CHILDREN'S MENTAL HEALTH NEED IN ONTARIO

Children's mental health need in Ontario: measurement, variations in unmet need and the alignment between children's mental health service expenditures and need

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LAY ABSTRACT

The goals of this thesis are to address issues relating to: (1) measuring child and adolescent mental health need using brief, self-report problem checklists and (2) using these measures to answer questions about children's mental health service use and service expenditures in the general population in Ontario. The individual manuscripts in this thesis respond to the need for simple, brief, self-report measures of child and adolescent mental disorders and advance our knowledge about policy and funding decisions in children's mental health services research in Ontario.

ABSTRACT

This thesis draws on the 2014 Ontario Child Health Study (2014 OCHS) to address four contemporary and policy-relevant issues associated with measuring child and adolescent mental health need and children's mental health service use in the general population. The first and second papers focus on the development and evaluation of instruments to measure child mental disorder. The first paper develops a simple, brief symptom checklist used to measure child mental disorder conceptualized as a dimensional phenomenon, a core concept in the 2014 OCHS. The second focuses on a briefer version of this checklist to measure child mental disorder dimensionally in general and clinical populations for the purposes of assessing and monitoring children's mental health need. The third and fourth papers use these measures as the basis for assessing children's mental health need in evaluations of policy-relevant health service questions. The third paper focuses on a substantive question about area-level variation in children's unmet need for mental health services using 2014 OCHS data linked to government administrative data and 2016 Census data. The fourth paper estimates the extent to which child mental health service expenditures in 2014-15 were allocated according to children's mental health need. Together, these papers respond to the need for simple, brief, self-report measures of child and adolescent mental disorders and show how these types of measures, in combination with administrative government data sources can advance our knowledge about policy and funding decisions in children's mental health services research in Ontario.

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LIST OF ALL ABBREVIATIONS AND SYMBOLS

ABBREVIATIONS

ADHD: Attention-deficit hyperactivity disorder
AVE: Average Variance Extracted
BCFPI: Brief Child and Family Checklist
CBCL: Child Behaviour Checklist
CD: Conduct disorder
CFA: Confirmatory factor analysis
CFI: Comparative fit index
ChYMH: InterRAI Child and Youth Mental Health Assessment
CI: Confidence interval
CIHI: Canadian Institute for Health Information
CIHR: Canadian Institutes of Health Research
df: Degrees of freedom
DSM: Diagnostic & Statistical Manual
EFA: Exploratory factor analysis
Ext: Externalizing
GAD: Generalized anxiety disorder
Int: Internalizing
IRT: Item response theory
K-SADS-PL: Schedule for Affective Disorders and Schizophrenia for School-Aged Children-Present and Lifetime Version
M: Mean
MCYS: Ministry of Children and Youth Services
MDD: Major depressive disorder
MHASEF: Mental Health and Addictions Scorecard and Evaluation Framework
MINI-KID: Mini International Neuropsychiatric Interview for Children and Adolescents (MINI-KID)
MOHLTC: Ministry of Health and Long-Term Care
MTMM: Multitrait-multimethod matrix
OCHS: Ontario Child Health Study
OCHS-EBS: Ontario Child Health Study Emotional Behavioural Scales
OCHS-EBS-B: Ontario Child Health Study Emotional Behavioural Scales-Brief Version
OCHS-R: Ontario Child Health Study-Revised Scales
ODD: Oppositional-defiant disorder
OR: Odds ratio
PMK: Person most knowledgeable
RMSEA: Root mean squared error of approximation
SAD: Separation anxiety disorder
SD: Standard deviation
SDI: Standardized diagnostic interview
SDQ: Strengths and Difficulties Questionnaire

SE: Standard error
SEM: Structural equation Modelling
SP: Social phobia/social anxiety disorder
TAU: Target allocation unit
UK: United Kingdom
US: United States
WHO: World Health Organization

SYMBOLS
κ: Kappa
χ^2: Chi-square
α: Cronbach's alpha OR item difficulty in the context of IRT
r: Pearson correlation coefficient
β: item discrimination
√: Square root

DECLARATION OF ACADEMIC ACHIEVEMENT

This thesis comprises four studies written by L. Duncan. Ms. Duncan developed their objectives, questions and goals, conducted the data analyses, interpreted the results, prepared the manuscripts and made revisions according to co-author suggestions. These manuscripts were all prepared as part of the PhD. thesis according to the education plan developed with the supervisor and members of the thesis committees. The work was conducted between January 2016 and November 2019. These manuscripts represent original work conducted by Ms. Duncan, under supervision from her committee. Much of the work contained within this thesis was a result of collaborations with and contributions from other researchers. This is acknowledged through the inclusion of multiple co-authors on each of the individual papers. As such, these manuscripts are justified for inclusion in the main body of the thesis.

This thesis comprises two published manuscripts, one manuscript that is under review and one manuscript that is ready to be submitted. For each manuscript, the authors and co-authors and their contributions are documented below. Scholarly works have been printed under license by the Canadian Journal of Psychiatry.

Author	Contributions
1. The 2014 Ontario Child Health Study Emotional Behavioural Scales (OCHS-EBS) Part I: A checklist for dimensional measurement of selected DSM-5 disorders	
Work conducted from Jan 2016 to June 2018	
L. Duncan, MA (Student)	Data collection, analytical strategy, data analysis for Table 1, 2, and 4, and writing and revising the manuscript.
K. Georgiades, PhD (Committee member)	Study design and manuscript review.
L. Wang, PhD	Data analysis for Table 3, 5, and manuscript review.
J. Comeau, PhD M. A. Ferro, PhD	Manuscript review.
R. J. Van Lieshout, MD, PhD, FRCPC P. Szatmari, MD, FRCPS K. Bennett, PhD H. L. MacMillan, MD, FRCPC E. L. Lipman, MD, FRCPC M. Janus, PhD	Manuscript review and member of expert panel.
A. Kata, MA, MPH	Data collection and manuscript review.
M. H. Boyle, PhD (Supervisor)	Study design, analytical strategy, manuscript review and editing.

2. Psychometric properties of a brief version of the 2014 Ontario Child Health Study Emotional Behavioural Scales (OCHS-EBS-B) Part I: A checklist for dimensional measurement of children's emotional, behavioural and attention problems in general and clinical populations	
Work conducted from Jan 2017 to November 2019	
L. Duncan, MA (Student)	Analytical strategy, data analysis for Table 1, 2, 3 and 4, and writing and revising the manuscript.
K. Georgiades, PhD (Committee member)	Study design and manuscript review.
L. Wang, PhD	Data analysis for Table 3, 6 and manuscript review.
S. Birch, PhD (Committee member)	Manuscript review.
M. H. Boyle, PhD (Supervisor)	Study design, analytical strategy, manuscript review and editing.
3. Area-level variation in children's unmet mental health need: Findings from the 2014 Ontario Child Health Study	
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L. Duncan, MA (Student)	Analytical strategy, all data analysis, writing and revising the manuscript.
K. Georgiades, PhD (Committee member)	Study design and manuscript review.
G. J. Reid, PhD J. Comeau, PhD S. Birch, PhD (Committee member) L. Wang, PhD	Manuscript review.
M. H. Boyle, PhD (Supervisor)	Study design, analytical strategy, manuscript review and editing.
4. Children's Mental Health Need and Expenditures in Ontario: Findings from the 2014 Ontario Child Health Study	
Work conducted from Jan 2018 to December 2018	
L. Duncan, MA (Student)	Analytical strategy, all data analysis, writing and revising the manuscript.
K. Georgiades, PhD (Committee member)	Study design and manuscript review.
S. Birch, PhD (Committee member) J. Comeau, PhD	Manuscript review.
L. Wang, PhD	Data preparation and manuscript review.
M. H. Boyle, PhD (Supervisor)	Study design, analytical strategy, manuscript review and editing.
2014 Ontario Child Health Study Team	Study design and manuscript review.

CHAPTER 1: INTRODUCTION

There have been repeated calls for Canada to take a population health approach to mental health (National Collaborating Centre for Healthy Public Policy, 2014) and to children's mental health specifically (Waddell, McEwan, Shepherd, Offord, & Hua, 2005; Waddell, Shepherd, Chen, & Boyle 2013; Boyle et al. 2019a). A population approach includes child and youth (herein child(ren)) mental health promotion, the prevention of mental disorders and treatment provision (National Collaborating Centre for Healthy Public Policy, 2014). Population health approaches must be founded on good quality data and information. To monitor the needs (both terms 'needs' and 'need' are used throughout) that exist in the population and measure society's progress in responding to those needs, data and information on those needs, their determinants and interventions are required (Waddell, Shepherd, Chen, & Boyle 2013, Canadian Institute for Health Information, 2015). Repeated cross-sectional epidemiologic surveys serve this purpose, although they are expensive and becoming increasingly more difficult to implement in the face of dwindling response rates (Czajka & Beyler, 2016). In addition, similar data are needed from children who are receiving mental health services, along with information about the types of services received and their outcomes (Waddell, Shepherd, Chen, & Boyle 2013). Collecting data from both children in the general population and children receiving services enables understanding how well the needs of the population are being addressed, and ensures the effective and efficient use of public resources (Ford, 2008; Boyle et al., 2019a, Duncan, Boyle, Abelson & Waddell, 2018).

Ontario has access to high quality epidemiologic data on the mental health needs of children through the Ontario Child Health Study (OCHS), which was originally conducted in 1983 and repeated in 2014 (Boyle et al., 1987; Boyle et al., 2019). However, efforts to implement a standardized approach to routine data collection within children's mental health agencies have faltered (Duncan, Boyle, Abelson & Waddell, 2018). In 1999, the Ontario government implemented Canada's first systematic screening and outcome measurement plan but this was subsequently abandoned in 2015 when the government removed funding support for the instruments being used as part of the plan (O'Hara, 2014). Work has been done to try to understand the reasons for this decision and to examine future prospects for the measurement of children's mental health in the province (Duncan, Boyle, Abelson & Waddell, 2018). The authors acknowledge that Ontario is constrained by limits on accountability mechanisms that are available to policymakers and the presence of multiple players in the children's mental health sector—all with a different set of interests. Opportunities for change are identified but there appears to be a lack of government will to introduce or support change.

In the absence of a data-informed, population approach to addressing the mental health needs of children, the Ontario government is unable to address criticisms it has received to date. Governments have come under fire for: (1) a mental health system that is complicated and disorganised (Canadian Institute for Health Information, 2015); (2) a lack of ministerial coordination (Kirby & Keon, 2006); (3) the inability of the various services to effectively and efficiently meet the needs of Ontario children (Auditor General of Ontario, 2008); and (4) for services that are hard to navigate and not evidence-based (Office of the Provincial Advocate for Children and Youth, 2012). Most recently, the Auditor General of Ontario (2018), commenting on the Child and Youth Mental Health program of services, wrote that the government, "does not monitor and effectively administer this program to ensure that children and youth in need of mental health services are provided with timely, appropriate and effective mental health services, and to ensure that mental health services are delivered efficiently" (Auditor General of Ontario, 2018 pp.111). The various sources of system complexity complicate the evaluation of system responsiveness but also make this task even more critical. Currently, it is unknown how children's mental health services and resources to services are distributed across sectors, as is the extent to which children are accessing various services across sectors (Duncan, Boyle, Abelson & Waddell, 2018).

