0 = *all other area*) was added as an important Service Area variable.

2. Proportion of rural population, public transportation dissatisfaction, and average household income. Area-level socio-demographic characteristics were derived from the 2016 Census Profile at the Census Division level (Statistics Canada 2018) which also forms the basis of Service Area geography. Census variables included the percentage of rural population (vs. small, medium and large urban) measured in 10% increments and mean household income measured in $10,000 increments. Lower incomes are indicative of higher socio-economic disadvantage. A survey question from the 2014 OCHS asking public transportation users to rate their satisfaction with public transport was aggregated to the Service Area level to characterize Service Area-level satisfaction. Response options went from '1 = *very satisfied*' to '4 = *very dissatisfied*'. This variable was generated by computing aggregated weighted means at the Service Area level—weighted using dwelling sampling probability weights provided by Statistics Canada. Fifteen percent of the data on this variable was missing but as the pattern of missing data was randomly distributed across Service Areas all available data was used to generate this aggregate variable.

Analysis

To address the first research question about the proportion of children with unmet need for MCYS-funded community-based mental health services in Ontario, we generated a two-by-two table of the cross classification of children's mental health need by mental health service use according to our definitions. Multilevel, random intercept binary logistic regression models were then used to analyze children's unmet need for mental health services (level 1) nested within MCYS Service Areas (level 2). To address the second research question about whether unmet need varies by Service Area, a null random intercept model was estimated. By specifying a random intercept in the model, it is possible to estimate the amount of between-area variation in children's unmet need. To visualize differences between areas in unmet need, we plotted the area-level residuals (random effects) from this null model to observe the extent to which specific Service Areas estimates of unmet need for mental health services deviate from overall mean levels of unmet need in Ontario. To assess the third and fourth research questions, we added potential predictor variables to the model.

Twenty-eight of the 33 Ontario Service Areas were represented in the 2014 OCHS data. The stratified, cluster sampling design of the 2014 OCHS meant there was a trade-off between: (a) sufficient clustering of families within areas to examine contextual effects, and (b) coverage of families within all areas. Due to the clustering, there were five Service Areas that contained no survey respondents. There is no consensus on the minimum number of level 2 units needed in multilevel models. Recommendations range from 10 (McNeish and Stapleton 2016) to 30 (Kreft 1996) and depend on the overall available sample, the within-area sample size, and the research question. Twenty-eight Service Areas are sufficient for estimating random effects, but this number limits the ability to look at more than one or two area-level predictors in a model at a time. Therefore, we were only interested in unadjusted associations so Service Area-level predictors were added and assessed one at a time. The number of children per area ranged from approximately 50 to 2500 which meets the minimum sample size requirement of 50 required to estimate unbiased level 2 standard errors (Maas and Hox 2005).

Sampling weights based on the probability of being selected and participating in the study were applied at the child level (level 1). To account for the complex survey design, mean bootstrap weights were applied with an adjustment factor to produce accurate standard errors for child-level variables. Area-level weights were not needed, as

all Service Area-level variables were either population estimates or weighted aggregates representing population-level estimates. The analysis was conducted in MLwiN version 2.35 (Rasbash et al. 2004). The null model was fitted using 1st order marginal quasi-likelihood procedures and iterative generalized least squares estimation. Subsequent models were fitted using 2nd order predictive quasi-likelihood as recommended by Rasbash et al. (2004) to deal with issues of downward biased estimates. Significance in all models was assessed using a Wald test. Ideally, a likelihood ratio test would be conducted but discrete response models in MLwiN are estimated using quasi-likelihood methods making the likelihood value unreliable (Rasbash et al. 2004). Significance is assessed against three levels: $p < 0.05$(*), 0.01(**) and 0.001(***). P values were adjusted using the Benjamini and Hochberg (1995) method to account for multiple testing.

Sample for Analysis

All 2014 OCHS respondents were eligible for inclusion in the analysis. Thirty-seven respondents (0.3%) who were missing data on the variables needed to derive unmet need were omitted from the analysis. Children without a mental health need who were using community-based mental health services (1.2%) were omitted from the regression analysis as they represent a unique category that have neither met or unmet need for mental health services.