The current situation in Ontario is partly a result of the genesis of service provider organisations. Historically, individual agencies and organisations arose independently as a local response to children's mental health need. Over time, other organisations appeared and in 1990 the Child and Family Services Act (Government of Ontario, 1990) was instituted to bring these organisations under the purview of the Ontario government. Since that time, and under different Ministries, the government has been responsible for funding children's mental health services with little additional oversight (Duncan, Boyle, Abelson & Waddell, 2018) and with resistance from agency staff to efforts to institute accountability mechanisms (Barwick, Boydell, Cunningham, & Ferguson, 2004). In 2019, the government introduced changes to the structure and organisation of the Ontario health system, which included repealing the Child and Family Services Act. It is still unclear how these changes will affect the provision of children's mental health services in Ontario. Papers 3 and 4 include additional description of the landscape of children's mental health.

Change is needed if we are to determine the extent to which governments are fulfilling their mandates to address the mental health needs of children. Accordingly, the overarching objectives of this thesis are to: (1) provide the tools that can be used to assess children's mental health need in a population health approach to addressing these needs; and (2) provide an example of methods and processes that could be used in the evaluation of service response to children's mental health need.

Having outlined the general framework and background context for the work contained in this thesis, the remainder of this introduction provides conceptual background and context on: (1) defining and measuring children's mental health need, and (2) evaluating service responses to children's mental health need. We then outline the thesis objectives and their importance.

1. Children's mental health need

Childhood mental disorders affect one in five children worldwide (Belfer, 2008), contribute to substantial individual and social burdens (Waddell, Schwartz, & Andres, 2018), and lead to adverse outcomes later in life (Fergusson, Horwood & Ridder, 2005; Colman et al., 2009). In Canada, mental illness is the primary cause of disability and produces $51 billion per year in health care costs and lost productivity (Lim, Jacobs, Ohinmaa, Schopflocher, & Dewa, 2008). As a result, children's mental health need represents a considerable public health concern (Kvalsvig, O'Connor, Redmond, Goldfeld et al. 2014). In response to this concern, governments have implemented mental health policies and programs designed to address the population's need for mental health care (World Health Organization, 2005). This typically includes the provision of mental health treatment services to ameliorate disorders and other mental health challenges children face. The ability of mental health systems to respond to the needs of children has been identified as an intrinsic goal of health care systems (World Health Organization, 2000) and this 'responsiveness' serves numerous overarching population health policy principles including health equity, accountability and efficiency (Bhattacharya & Bhatt, 2017).

1.1 The role of psychiatric disorder in children's mental health need

The papers in this thesis draw on two different approaches to defining mental health need adapted from the typology of need discussed by Bradshaw (1972; 2005). He identifies need as normative (presence of mental disorder); felt (parent/youth 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 no consensus about the most accurate definition of need in children's mental health and the appropriate choice depends on how the definition is being used (Wolpert & Ford, 2015). In papers 1 and 2, we start by defining mental health need as normative, or the presence of a psychiatric disorder. In papers 3 and 4, we expand this to include subjective perceptions of need for reasons outlined below.

1.2 Issues in the classification of child psychiatric disorder

There are two common approaches to the classification of child psychiatric disorder: categorical and dimensional (Boyle & Georgiades, 2010). Categorical classification views disorder as a discrete phenomenon represented as a binary

'present/absent' variable. Categorical representations of psychiatric disorder are based on psychiatric nosologies such as the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM) (DSM-5; American Psychiatric Association, 2013) developed to support clinical decision making. Disorders consist of groupings of symptoms and in some cases require the presence of impairment or a certain age of onset. Being classified as having a disorder requires meeting a set of these criteria. Dimensional classification views disorder as an underlying continuum of response associated with co-varying symptoms represented on a frequency or severity scale (Clark, Watson & Reynolds, 1995). These classifications are usually derived empirically using statistical methods such as factor analysis to evaluate patterns of covariance among the symptoms chosen to represent disorder. They are not dependent on an underlying formal classification system such as the DSM.

1.3 Issues in the measurement of child psychiatric disorder

Standardized diagnostic interviews (SDI) are used to assess and classify child psychiatric disorder categorically. They were developed in response to concerns about the low reliability of clinical diagnoses (Kraemer, Kupfer, Clarke, Narrow, & Regier, 2012), and have now become the de facto gold standard for classifying child psychiatric disorders (Drill, Nakash, DeFife, & Westen, 2015; Nordgaard, Revsbech, Sæbye, & Parnas, 2012). This is despite meta-analytic evidence showing that overall test-retest reliability of SDIs is modest ($\kappa = 0.58$; 95% CI, 0.53 to 0.63) and variable across studies (Duncan et al., 2019). To measure child psychiatric disorder dimensionally, self-completed problem checklists are used. These checklists include brief descriptions of symptoms that are rated based on frequency or severity and summed to generate a scale score. Applying a threshold or cut-point to these scale scores enables the derivation of categorical, as well as dimensional, measures.

There have been debates over whether categorical or dimensional representations of disorder are most accurate (Cogill & Sonuga-Barke, 2012). Categorical and dimensional representations of disorder are suited to different uses. Categories are useful from a practical perspective as they allow easy grouping of individuals based on the presence/absence of disorder that can assist decision-making by clinicians, administrators and policymakers (Boyle et al., 2017). Dimensional representations are useful from a descriptive and statistical perspective as they contain more information, and provide psychometric advantages that have been quantified as a 15% increase in reliability and a 37% increase in validity compared to categorical measures (Markin, Chmielewski, & Miller, 2011). However, the notion that childhood psychiatric disorder is categorical in the sense of representing a true 'class' or discrete phenomenon has little empirical support. The construction of categories to represent psychiatric disorder rests on arbitrary

judgements about the frequency and severity of symptoms defining each disorder (Cogill & Sonuga-Barke, 2012).

The establishment of a knowledge base in children's mental health that can be used to assess population need and to evaluate system responsiveness depends on the availability of instruments that are reliable and valid in the measurement of disorders as dimensional and categorical phenomena. With the use of thresholds or cut-points, problem checklists can be used both ways. At the same time, there is growing evidence that problem checklists can classify child psychiatric disorder with comparable levels of reliability and validity to SDIs (Boyle et al., 2017: Boyle et al., 2019b). Checklists possess a number of additional benefits—they are shorter, cheaper, less burdensome to respondents and more straightforward to administer than SDIs. This evidence suggests that problem checklists are an optimal choice in the measurement of disorder for the purposes of population needs assessment.

However, few checklist measures have been developed and evaluated with this dual purpose of dimensional and categorical measurement. The 2014 Ontario Child Health Study (Boyle et al., 2019; Statistics Canada 2017), a large scale, epidemiological study provided the opportunity to develop these instruments. The first and second papers in this thesis develop and evaluate tools designed to measure child psychiatric disorder. These two papers focus on the development and evaluation of instruments to measure disorder as a dimensional phenomenon. Each of these thesis papers set the stage for accompanying papers (not part of this thesis but published/submitted as partner papers) that convert scales scores to binary measures and evaluate their usefulness as categorical representations of disorder (e.g., Boyle et al., 2019b).

The first paper develops and evaluate instruments comprised of 52-items rated by parents and youth to measure seven DSM-5 disorders dimensionally for use in research and clinical populations. These instruments are brief, inexpensive to administer and psychometrically sound. Intended for use in both epidemiological research studies and in community-based child mental health service agencies, these instruments were created as an alternative to lengthier, more burdensome assessments.

The second paper identifies and evaluates a subset of 22 items rated by parents to measure emotional, behavioural and attention problems dimensionally in the general population and clinical samples. The 22 items selected for these instruments are a subset of the items developed in paper 1. A reduced set of items was deemed necessary to shorten completion time for use in general population studies (Atrostic, Bates, Burt, & Silberstein, 2001) and in community-based child mental health service agencies. The strategy of having overlapping items across measures makes it possible to link assessments of children's mental health need in both the general population and among those who are in contact with services

(Wolpert & Ford, 2015)—a prerequisite for implementing a population-health strategy to children's mental health (Boyle et al., 2019a). To ensure usefulness for this purpose, the measure developed in paper 2 is evaluated in both general population and community-based mental health services samples. These papers both use the 2014 OCHS study sample and employ some of the same methods. Therefore, the reader should expect some overlap in the methods sections of these papers.

1.4 The role of subjective perceptions of need in children's mental health need

As indicated by Bradshaw's typology of need (1972; 2005), children's mental health need is more complex than simply the presence of psychiatric disorder. In particular, 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 psychiatric disorder (Wichstrøm, Belsky, & Jozefiak, 2014). In a review of approaches and predictors associated with assessing population need for mental health care, Aoun, Pennebaker and Wood (2004) argue that the level of impairment caused by mental health problems and how that impairment is perceived by the individual can determine the level of service required. They argue that measures of need should place greater emphasis on perceived need, quality of life and symptom severity levels. Therefore, when considering questions and issues related to system responsiveness, it may be appropriate to expand the definition of children's mental health need. This is the approach taken in the second two papers of the thesis. Given the connection between perceptions of need and service use (Wichstrøm, Belsky, & Jozefiak, 2014) and the observed increase in perceived or felt need in the past 30 years (Comeau et al., 2019), we incorporate perceptions of need into our definition of children's mental health need. Paper 3 goes one step further and compares the results when using two different definitions of need—one based on disorder and one based on perceived need.

2. Evaluating service responses to children's mental health need

Having developed measures of children's mental health need in papers 1 and 2, papers 3 and 4 examine how data collected by these measures can be used to evaluate service responses. Responsiveness—the ability for mental health systems to respond to the needs of children—is an intrinsic goal of health care systems (World Health Organization, 2000) that serves population health policy principles including health equity, accountability and efficiency (Bhattacharya & Bhatt, 2017). We define service response broadly as the idea that governments should deliver mental health services to those who need them. Our definition does not include service response understood as effectiveness of specific services or treatment programs that might be delivered as part of the broader service system.

Health services research aims to better understand, and ultimately improve, the management, organisation, delivery and outcomes of health care, and can inform government approaches to service planning and evaluation. Researchers have outlined how epidemiologic data can be used to plan, organize and evaluate mental health services for children (Costello, Burns, Angold, & Leaf, 1993; Wolpert & Ford, 2015). These authors discuss the challenges of defining need, as already discussed, and suggest examining service gaps and the reasons for these gaps. They also suggest looking at barriers to help-seeking, factors that predict access and provide recommendations on using epidemiology to determine service organisation and funding arrangements. However, the field of children's mental health services research is continually under-funded and under-developed (Burns & Friedman, 1990; Hoagwood et al., 2018). As a result, there are few attempts to evaluate service response to children's mental health need in real-world settings.

Papers 3 and 4 in this thesis address two issues in children's mental health service provision in Ontario. The first issue is about service efficiency (Cornia & Stewart, 1995) and is based on the principle that children's mental health services should be delivered to those that have a mental health need. Paper 3 focuses on the determinants of 'unmet need' – the number of children who have a mental health need but are not receiving services (Wolpert & Ford, 2015). Our approach to evaluating unmet need in Paper 3 is through the assessment of area-level variation and correlates of children's unmet need for mental health services, drawing on evidence from the small field of mental health geography (Philo, 2005) and using multi-level regression modelling to identify area-level factors associated with unmet need.

The second issue we address is resource allocation to children's mental health services, a critical aspect of a population health perspective (Kindig & Stoddard, 2003). Needs-based planning is a commonly used rational planning approach in health care (Eyles & Birch, 1993; Birch et al., 2007). This type of approach is based on the principle that resources should be allocated according to need. In Ontario, needs-based planning models have been developed in substance use services and supports (Rush, 2014). In children's mental health services, the government considered but never implemented a funding formula approach (MNP, 2016a; 2016b). Paper 4 evaluates the extent to which service expenditures are allocated according to need by taking a funding formula approach (Buehler & Holtgrave, 2007) that accounts for population need and service use amongst children with and without need. This formula is then applied to distribute available expenditures and the result is compared with the actual distribution of expenditures. As most governments allocate resources according to child population size at a minimum, we also try to articulate the benefit of adjusting for children's mental health need in addition to child population size.

2.1 Previous attempts to evaluate service responses to children's mental health need

In Canada, research using population approaches to evaluating service responses to children's mental health need is limited, representing a significant knowledge gap. Efforts have been made to use administrative health data to produce scorecards on system performance (Mental Health and Addictions Scorecard and Evaluation Framework Research Team, 2015; 2017) and assess trends over time (Gandhi, Chiu, Lam et al., 2016). The data used in these analyses only include children who have been 'touched' by the health system and restrict the evaluation of responsiveness to one part of the population—health system users. Other efforts to evaluate service response include research examining whether services are distributed according to need in Quebec (Blais, Breton, Fournier, St-Georges & Barthiaume, 2003) and an examination of resource allocation to children's mental health services and child welfare in Ontario (Boyle & Offord, 1988). The existing evidence is further discussed in papers 3 and 4 of the thesis.

Part of the reason for the lack of research in this area is the limited availability of population-level data that can be linked with administrative services data to answer policy-relevant research questions. The data in the 2014 OCHS represent a unique opportunity in this regard. Papers 3 and 4 not only expand our knowledge about system-level issues related to children's mental health service response but represent examples to policymakers of the types of questions that can be addressed when data of this type are available. This is turn reinforces the importance of taking a systematic, population health approach to addressing children's mental health need.

3. Thesis objectives

The overarching objectives of this thesis are to: (1) provide tools that can be used to assess children's mental health need within a population health framework; and (2) provide examples of methods that could be used in the evaluation of service response to children's mental health need. This thesis utilises concepts, methods and analytical approaches from many disciplines within the field of health research methodology—psychiatric epidemiology, health measurement, health economics and health services research. The work contained within this thesis takes a distinctly positivist, quantitative ontological and epistemological perspective. Each of the four papers in this thesis is a manuscript that has been already published (papers 1 & 4), is under review (paper 3) or is soon to be submitted for publication (paper 2). The first two papers focus on the measurement of children's mental health need. The second two papers make use of these measures to evaluate service responses to children's mental health need.

Paper 1 develops a brief problem checklist for the dimensional measurement of DSM-5 disorders; the Ontario Child Health Study Emotional Behavioural Scales (OCHS-EBS) that has research utility in general population samples and clinical utility as an instrument for service providers to use to assess need at either intake or discharge. A partner paper published at the same time and co-authored by Ms. Duncan evaluates the same checklist for categorical measurement (Boyle et al., 2019b). Following publication of this paper, Ms. Duncan co-authored a paper arguing for a children's mental health information system to collect data on children's mental health needs in the general population and in clinical settings (Boyle et al., 2019a). This paper outlines the content, prerequisites and organization of such a system. It emphasizes the collection of a standardized, objective, core set of identical measures of children's mental health in both the general population and in children's mental health agencies to ensure that the data collected can be used to improve decision-making. While a 52-item checklist might be appropriate for research and clinical use, it is too long to be practical for use in a children's mental health information system. This provided the motivation for Paper 2.

Paper 2 responds to the need for even briefer problem checklist measures and describes the development and evaluation of a briefer 22-item checklist (OCHS-EBS-B) that could serve a purpose in a children's mental health information system, like the one outlined in a paper by Boyle and colleagues (2019a). This system would involve parallel assessments of children's mental health need in both general population and community-based mental health agencies in order to determine the needs that exist in the population and the needs that are being addressed by mental health agencies. Such a system would support improved and evidence-based decision making. A partner paper to be submitted for publication at the same time and co-authored by Ms. Duncan evaluates the brief checklist for categorical measurement.

Paper 3 identifies area-level variation and correlates of children's unmet mental health need. This paper capitalises on the clustered sampling approach taken by the 2014 OCHS study based on Census geography that overlaps with the administrative boundaries of children's mental health services. It uses the OCHS-EBS developed in paper 1 to measure assessed need.

Paper 4 uses the same survey and administrative data to evaluate the extent to which children's mental health service expenditures are allocated according to need. This paper was motivated by a similar analysis that was conducted in 1988 (Boyle & Offord) and a hope that it may be possible to compare results over time. Unfortunately, due to changes in service governance and organisation this was not possible. The paper includes two different approaches to need definition and presents two sets of results according to the alternate definitions, one based on assessed need (mental health disorder) and one based on perceived need. This paper also uses the OCHS-EBS from paper 1 to measure assessed need.

Observations have been made that, "(p)sychiatric epidemiology should become more central to mental health service planning" (McGrath et al; 2018). This thesis represents a serious attempt to provide the tools and some of the evaluation methods that are needed to achieve this objective.

3.1 Importance

I believe that the work in this thesis demonstrates importance, originality, relevance, and impact. Children's mental disorders have wide-ranging impacts and are an important determinant of outcomes later in life (Waddell, Schwartz, & Andres, 2018; Fergusson, Horwood & Ridder, 2005; Colman et al., 2009). Therefore, this thesis addresses an important public health issue. In terms of originality, this work makes two novel contributions. First, it offers up-to-date, psychometrically robust measures of children's mental health need that can be used in a population health approach to monitoring children's mental health need and evaluating service response to need. Second, the two evaluations use innovative analytical methods to address a knowledge gap in children's mental health services research and contribute new evidence on the magnitude and correlates of variation in area-level unmet need and the benefit of adjusting for children's mental health need in funding formulas designed to allocate resources to services. In terms of relevance, the work in this thesis aligns with the overall goal of health policies and programs in Canada. The mandate and objectives of governments are to provide accessible, efficient and effective responses to children's mental health need in the general population (WHO, 2000). Papers 3 and 4 are directly relevant to these objectives by addressing questions of accessibility (unmet need) and efficiency (unmet need and resource allocation). In terms of practical impact, this thesis provides the tools that could be used by decision makers to evaluate improve health system responses to children's mental health need and provides direction on processes and strategies that Ontario policymakers could take with the data they have available to them.

In summary, findings from this thesis can: (1) inform systematic approaches to the measurement of mental health need; (2) motivate future research in the evaluation of service response; and (3) be used to develop population approaches to policy evaluation and planning in the children's mental health system that will ultimately improve the ability for children's mental health services to respond to the needs of children and their families.

3.2 Areas of duplication

All studies in this thesis use data from the 2014 OCHS and as such, there is some repetition in the description of data across papers. A similar analytical strategy is employed in papers 1 and 2 and so there is some repetition in the methods and analysis of these papers. The analyses of children's mental health

services in papers 3 and 4 both focus on the Ontario context and so the description of the service landscape is similar in papers 3 and 4. Papers 3 and 4 also use the same combination of survey data, administrative and Census data so there will be some repetition in the description of data.

It is also worth noting that due to the different style requirements and country of publication of the journals in which the thesis papers have been published or submitted, the reader will find differences in referencing styles and some spelling, numbering and other conventions.

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CHAPTER 2: THE 2014 ONTARIO CHILD HEALTH STUDY EMOTIONAL BEHAVIOURAL SCALES (OCHS-EBS) PART I: A CHECKLIST FOR DIMENSIONAL MEASUREMENT OF SELECTED DSM-5 DISORDERS

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2.2 CONTEXT AND IMPLICATIONS OF THIS STUDY: The Ontario Child Health Study Emotional Behavioural Scales (OCHS-EBS) address limitations of previous measures by balancing the number of items selected (burden) against comprehensive coverage of common disorders, selecting items according to DSM-5 disorder symptoms and serving both the needs of decision makers (categorical measures) and the pragmatics of measurement and analysis (dimensional measures). The paper describes the development and psychometric properties of the OCHS-EBS for dimensional measurement of seven DSM-5 disorders and provides evidence indicating that the OCHS-EBS provides reliable and valid dimensional measurement of disorders assessed by caregivers and youth. This instrument has clinical utility for service providers as many community-based children's mental health agencies do not implement standardized assessments of child mental disorder at either intake (to characterize the mental health needs of their patients/clients) or follow-up (to assess improvement or deterioration in their mental health status). This instrument could be used in this way.

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The 2014 Ontario Child Health Study Emotional Behavioural Scales (OCHS-EBS) Part I: A Checklist for Dimensional Measurement of Selected *DSM-5* Disorders

Échelles émotionnelles comportementales de l'Étude sur la santé des jeunes ontariens (EEC-ESJO) de 2014, première partie : une liste de vérification pour la mesure dimensionnelle de troubles choisis du DSM-5

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Abstract

Objectives: To describe the development and psychometric properties of the 2014 Ontario Child Health Study Emotional Behavioural Scales (OCHS-EBS) for dimensional measurement of 7 disorders based on criteria from the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-5*).

Methods: Scale items were selected by agreement among 19 child psychologists and psychiatrists rating the correspondence between item descriptions and *DSM-5* symptoms. Psychometric evaluation of the item properties and parent/caregiver and youth scales came from a general population study of 10,802 children and youth aged 4 to 17 years in 6537 families. Test-retest reliability data were collected from a subsample of 280 children and their caregivers who independently completed the OCHS-EBS checklist on 2 occasions 7 to 14 days apart. Structural equation modelling was used to assess internal and external convergent and discriminant validity—the latter tested against the Mini International Neuropsychiatric Interview for Children and Adolescents (MINI-KID).