Results

Table 1 shows the weighted sample characteristics for children and Service Areas and the range of observed values for Service Area characteristics. Twenty percent of the sample were classified as having a mental health need and 5.6% had contact with an MCYS-funded community-based children's mental health agency. A supplementary table in the Appendix shows the Service Area characteristics.

1. What proportion of children have unmet need for MCYS-funded community-based mental health services? Table 2 shows the distribution of mental health need and service use across the province. The proportion of all children with unmet need for MCYS-funded community-based mental health services is 15.6%. Children with a mental health need who are receiving mental health services represent 4.4% of the sample and children without a need who are not accessing services represent 78.8%. A small proportion of children (1.2%) do not meet our classification criteria for a mental health need but are using services.

2. Does the proportion of children with unmet need for MCYS-funded community-based mental health services vary by Service Area? To answer this question, we fitted a null random intercept model to the data. The coefficient and standard error (*SE*) for the random effect is 0.055 (*SE* = 0.027) and significant at the $p < 0.05$ level (results not shown in table). Following the procedures for calculating the variance partition coefficient outlined by Rasbash et al. (2004), this means 1.64% of the reliable variance in unmet

Table 2 Cross-classification of children's mental health need and MCYS-funded community-based mental health service use (n = 10,765)

Mental health service use	With mental health need % (SE)		Total %
	Yes	No	
Yes	4.4 (0.40)	1.2 (0.20)	5.6 (0.50)
No	15.6 (0.64)	78.8 (0.85)	94.4 (0.50)
Total %	20.0 (0.79)	80.0 (0.79)	

Table 1 Sociodemographic & service area characteristics of study sample

Characteristics	Mean/% (SE)	
Children (n = 10,765)[a]		
Male, %	51.0 (0.87)	
Age in years, mean	10.4 (0.07)	
With mental health need, %	20.0 (0.79)	
With mental health service contact, %	5.6 (0.50)	
Service Areas (n = 28)[b]	Mean (SD)	[min–max]
Mental health service dollar per capita expenditures	$135.94 (76.28)	[$35.21–$417.50]
Number of children's mental health agencies	8.96 (15.44)	[1–85]
% Rural population	27.3 (20.1)	[0–62.2]
Dissatisfaction with public transport	2.24 (0.45)	[1.70–3.71]
Mean household income	$90,803 (14,797)	[$72,831–$139,315]

SE = standard error, *SD* standard deviation

[a]For individual child variables, descriptives reported are means/percentages of all individuals

[b]For Service Area variables, descriptives reported are means across 28 Service Areas

need was attributable to between-Service Area differences. Service Area-level proportions of children's unmet need for mental health services range from 9 to 30% (see supplementary table).

To visualize the random effects, we estimated and plotted the area level standardized residuals from the null model. Figure 1 shows the plot of residuals in ascending order, from the lowest estimate of unmet need for mental health services to the highest, along with their 95% confidence limits. These residuals represent how far Service Area estimates of unmet need for services depart from the overall provincial mean estimate (the dotted line in the middle of the graph reflects mean proportion of children with unmet need for mental health services in Ontario). The confidence intervals around the residuals for Toronto, Essex, York, Peel, (lower unmet need), and Ottawa (higher unmet need) Service Areas do not overlap zero, which means that these Service Area estimates differ significantly from the provincial mean at the $p < 0.05$ level.