Results: Confirmatory factor analyses exhibited adequate item fit to all scales. Except for conduct disorder and youth-assessed separation anxiety disorder, internal (Cronbach's α) and test-retest reliability (Pearson's r) for scale scores were 0.70 or above. Except for youth-assessed conduct disorder, the OCHS-EBS met criteria for internal and convergent and discriminant validity. Compared with the MINI-KID, the OCHS-EBS met criteria for external convergent and discriminant validity.

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Conclusions: The OCHS-EBS provide reliable and valid dimensional measurement of 7 *DSM-5* disorders assessed by caregivers and youth in the general population. Part II describes use of the OCHS-EBS as a categorical (present/absent) measure of disorder.

Abrégé

Objectifs : Décrire le développement des propriétés psychométriques des échelles émotionnelles comportementales de l'Étude sur la santé des jeunes ontariens (EEC-ESJO) de 2014 pour la mesure dimensionnelle de 7 troubles basés sur les critères du *DSM-5*.

Méthodes : Les items des échelles ont été choisis d'un commun accord par 19 psychologues et psychiatres pour enfants qui ont évalué la correspondance entre les descriptions des items et les symptômes du *DSM-5*. L'évaluation psychométrique des propriétés des items et des échelles des parents et des adolescents provenait d'une étude dans la population générale de 10 802 enfants et adolescents âgés de 4 à 17 ans et issus de 6 537 familles. Les données de fiabilité test-retest ont été recueillies d'un sous-ensemble de 280 enfants et leurs parents qui ont indépendamment répondu à la liste de vérification des EEC-ESJO à deux occasions, entre 7 à 14 jours d'intervalle. La modélisation par équation structurelle a servi à évaluer la validité convergente et discriminante interne et externe—la validité discriminante a été ensuite testée par rapport à la mini-entrevue neuropsychiatrique internationale pour enfants et adolescents (MINI-KID).

Résultats : Des analyses factorielles confirmatoires ont montré un ajustement des items adéquat dans toutes les échelles. À l'exception du trouble des conduites et du trouble d'anxiété de séparation évalué par les adolescents, la fiabilité interne (α de Cronbach) et de test-retest (*r* de Pearson) pour les scores aux échelles était de 0,70 ou plus. À l'exception du trouble des conduites évalué par les adolescents, les EEC-ESJO satisfaisaient aux critères de la validité convergente et discriminante interne. Comparées avec la MINI-KID, les EEC-ESJO satisfaisaient aux critères de la validité convergente et discriminante externe.

Conclusions : Les EEC-ESJO offrent une mesure dimensionnelle fiable et valide de sept troubles du *DSM-5* évalués par des parents et des adolescents de la population générale. La deuxième partie décrit l'utilisation des EEC-ESJO à titre de mesure catégorique (présent/absent) d'un trouble.

Keywords

symptom checklist, measurement, structural equation modelling, validity, reliability, child psychiatric disorder

Self-completed symptom checklists of child and adolescent psychiatric disorders are inexpensive to implement, pose little burden to respondents, and can be administered in almost any setting to multiple informants (e.g., parents, teachers, and youth) using various modes of administration (e.g., in person, by mail, Internet, telephone).[1] Many checklists have been developed to measure childhood psychopathology dimensionally, including the Child Behavior Checklist (CBCL)[2] and the Strengths and Difficulties Questionnaire (SDQ).[3] However, these types of measures are limited in terms of 1) efficiency, 2) conceptualization, and 3) versatility. First, the CBCL is long at over 100 items, while the SDQ is short but at the expense of coverage (it includes emotional symptoms, conduct problems, and hyperactivity only). Second, no a priori attempt was made in the measurement development process to align items and syndromes with conceptualizations of disorder based on the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-5*).[4] Third, developed prior to consensus on the practical and theoretical advantages of measuring psychiatric disorder as both dimensional and categorical phenomena,[5-8] there is no evidence that the scales associated with these measures, when converted to categorical measures of disorder (present/absent), are able to classify disorder as reliably and validly as structured interviews.[9] The Ontario Child Health Study Emotional Behavioural Scales (OCHS-EBS) address these limitations by balancing the number of items selected (burden) against comprehensive coverage of common disorders, selecting items according to *DSM-5* disorder symptoms and serving both the needs of decision makers (categorical measures) and the pragmatics of measurement and analysis (dimensional measures). The current study focuses on the OCHS-EBS as dimensional measures of disorders and 1) describes how the development of these scales addresses the limitations of existing measures and 2) presents the reliability and validity of these scales for measuring child psychiatric disorders as dimensional phenomena. A separate article (Part II) evaluates the OCHS-EBS when used as a categorical (present/absent) measure of disorders.

Development

The following practical requirements guided the development of the OCHS-EBS. One, in implementing the 2014 OCHS—a sequel to the original 1983 study[10,11]—we wanted scales to assess disorders commonly reported in general population surveys.[12] These included the following *DSM-5*

conditions: generalized anxiety disorder (GAD), separation anxiety disorder (SAD), major depressive disorder (MDD), social anxiety disorder (social phobia) (SP), attention-deficit hyperactivity disorder (ADHD), oppositional-defiant disorder (ODD), and conduct disorder (CD). Two, aware of declining response rates associated with the burden of participating in general population surveys,[13] we chose a completion time expected to fall within the tolerance of prospective respondents—7 to 10 minutes (about 50 items). Three, in measuring each disorder, we wished to achieve a similar standard of reliability and validity with the minimal number of items. This meant using clinical judgements as the basis for selecting items optimally matched with *DSM-5*[4] symptoms. Our primary focus was the development of a parent- or caregiver-reported assessment for children aged 4 to 17, but we also evaluated an identical youth-reported assessment for youth aged 12 to 17.

The authors created a pool of 72 items by consensus to represent *DSM-5* symptom criteria—64 taken from the Ontario Child Health Study–Revised (OCHS-R) scales[14] and 8 newly formulated to cover unrepresented symptoms. Nineteen child psychologists, psychiatrists, and epidemiologists not involved in developing the item pool were asked to assess each item in relation to *DSM-5* symptom criteria by independently 1) rating the extent to which its content captured the meaning of its *DSM-5* symptom analogue and 2) rank ordering the set of items associated with each scale in terms of how well they represented the core of each *DSM-5* disorder. The item rating was scored as 1 = no correspondence; 2 = poor correspondence, could be interpreted to mean something else; 3 = good correspondence, provides similar information and meaning and represents the symptom adequately; and 4 = excellent match, provides almost the same information and meaning and represents the symptom very well. The item ranking involved ordering the list of items associated with each *DSM-5* disorder as to how well they represented the disorder overall.

To provide assurance that selected checklist items captured the operational meaning of each disorder (content validity), our criterion for selecting individual items was statistically significant agreement ($P < 0.015$ based on the sign test) achieved when 14 of 19 clinicians rated the item as providing 3) good or 4) excellent correspondence to its *DSM-5* symptom analogue. When more than 1 item per symptom met this rating criterion, the one with a higher ranking was selected. Items not meeting the rating criteria were added by the development team if they were deemed highly representative of the disorder based on expert rankings. Fifty-five items met the criterion for consensus agreement among raters. Based on high rankings, the development team added 3 CD items ('Gets in many fights', 'Sets fires', 'Steals outside the home') and 1 SP item ('Doesn't like to be with people he/she doesn't know') from the item pool not meeting rating criteria for a total of 59 items.

Evaluation

Methods

Participants. This study uses data from the 2014 Ontario Child Health Study (OCHS),[15] an epidemiological study of children and youth aged 4 to 17 years and their families, designed by researchers at McMaster University and conducted by Statistics Canada. Using the Canadian Child Tax Benefit file as the sampling frame, 15,796 dwellings were selected, 12,871 were eligible, and 6537 participated (50.8%). Dwellings were selected based on a complex 3-stage survey design that involved cluster sampling of residential areas and stratification by residency (urban, rural) and income (areas and households cross-classified by 3 levels of income: <20th, 20th to 80th, and >80th percentiles). Within families, the primary parent/caregiver, their partner or spouse, and up to 4 children per family were interviewed, resulting in 10,802 primary parent/caregiver reports on all children aged 4 to 17 years and 4428 youth reports for youth aged 12 to 17 years. To assess the reliability of study measures, a subsample of 180 caregivers and up to 2 of their children were reinterviewed 7 to 14 days after the initial interview. To obtain this subsample, Statistics Canada increased the number of dwellings chosen in selected urban clusters representing the 3 income strata and invited eligible families to participate until a total sample of 180 families was achieved. Interviewers provided a brief description of the study and booked consenting families. All families were interviewed at their homes by trained Statistics Canada interviewers. All study procedures, including consent and confidentiality requirements, were approved by the chief statistician at Statistics Canada and were conducted according to the Statistics Act.[16] Families were interviewed between October 2014 and October 2015. The sample for analysis includes respondents with complete data on study measures 10,495 4- to 17-year-olds (2.9% sample loss) and 3945 youth aged 12 to 17 years (10.9% sample loss).

Concepts and measures

OCHS-EBS items. Identical checklists of items from the item pool were completed by parents or caregivers of 4- to 17-year-olds and 12- to 17-year-olds themselves as a self-administered paper (caregivers) or computerized (youth) questionnaire. Items were randomly ordered but in the same random order for both respondents. Respondents rated how well the statement describes the child or youth in the past 6 months as 0 = never or not true, 1 = sometimes or somewhat true, and 2 = often or very true. Included in the analysis are respondents with no missing scale items, which excluded only 0.75% of parent/caregivers and 0.9% of youth.

Mini International Neuropsychiatric Interview for Children and Adolescents (MINI-KID). Based on the adult MINI,[17,18] the MINI-KID is a standardized diagnostic interview that assesses *DSM-IV-TR* disorders in children and youth aged 6 to 17 years. Evaluated in 2 studies,[19,20] the MINI-KID

exhibits good test-retest reliability ($\kappa = 0.56$ to 0.87) for mood, anxiety, substance use, ADHD, and behavioural and eating disorders based on joint caregiver-child interviews and adequate agreement with another diagnostic interview.[19] The MINI-KID was administered separately to youth and caregivers.

In the 2014 OCHS, 7 disorder modules were administered independently to 1 randomly selected child per family and his or her caregiver ($n = 6537$). The MINI-KID training given to Statistics Canada lay interviews included a) supervisor-led reading and review of an interviewer manual; b) a guided training video on characteristics and symptom criteria of the included disorders and the MINI-KID, led by experienced researchers from McMaster University; c) watching example video interviews during the training session; and d) practice interviews among the interviewers. Interviewers were trained to ask the questions as worded, refrain from probing, encourage yes/no answers, and follow a protocol after 'don't know' responses to ensure standardized administrations in accordance with procedures outlined by the MINI-KID authors. An interviewer dictionary provided standard definitions for terms and phrases used.