3. Are higher dollar per capita expenditures or greater numbers of agencies within a Service Area associated with lower unmet need? Table 3 presents the unadjusted odds ratios and their 95% confidence intervals for the fixed effects in binary logistic multilevel regression models. Greater numbers of agencies within Service Areas was associated with reduced odds of unmet need for mental health services. There was no significant effect for dollar per capita expenditures. The odds of unmet need decreased by 1% as the number of agencies increases by one (agency numbers ranged from 1 to 85). As expected, the Toronto Service Area
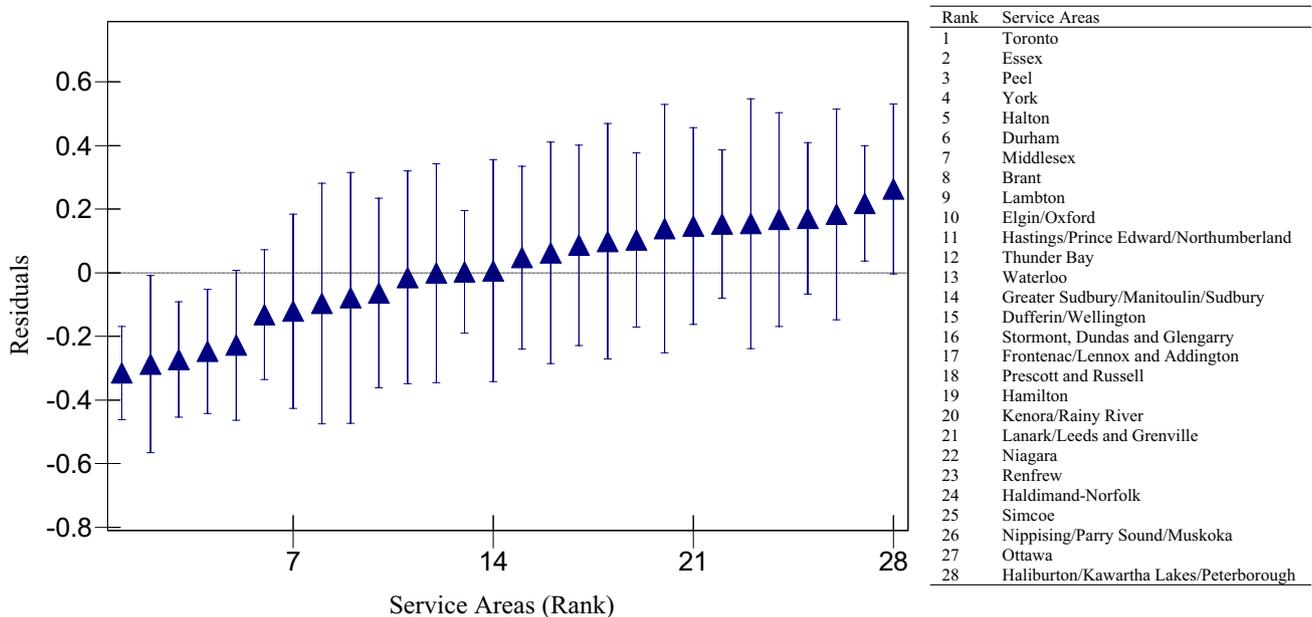

Fig. 1 Residual plot of random effects and service area ranking. The plot shows the residuals in ascending order along with their 95% confidence limits from service areas with the lowest estimates of children's unmet need for mental health services to those with the highest. The residuals indicate how far Service Area estimates of unmet need for mental health service depart from the overall mean (the dotted line in the middle of the graph reflects mean unmet need for mental health services in Ontario)

Table 3 Weighted fixed effect estimates and 95% confidence intervals for binary logistic multilevel models of children's unmet need for community-based mental health services ($n = 10,654$)

Service area characteristics	Unadjusted OR (95% CI)[a]
Mental health services dollar per capita expenditures	1.00 (1.00–1.00)
Number of children's mental health agencies	0.99 (0.99–0.99)***
Toronto	0.69 (0.62–0.77)***
% Rural population (10% increments)	1.10 (1.04–1.15)***
Dissatisfaction with public transport	1.44 (1.21–1.72)***
Mean household income ($10,000 s)	0.89 (0.84–0.94)**

Note. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$, *OR* odds ratio, *CI* confidence interval

Level 1 and Level 2 intercepts are not shown as each variable was added to the model one at a time

[a] All effects are robust to *p* value adjustment for multiple testing

was an outlier whereby residing in the Toronto Service Area compared to all other areas decreased the odds of unmet need by 31%.