Analysis

Internal validity. To evaluate empirically the 59 items remaining from scale development, we used confirmatory factor analysis (CFA) in Mplus 7.4[21] to confirm the expert item selection and assess the associations of the caregiver-reported items with their hypothesized scales (internal factor structure). CFA, as opposed to exploratory factor analysis (EFA), was used as the number of factors being assessed, and the organization of items within factors was already determined. However, correlations between items and scales were examined to determine if scale adjustments were required—a step that is typically part of an EFA procedure.[22] Based on Likert's method for summated rating scales,[23] we expected that items selected for each scale would represent each disorder as a unidimensional attribute, be associated with (load onto) their hypothesized scale at ≥ 0.60,[24] and provide adequate model fit to the observed data. Indicators of model fit and their criteria included the comparative fit index (CFI >0.95) and the root mean squared error of approximation (RMSEA <0.06).[25] The χ^2 test results of model fit are not used to assess model fit because large samples generate significant values even when there is satisfactory model fit.[24] Using the same CFA model fit criteria as above,[26] we expected measurement invariance (configural, metric, and scalar) for each age group (ages 4 to 11 and ages 12 to 17) based on the caregiver report and for males and females based on caregiver and youth reports. Configural measurement invariance indicates that the same items are associated with the same scales across all groups, metric invariance indicates factor loadings are similar across groups, and scalar indicates that scale means are equivalent across groups.[27]

Internal consistency and test-retest reliability. Internal consistency and test-retest reliability were expected to meet commonly accepted psychometric criteria,[28,29] which include estimates ≥ 0.70 for both Cronbach's α (internal consistency) and Pearson's r (test-retest reliability).

Internal convergent and discriminant validity. Building on the standard multitrait-multimethod (MTMM) approach to construct validation,[30] we used variance-based structural equation modelling to assess internal convergent and discriminant validity.[21,31,32] This method improves on the original MTMM approach by using objective criteria to evaluate construct validity and provides more sophisticated measurement of constructs.[31]

Convergent validity focuses on items that make up a scale and compares their shared variance with that scale (true measurement) in relation to their residual variance (measurement error); it is assessed using the average variance extracted (AVE) and is demonstrated when the value of AVE is ≥ 0.5, indicating that at least 50% of the total variance in the items quantified by their factor loadings is explained by the scale.[33,34]

Discriminant validity focuses on associations between items and their hypothesized scales in relation to their association with other scales in the set[35]; it is assessed by comparing the shared variance *within* each scale to the shared variance *between* scales and is demonstrated when the square root of AVE for a given scale is larger than the correlations between this scale and all others.[34,36] We expect some disorder overlap within individuals due to high rates of comorbidity[37,38] (e.g., depression and anxiety[39]) and shared symptom profiles for some disorders (e.g., irritability and moodiness appear in ODD, MDD, and GAD). As a result, the ability to discriminate between highly related or comorbid disorders will be reduced.[40]

External convergent and discriminant validity. To evaluate the external convergent and discriminant validity of the scales empirically, we compared the OCHS-EBS with independent MINI-KID disorder assessments. First, we estimated point-biserial correlations between instruments for caregiver and youth assessments. We expect the correlations between instruments of the same disorder to be higher than the between-instrument correlations for nonsimilar disorders. Second, we implemented a similar MTMM CFA approach as used to evaluate our item selection. In our analysis here, we incorporated different informants (caregiver, youth), different instruments (OCHS-EBS, MINI-KID), and the disorders included in OCHS-EBS. The model consists of 2 factors—one representing internalizing disorder derived from GAD, SAD, MDD, and SP and the other representing externalizing disorder derived from CD, ODD, and ADHD—for each informant and instrument type (Figure 1). As done with the items, model fit was assessed using CFI and RMSEA. Evidence of convergent validity required the AVE to be ≥ 0.5, and evidence of discriminant validity

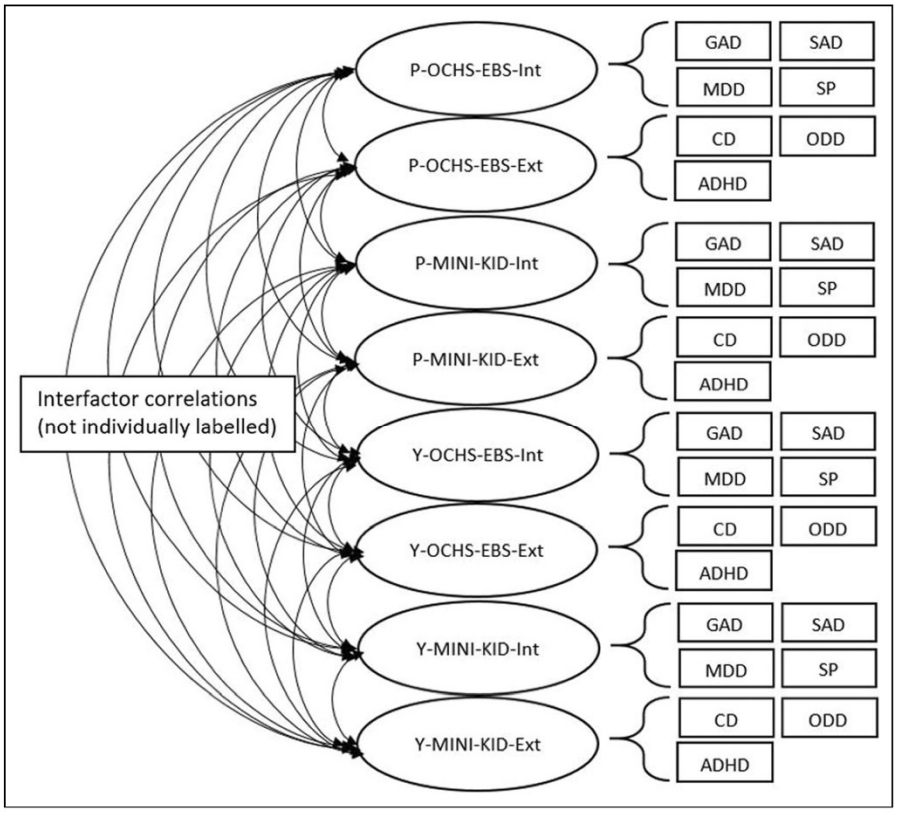

Figure 1. Multitrait-multimethod confirmatory factor analysis model for 8-factor model of internalizing and externalizing latent factors assessed using the Ontario Child Health Study Emotional Behavioural Scales (OCHS-EBS) checklist and Mini International Neuropsychiatric Interview for Children and Adolescents (MINI-KID) by parent/caregiver and youth informants. The arrows on the left correspond to interfactor correlations, values for which appear at the bottom of Table 5.

required the square root of AVE values to be larger than the interfactor correlations among different disorder groupings assessed by the same or different informants or instruments. For example, discriminant validity is confirmed when the square root of AVE for the caregiver checklist-assessed internalizing construct is larger than the interfactor correlations between this construct and both the checklist- and interview-assessed externalizing construct assessed by both the caregiver and youth.

Results

Table 1 presents summary statistics for the 2014 OCHS study sample weighted by their probability of selection and the reinterviewed subsample (unweighted, as weights not available). The sample characteristics are almost identical, although families had slightly higher incomes on average in the retest subsample. This was because families were

Table 1. Sample Characteristics.

Characteristic	2014 OCHS Study Sample[a]	Retest Sample
Youth		
n	10,802	280
Age, mean (SD)	10.63 (4.07)	10.11 (4.16)
Male, %	51.3	49.3
Parent/caregiver		
n	6537	180
Age, mean (SD)	41.54 (7.20)	41.39 (6.87)
Male, %	11.8	16.7
Family		
n	6537	180
Household income, mean (SD)	$100,500 ($162,600)	$114,000 ($94,400)
Single parent, %	20.6	17.2

OCHS, Ontario Child Health Study.
[a]Weighted according to the probability of selection.

Table 2. Weighted Variability and Reliability of the OCHS-EBS by Gender and Age.[a]

Disorder	Mean (SD)			Internal Consistency (α)	Test-retest reliability (*r*)[b]
	All	Male	Female		
Parent/caregiver Report (ages 4 to 11), $n = 6203$					$n = 148$
GAD	1.40 (2.03)	1.41 (2.04)	1.38 (2.02)	0.81	0.73
SAD	1.29 (2.04)	1.21 (1.99)	1.36 (2.08)	0.8	0.77
MDD	1.11 (1.70)	1.24 (1.84)	0.97 (1.52)	0.7	0.78
SP	1.61 (1.93)	1.53 (1.91)	1.70 (1.95)	0.81	0.7
ADHD	2.83 (3.21)	3.38 (3.43)	2.24 (2.83)	0.87	0.76
ODD	1.56 (1.98)	1.82 (2.16)	1.28 (1.73)	0.79	0.77
CD	0.33 (0.89)	0.43 (1.01)	0.22 (0.73)	0.62	0.71
Parent/caregiver report (ages 12 to 17), $n = 4292$					$n = 105$
GAD	1.89 (2.38)	1.75 (2.34)	2.04 (2.42)	0.85	0.84
SAD	0.72 (1.59)	0.65 (1.51)	0.81 (1.67)	0.81	0.79
MDD	1.87 (2.55)	1.72 (2.48)	2.03 (2.61)	0.83	0.75
SP	1.78 (2.25)	1.70 (2.30)	1.87 (2.20)	0.86	0.78
ADHD	2.28 (2.93)	2.71 (3.19)	1.81 (2.54)	0.87	0.87
ODD	1.68 (2.22)	1.80 (2.31)	1.54 (2.10)	0.84	0.7
CD	0.44 (1.36)	0.52 (1.55)	0.36 (1.11)	0.8	0.82
Youth report (ages 12 to 17), $n = 3925$					$n = 96$
GAD	3.26 (3.05)	2.67 (2.75)	3.90 (3.23)	0.86	0.78
SAD	1.95 (2.49)	1.64 (2.21)	2.29 (2.72)	0.79	0.54
MDD	2.86 (3.32)	2.30 (2.75)	3.46 (3.76)	0.85	0.78
SP	3.08 (2.69)	2.75 (2.57)	3.44 (2.78)	0.84	0.78
ADHD	3.79 (3.19)	3.85 (3.26)	3.71 (3.11)	0.81	0.74
ODD	2.07 (2.20)	2.05 (2.16)	2.08 (2.24)	0.76	0.82
CD	0.90 (1.50)	0.97 (1.58)	0.83 (1.42)	0.66	0.6

ADHD, attention-deficit hyperactivity disorder; CD, conduct disorder; GAD, generalized anxiety disorder; MDD, major depressive disorder; OCHS-EBS, Ontario Child Health Study Emotional Behavioural Scales; ODD, oppositional defiant disorder; SAD, separation anxiety disorder; SP, social anxiety disorder (social phobia).