4. Are rural Service Areas, Service Areas with poor public transportation or higher levels of socio-economic disadvantage associated with higher unmet need? Both rural areas and areas with higher levels of public transport dissatisfaction were associated with increased odds of unmet need for mental health services. A 10% increase in the percentage of rural population (vs. urban) was associated with a 10% increase in the odds of unmet need. Higher dissatisfaction with public transport was associated with a 44% increased odds of unmet need for mental health services. Higher average household income was associated with reduced odds of unmet need; as mean income increases by $10,000, unmet need decreases by 11%.

Discussion

Unmet need remains a significant challenge in children's mental health services. Our estimate of between-area variation in children's unmet need for mental health services at 1.64% represents a small but meaningful difference, based on criteria recommended by Duncan and Raudenbush (1999). Service Areas with fewer agencies, in rural locations, with poor public transportation or higher levels of socio-economic disadvantage among the populations they serve are associated with higher odds of unmet need. This study overcomes the limitations of previous studies in the following four ways. First, in order to study area-level variation in children's unmet need adequately and in a way that can inform policy, the areas being studied must align with government administrative jurisdictions responsible for the overall provision of services. MCYS Service Areas represent both units of geography (Census Divisions) and government administrative jurisdictions and are the level at which: (a) children's mental health services are administratively organized, (b) policy is made, (c) resources are allocated, and (d) administrative data are collected. This alignment ensures decision-makers can address unmet need by making or changing policies around service provision or funding allocation. Second, to avoid the ecological fallacy, we use multilevel models, which include individual-level data from the 2014 Ontario Child Health Study with large numbers of respondents in areas of interest. Third, to assess unmet need for mental health services adequately, we use data that includes both service users and non-users. Finally, to characterize the areas of interest, we use Canadian Census data and MCYS administrative data linked, at the Service Area level, to the 2014 OCHS survey data. Given these data strengths, this study generates new knowledge on the understudied topic of area-level variation in children's unmet need for community-based mental health services and identifies Service Area-level factors associated with unmet need.

Unmet need for services is one aspect of service targeting, where targeting is defined as the delivery of services to those with a need who stand to benefit from receiving those services. In trying to get services to those in need, Cornia and Stewart (1995) identify two types of service errors. The first error is the failure of services to reach those with a mental health need (unmet need) and the second is the provision of services to those not needing them. This study, and others, focus on unmet need—the first type of error. This is appropriate when this group represents the larger constituent, as it does in our sample. However, neglecting to examine the second type of error fails to provide a complete picture of service efficiency (Allin and Masseria 2009). It is possible that factors associated with children's unmet need could exhibit different associations from those receiving unneeded mental health services. Furthermore, overtreatment leads to waste in the service system when children receive services that cannot help them (Berwick and Hackbarth 2012) and could actually lead to adverse outcomes through misidentification of mental health need and resulting stigma or differential treatment at home, in school or other settings. Although it represents a small proportion of our sample (1.2%), this group should be included for study when there is adequate sample available.

Existing epidemiological evidence has estimated proportions of children with unmet need for mental health services in the general population ranging from ~ 10% in Canada (Georgiades et al. 2019) to 17% (Flisher et al. 1997) in the US, compared to 16% in the current study. These studies use different definitions of mental health need (e.g. DSM-based disorder classifications) and included additional sources of mental health services (e.g. hospitals, doctor's offices and in some cases schools). The current study focuses on MCYS-based services, which excludes services from the medical or education sectors. As a result, there will be some children misclassified with unmet need whose needs are being met through services provided by non-MCYS services.

This study found small between-area differences in children's unmet need, which suggests that factors influencing unmet need generally exert similar influence across Service Areas. Finding that 5 out of 28 Service Area estimates of unmet need differed significantly from the provincial mean helps us to understand how areas compare to each other. It does not help us understand how areas compare to the ideal scenario where 100% of children with a mental health need are accessing services. From a policy perspective, the overall ranking of areas is useful when considering where efforts to improve targeting should be focused. For MCYS, this would be the areas depicted on the right side of Fig. 1 (e.g. Nippissing/Parry Sound/Muskoka, Ottawa, and Haliburton/Kawartha Lakes/Peterborough). However, only one Service

Area (Ottawa) had statistically significantly higher unmet need than the provincial average.

The primary focus of our study was the identification of potential policy levers that could be adjusted to reduce children's unmet need for mental health services. Our findings indicate that unmet need was higher in Service Areas characterized by fewer service agencies. This does not mean that there were fewer *services*, but that there were fewer *agencies* providing the array of services outlined by MCYS. In some areas, one or two large agencies provide a broad range of services while in others, smaller, more numerous agencies provide the same range of services. This suggests that there may be benefits conferred on a Service Area's ability to address unmet need when there are more agencies in the Service Area. More agencies could mean greater access opportunities and alternatives for children and families through an increased availability of options or through having services available in more numerable locations, not just in one or two central service locations. When there are more agencies, they may be smaller organizations that are more flexible and nimble in being able to respond to population needs. Larger agencies may have benefits in terms of centralized processes but may be disadvantaged in responsiveness. Incorporating additional data on agency size would be an important next step. This finding has service planning implications for Service Areas with only one or two agencies or in areas considering consolidating or merging service agencies.

The Toronto Service Area was examined separately as an outlier in total expenditures and number of agencies. Living in the provincial capital of Ontario—the largest urban centre in Canada—is associated with a significantly lower likelihood of children's unmet need for community-based mental health services. Compared to other Service Areas in Ontario, Toronto appears to be better able to reach children with mental health need, according to our definition and is one of the Service Areas with a statistically significantly lower estimate of unmet need compared to the provincial average. It is not exactly clear why this is the case, but we can speculate that access to and availability of children's mental health services is likely to be better in a city that has far more numerous agencies than other Service Areas. Families are likely to live closer to an agency, while staff at agencies also have options to refer families to a number of specialized mental health hospitals and university-based research centres for information, advice or treatment. However, the Ottawa Service Area—home to the Federal capital of Canada and numerous university and specialized hospitals—is the only Service Area with statistically significantly higher unmet need than the provincial average. This suggests there is something unique to Toronto, in addition to being a large, urban centre, which increases its ability to meet the needs of children. It could be argued that the location of Ontario's provincial government offices in

Toronto could also be exerting a positive impact on service provision although there is no formal, additional oversight from MCYS in Toronto. Further work is needed to better understand whether there are processes in place in Toronto that could be introduced in other Service Areas or if there are other aspects of Toronto service planning that are contributing to this result.

Finding increased odds of children's unmet need for community-based mental health services in rural versus urban areas provides additional evidence of a 'rural disadvantage'. Service Areas with a larger rural population were associated with increased odds of unmet need for mental health services. In post hoc analysis, this effect remained even when we controlled for the Toronto effect ($OR = 1.09$ [95% $CI = 1.03–1.15$]). This is consistent with previous research documenting urban–rural health inequities in Canada (Pong et al. 2009; DesMeules et al. 2006; Mitura and Bollman 2004, Nagarajan 2004). It is also consistent with increased challenges of providing children's mental health services in rural versus urban areas (Boydell et al. 2006; Howell and McFeeters 2008). There is particular concern about health and health service inequities in Indigenous and Northern communities in Ontario and Canada that tend to be in remote or rural areas (Canadian Mental Health Association 2009). Unfortunately, there were too few Northern communities included in the 2014 OCHS sample to look at this specifically.

The positive Toronto effect and negative rural effect suggest that there are geographic service delivery advantages in urban Service Areas and in large urban centres, in particular. Decision-makers may need to increase funding or resources to support mental health service provision in rural areas, as agencies may have to work harder to counter geography-related barriers to ensure that services reach those who need them. This could mean service outreach, mental health promotion and literacy, clearer service pathways and referral processes. Unmet need could also be due to a lack of qualified individuals living in rural areas or wanting to relocate to work in rural areas. In these cases, greater salary incentives or relocation benefits could be considered.