[a]The 2014 Ontario Child Health Study (OCHS) sample was weighted based on the probability of selection. Retest subsample was unweighted.

[b]All estimates $P < 0.01$.

sampled evenly across the 3 income strata, resulting in low- and high-income families being overrepresented in the subsample.

Internal validity. Following confirmatory factor analysis with 59 eligible items, 7 selected items were dropped based on low factor loadings (<0.60), high correlations with 1 or more different disorder scales, or high correlations with other items (results available in the Appendix). This left 52 items selected for 7 disorders: 48 meeting the criterion for symptom agreement among raters (14 or more of 19 raters) and 4 ranked highly as representing specific disorders (3 CD items: 'Gets in many fights', 'Sets fires', 'Steals outside the home' and 1 SP item: 'Doesn't like to be with people he/she doesn't know'). All factor loadings exceeded 0.60; all models fit the data according to our criteria, and except for CD, measurement invariance (configural, metric, and scalar) of the factor structure was confirmed for all scales across sex (caregiver and youth report) and age groups (caregiver report) (results not shown).

Internal consistency and test-retest reliability. Table 2 displays the scale means and standard deviations by child sex, Cronbach's α for internal consistency, and test-retest reliabilities for caregiver report for ages 4 to 11 and 12 to 17, as well as youth report for ages 12 to 17. The scales comprise the same items across samples and informants. With the exception of youth-assessed CD and caregiver-assessed CD for ages 4 to 11, reliability estimates were all over 0.70 with 1 test-retest exception (youth-assessed SAD: 0.54). Average internal consistency was 0.80 for caregiver report for ages 4 to 11, 0.84 for caregiver report for ages 12 to 17, and 0.82 for youth report. Average test-retest reliability was 0.75, 0.79, and 0.74 for these 3 groups, respectively.

Internal convergent and discriminant validity. Table 3 summarizes the convergent and discriminant validity of the scales. Except for youth report CD, AVE values for both caregiver and youth report scales were over 0.5, demonstrating convergent validity. Discriminant validity is established for a scale when the square root of AVE is larger than the correlations between this scale and all other scales in the measurement model. This was demonstrated in 35 of 42 comparisons in the caregiver model and 25 of 42 comparisons in the youth model. Discriminant validity test failures

Table 3. Weighted Scale AVE Values, Interfactor Correlations, and Fit Indices for Confirmatory Factor Analysis by Informant.

		Interfactor Correlations					
Characteristic	AVE ($\sqrt{}$ AVE)	GAD	SAD	MDD	SP	ADHD	ODD
Parent/caregiver informant							
GAD	0.67 (0.82)						
SAD	0.67 (0.82)	0.68					
MDD	0.59 (0.77)	0.83	0.57				
SP	0.72 (0.85)	0.65	0.56	0.64			
ADHD	0.64 (0.80)	0.63	0.48	0.68	0.43		
ODD	0.64 (0.80)	0.67	0.49	0.80	0.51	0.76	
CD	0.61 (0.78)	0.50	0.30	0.67	0.33	0.72	0.88
Model fit indices							
χ^2 (*df*)[a]	2264.367 (*df* = 1253)	*P* < 0.001					
CFI	0.943						
RMSEA	0.009						
Youth informant							
GAD	0.70 (0.84)						
SAD	0.52 (0.72)	0.71					
MDD	0.57 (0.76)	0.92	0.75				
SP	0.60 (0.77)	0.77	0.66	0.74			
ADHD	0.50 (0.70)	0.68	0.61	0.78	0.69		
ODD	0.51 (0.71)	0.72	0.72	0.78	0.70	0.88	
CD	0.48 (0.69)	0.50	0.56	0.63	0.43	0.71	0.84
Model fit indices							
χ^2 (*df*)[a]	3808.501 (*df* = 1253)	*P* < 0.001					
CFI	0.970						
RMSEA	0.014						

ADHD, attention-deficit hyperactivity disorder; AVE, average variance extracted; CD, conduct disorder; CFI, comparative fit index; GAD, generalized anxiety disorder; MDD, major depressive disorder; ODD, oppositional defiant disorder; RMSEA, root mean squared error of approximation; SAD, separation anxiety disorder; SP, social anxiety disorder (social phobia).
[a]χ^2 test

Table 4. Multitrait, Multimethod Matrix Showing Point-Biserial Correlations between the OCHS-EBS Scale Scores and MINI-KID Disorder Classifications by Informant.[a]

	MINI-KID-P								MINI-KID-Y							
Trait	GAD	SAD	MDD	SP	ADHD	ODD	CD	Trait	GAD	SAD	MDD	SP	ADHD	ODD	CD
	OCHS-EBS-P								OCHS-EBS-Y							
GAD	.54							GAD	.51						
SAD	.37	.37						SAD	.28	.26					
MDD	.56	.25	.59					MDD	.45	.33	.41				
SP	.37	.14	.29	.48				SP	.33	.17	.23	.32			
ADHD	.33	.12	.33	.34	.48			ADHD	.28	.19	.23	.19	.29		
ODD	.31	.12	.36	.29	.34	.51		ODD	.28	.21	.25	.23	.28	.36	
CD	.24	.09	.27	.24	.30	.47	.47	CD	.19	.24	.21	.18	.24	.35	.37

ADHD, attention-deficit hyperactivity disorder; CD, conduct disorder; GAD, generalized anxiety disorder; MDD, major depressive disorder; MINI-KID, Mini International Neuropsychiatric Interview for Children and Adolescents interview; OCHS-EBS, Ontario Child Health Study Emotional Behavioural Scales checklist; ODD, oppositional defiant disorder; P, parent; SAD, separation anxiety disorder; SP, social anxiety disorder (social phobia); Y, youth.
[a]All correlations *P* < 0.01.

resulted from interfactor correlations being larger than the square root of AVE for GAD (MDD), MDD (GAD, ODD), ODD (CD, MDD), and CD (ODD) in the caregiver model and for GAD (MDD), SAD (MDD), MDD (GAD, ADHD, ODD), SP (GAD, MDD), ADHD (MDD, ODD, CD), ODD (GAD, MDD, SAD, CD, ADHD), and CD (ODD, ADHD) in the youth model. Both models fit the data according to our criteria. Given the convergent validity failure of youth report CD, we repeated the analysis excluding CD. Convergent validity was established for the remaining 6 scales, and discriminant validity was demonstrated in 24 of 30 cases; test failures resulted from higher square root AVE values than interfactor correlations for GAD (MDD), MDD (GAD), ADHD (MDD, ODD), and ODD (MDD, ADHD).

Table 5. Weighted Standardized Factor Loadings, AVE Values, Interfactor Correlations, and Fit Indices for Confirmatory Factor Analysis—Parent/Caregiver and Youth Informant.

	Parent/Caregiver		Youth	
Model	Standardized Factor Loadings (Error Variance)	AVE ($\sqrt{}$ AVE)	Standardized Factor Loadings (Error Variance)	AVE ($\sqrt{}$ AVE)
OCHS-Int		0.53 (0.73)		0.58 (0.76)
GAD	0.79 (0.38)		0.81 (0.34)	
SAD	0.57 (0.68)		0.59 (0.65)	
MDD	0.88 (0.23)		0.93 (0.14)	
SP	0.62 (0.62)		0.67 (0.55)	
OCHS-Ext		0.61 (0.78)		0.58 (0.76)
ADHD	0.60 (0.64)		0.62 (0.62)	
ODD	0.89 (0.21)		0.86 (0.26)	
CD	0.82 (0.33)		0.79 (0.38)	
MINI-Int		0.71 (0.85)		0.78 (0.88)
GAD	0.94 (0.12)		0.90 (0.19)	
SAD	0.72 (0.48)		0.86 (0.26)	
MDD	0.88 (0.23)		0.91 (0.17)	
SP	0.82 (0.33)		0.87 (0.24)	
MINI-Ext		0.84 (0.91)		0.85 (0.92)
ADHD	0.98 (0.04)		0.99 (0.02)	
ODD	0.98 (0.04)		0.92 (0.15)	
CD	0.89 (0.21)		0.86 (0.26)	

	Interfactor Correlations[a]						
	P-OCHS-Int	P-OCHS-Ext	P-MINI-Int	P-MINI-Ext	Y-OCHS-Int	Y-OCHS-Ext	Y-MINI-Int
P-OCHS-Ext	0.73						
P-MINI-Int	0.76	0.48					
P-MINI-Ext	0.47	0.71	0.57				
Y-OCHS-Int	0.43	0.27	0.48	0.23			
Y-OCHS-Ext	0.43	0.54	0.45	0.49	0.75		
Y-MINI-Int	0.40	0.33	0.72	0.34	0.70	0.49	
Y-MINI-Ext	0.35	0.51	0.52	0.77	0.33	0.62	0.61
Model fit indices							
χ^2 (df)[b]	745.799 ($df = 323$)		$P < 0.001$				
CFI	0.953						
RMSEA	0.011						

ADHD, attention-deficit hyperactivity disorder; AVE, average variance extracted; CD, conduct disorder; CFI, comparative fit index; Ext, externalizing; GAD, generalized anxiety disorder; Int, internalizing; MDD, major depressive disorder; MINI, Mini International Neuropsychiatric Interview for Children and Adolescents interview; OCHS, Ontario Child Health Study Emotional Behavioural Scales checklist; ODD, oppositional defiant disorder; P, parent; RMSEA, root mean squared error of approximation; SAD, separation anxiety disorder; SP, social anxiety disorder (social phobia); Y, youth.

[a]These correlations correspond to the paths identified in Figure 1.

[b]χ^2 test

External convergent and discriminant validity. Table 4 shows the correlations between the OCHS-EBS scale scores and MINI-KID disorder classifications for each informant. Correlations between instruments of the same disorder ranged from 0.37 to 0.59 for caregivers and 0.26 to 0.51 for youth. Between-instrument correlations for the same versus different disorders were higher in 81 of 84 comparisons. The exceptions were caregiver-assessed GAD (e.g., GAD-GAD = 0.54; GAD-MDD = 0.56), youth-assessed MDD, and youth-assessed SP.

Table 5 summarizes the results of using CFA to model the 7 disorders scale scores by the OCHS-EBS and binary classifications by the MINI-KID for both caregiver and youth informants. AVE values in our model are over 0.5, providing evidence of convergent validity. Discriminant validity is established for all constructs in our model evidenced when the square root AVE value of a particular construct is larger than the intercorrelations between that construct and contrasting trait constructs based on both caregiver and youth report. CFI and RMSEA values provide evidence of good model fit, according to our criteria.