The quality and availability of public transport within a Service Area seem to contribute to the problem of children's unmet need for mental health services. Although we did not have access to direct measures of the adequacy of public transport and services we were able to aggregate individual public transport-user satisfaction ratings to characterize Service Areas and found higher levels of dissatisfaction among public transport users was associated with higher odds of unmet need. Further research is needed to understand whether the reason for dissatisfaction is cost, availability, scheduling, reliability or something else. In order to receive services, families and youth have to physically attend the service location. For families without access to a

vehicle and for youth who are not able to drive themselves, adequate public transport services are critical. There are two possible ways to address this challenge. First, Lead Agencies of Service Areas may need to work with local municipalities to assess how satisfactory public transport services are and address situations where they are not. Second, MCYS and service providers might need to consider alternate methods of service provision that do not require in-person visits (such as phone or web-based services) or find alternate ways to bring mental health services to those children in need, perhaps through schools or other settings.

The negative association between Service Area-level income and unmet need aligns with existing evidence showing income gradients across health problems and health service use (Flisher et al. 1997). MCYS services in Ontario are free to users at the point of service, but we know that cost to service users is only one determinant of access (McIntyre et al. 2009). Instead, individuals in Service Areas with high incomes may have more positive attitudes about mental health services (less stigma), along with the knowledge and means (e.g., personal transportation, ability to take time off work) to access services. Unfortunately, this finding echoes what is already known about negative health outcomes for children and youth living in economically disadvantaged areas (Pickett and Pearl 2001; Wilson 2012). Children's unmet need for mental health services appears to be yet another area where socio-economic disadvantage has a negative influence. Designing and implementing policies that address child poverty has to be a priority in all areas of government (Racine 2016) and will take considerable time and coordination of efforts to resolve.

Limitations

This is the first study to examine the impact of contextual, area-level characteristics on child-level unmet need for community-based mental health services. Although this study addresses the limitations of ecological analysis and goes beyond the existing literature to cover new ground in the field of geography and mental health, it is not without limitations. First, theoretical frameworks that can provide insights into how area-level factors might influence children's unmet need for mental health services are not readily available. In order to identify potential factors, we combined theoretical frameworks from the small field of mental health geography (Philo 2005) with our understanding of the Ontario policy environment to guide the identification of key variables.

Second, we did not have sufficient survey data to include all 33 Ontario Service Areas. Third, even if data were available on all 33 Service Areas, these areas could still prove to be too large to identify between-area differences in children's unmet need. Large areas of geography tend to be heterogeneous with low levels of between-area differences whereas small areas of geography tend to be homogeneous with higher levels of between-area differences (Duncan and Jones 2000). Indeed, a UK multilevel analysis of mental disorders only determined variability at the individual and household level and not at the electoral ward level and concluded that these wards were likely too large (Weich et al. 2003). It is likely that our estimate of between-area variation in unmet need is a minimum estimate as the administrative areas used may be poorly aligned with the actual geography of unmet need. While using a lower level of geography might prove more fruitful, it would result in an inability to tie inferences to an administrative level of geography at which policy is made. The challenge is to delineate geographical boundaries that map into differences in the variables of interest. This is a challenge for anyone trying to do 'actionable' research constrained by administrative geographical boundaries that might be the level at which policy operates, but that might not make sense in relation to the object of study, in our case unmet need.

Fourth, although mental health services are organized into Service Areas and children and families are typically encouraged to seek services at an agency in their Service Area, they are not required to. Some Service Areas use a centralized intake and referral system that assesses the location of children and families in relation to services within the Service Area. External referrals through schools and healthcare providers such as family doctors and health teams will likely direct families to services in the Service Area in which they live as these groups often organize themselves into communities of practice. However, self-referrals are possible at many agencies and can occur regardless of where people live. It is possible that lengthy wait times or other access issues could force families to seek help in other Service Areas but we have no way of assessing this in the current study. We assign children to Service Areas based on where their home is located assuming that they will seek services close to home. Families that live close to Service Area boundaries may be more likely to seek services in an adjacent Service Area but this problem will apply equally to all Service Areas.

Fifth, in 2018 responsibility for children's mental health service provision in Ontario shifted from MCYS to the Ministry of Health and Long-Term Care, which is also going through a process of reorganization. Although this has not resulted in changes in day-to-day service provision activities, governance policies or funding processes, there may be future changes in the funding and arrangement of children's mental health services. While this does not affect our findings or their implications, they may need to be re-oriented if there is a change in the policy context.

Sixth, a challenge to geographic epidemiology in mental health observed by Holley (1998) also applies here. Namely,

there is a limited choice of indicators at the area-level. Indicators likely relevant to our research questions were either unavailable (e.g. average distance travelled to services could be assessed if specific postal code or geographic coordinates of households and services were available), or available but not appropriate to be used at the area level (e.g. the OCHS study asked questions about perceived barriers to service use but they were only asked of a small subset of individuals who felt they needed help in the past but had not sought services leading to a very small sample to base aggregations on). Being able to assess the impact of area-level barriers requires the availability of reliable data at that level on the constructs of interest.

Finally, the relationship between mental health need and service contact is complicated when they are assessed concurrently and with the same reference period as they are in the current study. There may be cases where need is absent and the service contact is present (i.e. occurred within the 6 months prior to the study interview) because the need was already addressed. Similarly, we cannot assume that concurrent need and service contact means that the need is being effectively addressed. The need could continue to be unmet, even with treatment, if that treatment is not appropriate or ineffective. Further, the unmet need variable used in the analysis does not measure the extent or depth of unmet need. Children and families could be under-served based on their needs to differing extents and our definition does not capture this. These are not issues that we can address due to the cross-sectional nature of the data. However, we can assume that even if the assessment of unmet need is not perfect for the reasons outlined above, these reasons should at least be consistent across Service Areas.

This issue is further complicated in the current study as we focus on service contact with MCYS-funded community-based services. Children with unmet need may be misidentified as they could have mental health needs that are being met in the health or education sector or through private providers, although the majority of treatment services are provided by MCYS in Ontario. This is an important area for further research as there is currently no standardized approach to coordinating care across sectors, we don't know how these different services are being accessed, how many children are receiving services from multiple sectors, or the extent to which area-level variation in unmet need would be larger or smaller if we took these other sectors into account. As MCYS provides the majority of treatment service and planning and policy decisions about children's mental health services are made independently of other sectors, we think our focus on MCYS-funded services is justified and more likely to produce policy-relevant results.

There are many opportunities for novel and innovative research in this largely neglected area and we hope that this study stimulates additional work in this area. In the identification of potential Service Area-level policy levers that could be used to address children's unmet need for mental health services, existing evidence is extremely limited and there is much work to be done. This type of work holds promise for generating new policy-relevant knowledge that can inform community-based mental health service provision. The increasing availability of administrative data and individual-level location tracked information could address some of the limitations identified. Further work is needed to understand whether Service Area-level interventions could address the urban–rural inequities identified. Qualitative research efforts in Service Areas with higher unmet need could provide additional insights into service barriers and could inform the development of alternate service delivery frameworks designed to address these barriers.

Conclusion

The data and analytical requirements for studying area-level variation in children's unmet need for community-based mental health services adequately has lead to a lack of research in this area to date. In addressing existing knowledge gaps, this study uncovered service arrangement, geographic and socio-economic inequities in children's unmet need for mental health services (the extent to which children with a mental health need are in contact with services). These findings represent significant challenges to policymakers and administrators in children's community-based mental health services that might extend beyond the mental health services sector. Nonetheless, Service Area initiatives to understand and address unmet need in areas with fewer agencies, rural areas, areas with higher socio-economic disadvantage and areas without satisfactory public transport could be warranted. With this increased understanding, potential policy implications include: (1) consideration of increasing agency numbers in Service Areas with smaller numbers of agencies, (2) greater funding or human resource support to rural Service Areas, (3) coordination with local municipalities or other government ministries to assess and address public transport issues, and (4) consideration of alternate service delivery methods that do not require in-person visits. Development of appropriate theoretical models in this area is needed in addition to further quantitative and qualitative research to identify and further understand Service Area-level barriers.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee (Hamilton Integrated Research Ethics Board 13-140), Statistics Canada's *Statistics Act* and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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