Discussion

This study presents the development and evaluation of the OCHS-EBS. From the initial pool of 72 items, 59 were selected

for empirical evaluation 55 matched with specific *DSM-5* symptoms by expert rating agreement and 4 with high disorder rankings to enhance coverage of CD and SP. Empirical evaluation based on CFA led to the removal of 7 items. The final scales consist of 52 items (6 GAD items, 7 SAD items, 9 MDD items, 5 SP items, 8 ADHD items, 6 ODD items, 11 CD items) that can be used to assess 7 *DSM-5* disorders in children and youth aged 4 to 17 by summing responses to form a scale score for each disorder. For ease of use, selected items have been formatted into identical, alphabetically ordered caregiver and youth instruments together with scoring instructions and are provided as online supplemental material.

Our scales performed well against the empirical standards of reliability and validity set in this study, with the exception of CD. Internal consistency reliability was less than $\alpha = 0.70$ for youth- and caregiver-reported (ages 4 to 11) CD while test-retest reliability was less than $r = 0.70$ for youth-reported CD. Although the internal convergent validity criterion was met for caregiver-reported CD, it was not met for youth-reported CD. Furthermore, in the youth model, CD was associated with many internal discriminant validity failures: excluding CD from the youth model reduced the number of internal discriminant validity test failures from 23 of 82 to 11 of 72.

The mixed success of CD was anticipated. Reliability is sample dependent, and scales measuring youth problem behaviour in general versus clinical populations will have lower means and variances, typically resulting in lower reliabilities as seen here.[41] This effect on reliability is compounded for CD because of the low prevalence of its symptoms. CD is an important part of the characterization of externalizing disorders along with ODD and ADHD. Despite its shortcomings as a scale, we recommend retaining the CD items in the OCHS-EBS to represent relatively rare and concerning behaviours.

Excluding youth-reported CD, CFA of individual items supported the internal convergent validity of the items selected to measure the disorders. However, a number of internal discriminant validity failures occurring between disorders overlapped with one another such as GAD and MDD or ODD and ADHD. These failures reflect excessive overlap among individual child psychiatric disorders, particularly within the broad groupings of externalizing and internalizing disorders,[38,40] which may be exacerbated in the OCHS-EBS by presenting the items in random order to reduce potential response bias.

Finally, evidence of external convergent and discriminant validity of the OCHS-EBS versus the MINI-KID for caregiver and youth informants was demonstrated for individual disorders in 81 of 84 comparisons. Again, exceptions occurred between disorders with similar characteristics (GAD and MDD as well as GAD and SP). When CFA was used to compare second-order factors representing externalizing and internalizing disorders derived for each informant (caregiver, youth) and each instrument (MINI-KID, OCHS-EBS), evidence of external convergent and discriminant validity of the OCHS-EBS was demonstrated for individual disorders and their grouping into externalizing and internalizing constructs.

Conclusion

In summary, this article describes the development and properties of the OCHS-EBS, which are brief dimensional measures of 7 child psychiatric disorders based on *DSM-5* criteria (GAD, SAD, MDD, SP, ADHD, ODD, and CD). Following a rigorous item selection process based on expert clinician judgements, scales were evaluated using a large general population study from Ontario, Canada. Our evaluation indicates that the items and scales meet the psychometric requirements of validity and reliability for use as dimensional measures of child and adolescent psychiatric disorders but that youth CD should be interpreted with caution. A variance-based structural equation model MTMM analysis provides evidence of both internal and external construct validity. This article is based on a single general population study, and further development and validation of the scales will be needed. Despite the large sample, this study does not include a clinical sample, and it will be important to investigate the reliability and validity of this scale in other samples. The psychometric adequacy of these scales for measuring child and adolescent psychiatric disorders as a categorical phenomenon is the focus of a Part II companion article.

Appendix

Table A1. Factor Loadings for 52 OCHS-EBS Items.

Disorder	Item	Factor Loading
GAD	Too fearful or anxious	.83
	Worries about doing better at things	.70
	Finds it hard to stop worrying	.74
	Anxious or on edge	.87
	Nervous, high-strung, or tense	.83
	When anxious, his or her mind goes blank	.85
SAD	Overly upset when leaving loved ones	.92
	Worries that bad things will happen to loved ones	.86
	Worries that something bad will cause separation from loved ones	.88
	Avoids school because of fear of separation from loved ones	.95
	Scared to go to sleep without parents being near	.76
	Has nightmares about being separated from loved ones	.87
	Complains of feeling sick before separating from loved ones	.90
MDD	Unhappy, sad, or depressed	.81
	Gets no pleasure from usual activities	.86
	Has trouble enjoying self	.88
	Changes in appetite	.71
	Trouble sleeping	.80
	Overtired or lacks energy	.67
	Feels worthless or inferior	.89
	Deliberately harms self or attempts suicide	.96

(continued)

Table A1. (continued)

Disorder	Item	Factor Loading
	Talks about killing self (youth item: thinks about killing self)	.96
SP	Doesn't like to be with people he or she doesn't know[a]	.83
	Afraid of doing things in front of others	.85
	Avoids social situations	.95
	Is nervous with people he or she doesn't know	.86
	Gets anxious about meeting new people	.88
ADHD	Makes careless mistakes	.69
	Can't concentrate, can't pay attention for long	.82
	Fails to finish things he or she starts	.88
	Distractible, has trouble sticking to any activity	.90
	Fidgets	.83
	Can't stay seated when required to do so	.85
	Impulsive or acts without thinking	.84
	Has difficulty awaiting turn in games or groups	.84
ODD	Loses temper	.86
	Argues a lot with adults	.86
	Blames others for own mistakes	.81
	Easily annoyed by others	.85
	Angry and resentful	.92
	Gets back at people	.91
CD	Cruelty, bullying, or meanness to others	.82
	Gets in many fights[a]	.78
	Uses weapons when fighting	.81
	Has been physically cruel to others	.87
	Destroys things belonging to his or her family or other children	.72
	Has broken into someone else's house, building, or car	.87
	Sets fires[a]	.85
	Steals outside the home[a]	.81
	Stays out at night despite being told not to	.71
	Runs away from home	.85
	Truancy; skips school	.70

ADHD, attention-deficit hyperactivity disorder; CD, conduct disorder; GAD, generalized anxiety disorder; MDD, major depressive disorder; OCHS-EBS, Ontario Child Health Study Emotional Behavioural Scales checklist; ODD, oppositional defiant disorder; SAD, separation anxiety disorder; SP, social anxiety disorder (social phobia).

[a]Item did not meet rating criteria but added based on high clinician ranking indicating a core disorder symptom. Based on confirmatory factor analysis with 59 items, 7 items were dropped due to factor loading <0.60 (CD items: 'Cruelty to animals', 'Has mugged people'), high correlation with a different scale (GAD item: 'Moody or irritable'; MDD item: 'Has difficulty making decisions'; ADHD item: 'Can't sit still, restless or hyperactive'), high correlation with another item (GAD item: 'When anxious, he/she has disturbed sleep'; ODD item: 'Defiant, talks back to adults').

Data Access

Data access available through Statistics Canada Research Data Centres.

Declaration of Conflicting Interests

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Supplemental Material

Supplemental material for this article is available online.

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Offord CENTRE FOR CHILD STUDIES

Ontario Child Health Study
Emotional Behavioural Scales: Parent Version (of youth 4-17)

The statements below describe some of the feelings and behaviours of children and youth. For each statement, please select the response that best describes your child **now or within the past 6 months**. You may only select one response.

	Never or not true	Sometimes or somewhat true	Often or very true		Never or not true	Sometimes or somewhat true	Often or very true
Afraid of doing things in front of others	0	1	2	Has broken into someone else's house, building or car	0	1	2
Angry and resentful	0	1	2	Has difficulty awaiting turn in games or groups	0	1	2
Anxious or on edge	0	1	2	Has nightmares about being separated from loved ones	0	1	2
Argues a lot with adults	0	1	2	Has trouble enjoying self	0	1	2
Avoids school because of fear of separation from loved ones	0	1	2	Impulsive or acts without thinking	0	1	2
Avoids social situations	0	1	2	Is nervous with people he/she doesn't know	0	1	2
Blames others for own mistakes	0	1	2	Loses temper	0	1	2
Can't concentrate, can't pay attention for long	0	1	2	Makes careless mistakes	0	1	2
Can't stay seated when required to do so	0	1	2	Nervous, high-strung or tense	0	1	2
Changes in appetite	0	1	2	Overly upset when leaving loved ones	0	1	2
Complains of feeling sick before separating from loved ones	0	1	2	Overtired or lacks energy	0	1	2
Cruelty, bullying or meanness to others	0	1	2	Runs away from home	0	1	2
Deliberately harms self or attempts suicide	0	1	2	Scared to go to sleep without parents being near	0	1	2
Destroys things belonging to his/her family or other children	0	1	2	Sets fires	0	1	2
Distractible, has trouble sticking to any activity	0	1	2	Stays out at night despite being told not to	0	1	2
Doesn't like to be with people he/she doesn't know	0	1	2	Steals outside the home	0	1	2
Easily annoyed by others	0	1	2	Talks about killing self	0	1	2
Fails to finish things he/she starts	0	1	2	Too fearful or anxious	0	1	2
Feels worthless or inferior	0	1	2	Trouble sleeping	0	1	2
Fidgets	0	1	2	Truancy, skips school	0	1	2
Finds it hard to stop worrying	0	1	2	Unhappy, sad or depressed	0	1	2
Gets anxious about meeting new people	0	1	2	Uses weapons when fighting	0	1	2
Gets back at people	0	1	2	When anxious, his/her mind goes blank	0	1	2
Gets in many fights	0	1	2	Worries about doing better at things	0	1	2
Gets no pleasure from usual activities	0	1	2	Worries that bad things will happen to loved ones	0	1	2
Has been physically cruel to others	0	1	2	Worries that something bad will cause separation from loved ones	0	1	2

Offord CENTRE FOR CHILD STUDIES

OCHS-EBS Scoring Instructions

The items are scored as follow: Never or not true=0, Sometimes or somewhat true=1, Often or very true=2.

Individual disorder scale scores: Item scores can be summed together for the following item sets to generate scale scores for the following seven disorders.

Internalizing and Externalizing scale scores: All externalizing and internalizing item scores can be summed together to generate scale scores for these two disorder groupings.

Total scale score: All 52 items can be summed together to generate a total score.

Externalizing

Conduct Disorder (11 items)
Cruelty, bullying or meanness to others
Destroys things belonging to his/her family or other children
Gets in many fights
Has been physically cruel to others
Has broken into someone else's house, building or car
Runs away from home
Sets fires
Stays out at night despite being told not to
Steals outside the home
Truancy, skips school
Uses weapons when fighting

Opposition Defiant Disorder (6 items)
Angry and resentful
Argues a lot with adults
Blames others for own mistakes
Easily annoyed by others
Gets back at people
Loses temper

Attention Deficit Hyperactivity Disorder (8 items)
Can't concentrate, can't pay attention for long
Can't stay seated when required to do so
Distractible, has trouble sticking to any activity
Fails to finish things he/she starts
Fidgets
Has difficulty awaiting turn in games or groups
Impulsive or acts without thinking
Makes careless mistakes

Internalizing

Major Depressive Disorder (9 items)
Changes in appetite
Deliberately harms self or attempts suicide
Feels worthless or inferior
Gets no pleasure from usual activities
Has trouble enjoying self
Overtired or lacks energy
Talks about killing self
Trouble sleeping
Unhappy, sad or depressed

Generalized Anxiety Disorder (6 items)
Anxious or on edge
Finds it hard to stop worrying
Nervous, high-strung or tense
Too fearful or anxious
When anxious, his/her mind goes blank
Worries about doing better at things

Separation Anxiety Disorder (7 items)
Avoids school because of fear of separation from loved ones
Complains of feeling sick before separating from loved ones
Has nightmares about being separated from loved ones
Overly upset when leaving loved ones
Scared to go to sleep without parents being near
Worries that bad things will happen to loved ones
Worries that something bad will cause separation from loved ones

Social Phobia/Social Anxiety Disorder (5 items)
Afraid of doing things in front of others
Avoids social situations
Doesn't like to be with people he/she doesn't know
Gets anxious about meeting new people
Is nervous with people he/she doesn't know

Offord CENTRE FOR CHILD STUDIES

Ontario Child Health Study
Emotional Behavioural Scales: Youth Version (12-17)

The statements below describe some of the feelings and behaviours of young people. For each statement, please select the response that best describes you **now or within the past 6 months**. You may only select one response.

	Never or not true	Sometimes or somewhat true	Often or very true		Never or not true	Sometimes or somewhat true	Often or very true
I am afraid of doing things in front of others	0	1	2	I have broken into someone else's house, building or car	0	1	2
I am angry and resentful	0	1	2	I have difficulty awaiting my turn in games or groups	0	1	2
I am anxious or on edge	0	1	2	I have nightmares about being separated from loved ones	0	1	2
I argue a lot with adults	0	1	2	I have trouble enjoying myself	0	1	2
I avoid school because of fear of separation from loved ones	0	1	2	I act without stopping to think	0	1	2
I avoid social situations	0	1	2	I feel nervous with people I don't know well	0	1	2
I blame others for my own mistakes	0	1	2	I lose my temper	0	1	2
I have trouble concentrating or paying attention	0	1	2	I make careless mistakes	0	1	2
I can't stay seated when required to do so	0	1	2	I am nervous or tense	0	1	2
I have had a change in appetite	0	1	2	I get overly upset when leaving loved ones	0	1	2
I feel sick before separating from loved ones	0	1	2	I feel overtired or lack energy	0	1	2
I am mean to others	0	1	2	I run away from home	0	1	2
I deliberately try to hurt or kill myself	0	1	2	I am scared to go to sleep without my parents being near	0	1	2
I destroy things belonging to others	0	1	2	I set fires	0	1	2
I am easily distracted, have difficulty sticking to any activity	0	1	2	I stay out at night despite being told not to	0	1	2
I don't like to be with people I don't know well	0	1	2	I steal things from places other than home	0	1	2
I am easily annoyed by others	0	1	2	I think about killing myself	0	1	2
I fail to finish things I start	0	1	2	I am too fearful or anxious	0	1	2
I feel worthless or inferior	0	1	2	I have trouble sleeping	0	1	2
I fidget	0	1	2	I cut classes or skip school	0	1	2
I find it hard to stop worrying	0	1	2	I am unhappy, sad or depressed	0	1	2
I get anxious about meeting new people	0	1	2	I use weapons when fighting	0	1	2
I get back at people	0	1	2	When anxious, my mind goes blank	0	1	2
I get in many fights	0	1	2	I worry about doing better at things	0	1	2
I get no pleasure from usual activities	0	1	2	I worry that something bad will happen to loved ones	0	1	2
I have been physically cruel to others	0	1	2	I worry that something bad will cause separation from loved ones	0	1	2

OCHS-EBS Scoring Instructions

The items are scored as follow: Never or not true=0, Sometimes or somewhat true=1, Often or very true=2.

Individual disorder scale scores: Item scores can be summed together for the following item sets to generate scale scores for the following seven disorders.

Internalizing and Externalizing scale scores: All externalizing and internalizing item scores can be summed together to generate scale scores for these two disorder groupings.

Total scale score: All 52 items can be summed together to generate a total score.

Externalizing

Conduct Disorder (11 items)
I am mean to others
I destroy things belonging to others
I get in many fights
I have been physically cruel to others
I have broken into someone else's house, building or car
I run away from home
I set fires
I stay out at night despite being told not to
I steal things from places other than home
I cut classes or skip school
I use weapons when fighting

Opposition Defiant Disorder (6 items)
I am angry and resentful
I argue a lot with adults
I blame others for my own mistakes
I am easily annoyed by others
I get back at people
I lose my temper

Attention Deficit Hyperactivity Disorder (8 items)
I have trouble concentrating or paying attention
I can't stay seated when required to do so
I am easily distracted, have difficulty sticking to any activity
I fail to finish things I start
I fidget
I have difficulty awaiting my turn in games or groups
I act without stopping to think
I make careless mistakes

Internalizing

Major Depressive Disorder (9 items)
I have had a change in appetite
I deliberately try to hurt or kill myself
I feel worthless or inferior
I get no pleasure from usual activities
I have trouble enjoying myself
I feel overtired or lack energy
I think about killing myself
I have trouble sleeping
I am unhappy, sad or depressed

Generalized Anxiety Disorder (6 items)
I am anxious or on edge
I find it hard to stop worrying
I am nervous or tense
I am too fearful or anxious
When anxious, my mind goes blank
I worry about doing better at things

Separation Anxiety Disorder (7 items)
I avoid school because of fear of separation from loved ones
I feel sick before separating from loved ones
I have nightmares about being separated from loved ones
I get overly upset when leaving loved ones
I am scared to go to sleep without my parents being near
I worry that something bad will happen to loved ones
I worry that something bad will cause separation from loved ones

Social Phobia/Social Anxiety Disorder (5 items)
I am afraid of doing things in front of others
I avoid social situations
I don't like to be with people I don't know well
I get anxious about meeting new people
I feel nervous with people I don't know well

CHAPTER 3: PSYCHOMETRIC PROPERTIES OF A BRIEF VERSION OF THE 2014 ONTARIO CHILD HEALTH STUDY EMOTIONAL BEHAVIOURAL SCALES (OCHS-EBS-B) PART I: A CHECKLIST FOR DIMENSIONAL MEASUREMENT OF CHILDREN'S EMOTIONAL, BEHAVIOURAL AND ATTENTION PROBLEMS IN GENERAL AND CLINICAL POPULATIONS

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3.2 CONTEXT AND IMPLICATIONS OF THIS STUDY: There is need for brief, practical, reliable and valid instruments that can be used in general population and clinical settings to assess and monitor children's mental health needs. The brief version of the Ontario Child Health Study Emotional Behavioural Scales (OCHS-EBS-B) developed and evaluated in this paper use fewer items to assess emotional, behavioural and attention problems with lower respondent burden but adequate reliability and validity. The parent/caregiver completed measure can be used as the basis for monitoring children's mental health need in the general population and clinical settings.

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3.4 CONFLICTS OF INTEREST: None

3.5 TO BE SUBMITTED TO: Assessment

Title: Psychometric properties of a brief version of the 2014 Ontario Child Health Study Emotional Behavioural Scales (OCHS-EBS-B) Part I: a checklist for dimensional measurement of children's emotional, behavioural and attention problems in general and clinical populations.

Proposed Journal: Assessment

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Abstract

Decision-making, planning and evaluation in children's mental health services and research require the collection of valid and reliable information about children's mental health problems. A need exists for very brief, standardized, valid and reliable self-completed checklist assessments of child and youth mental health problems that can be used to represent child mental disorder as both a dimensional and categorical phenomenon and administered to parents/caregivers in both general population and clinical settings. This article describes the development and properties of a brief, 22-item version of the Ontario Child Health Study Emotional Behavioural Scales (OCHS-EBS-B) to assess child emotional, behavioural and attention problems using two samples from Ontario Canada—a large general population sample and a test-retest reliability sample recruited from clinical and general populations. The evaluation indicates psychometric adequacy of the items and scales for dimensional measurement in general and clinical populations.

Keywords validity, reliability, psychopathology, child/youth, item response theory, structural equation modelling

Introduction

The purpose of government mental health policy, planning and service development in relation to children's mental health is to reduce the prevalence and incidence of child mental health problems and to improve the mental health functioning of all children, particularly those seeking help from children's mental health services. The World Health Organization (WHO) states, "the development of child and adolescent mental health policy and appropriate programs requires an understanding of the prevalence of mental health problems among children and adolescents" (WHO, 2005: p2-3) and notes that the first step in developing a mental health policy or plan is to assess the population's needs. To get a complete picture of population needs, assessments are required: (a) in the general population; and (b) in the subset of children and youth accessing mental health services (Boyle, Duncan, Georgiades, et al., 2019a: Government of Ontario, 2009). Data from both sources are critical for understanding the extent to which governments are achieving their policy, program and service objectives.

To our knowledge, there have been no instruments measuring children's mental health need developed and evaluated for parallel use in population surveys (to identify children's mental health need in the general population) and as part of children's mental health service intake assessments (to identify need amongst those accessing services). To be useful, such instruments must meet practical and scientific requirements that include (1) providing identical assessments that are brief, acceptable to respondents, easily scored, and amenable to different modes of data collection and (2) being reliable and valid for their intended use in both general population and clinical populations (Boyle et al., 2019a). It is also critical that this type of instrument is developed to provide both dimensional and categorical (present/absent) measurement of children's mental health need (Kraemer, 2007). This ensures its usefulness for measurement and analysis (dimensional) and clinical and administrative decision-making (categorical) that often require discrete counts of individuals with and without elevated mental health problems (Boyle, Duncan, Georgiades et al., 2017; Boyle, Duncan, Georgiades, et al., 2019b).

Existing instruments do not meet these requirements. Standardized diagnostic interviews used to classify child mental disorder do not meet practical criteria; they are time consuming, burdensome and expensive to implement. Recent evidence indicates that scale scores derived from problem checklists converted to binary measures can classify childhood psychiatric disorder as reliably and validly as interviews (Boyle et al., 2019b) while offering substantial practical advantages (Boyle et al., 2017). Problem checklists such as the Child Behaviour Checklist (CBCL: Achenbach, 1991) and Strengths and Difficulties Questionnaire (SDQ: Goodman, 2001) meet many of the practical criteria but were not developed and evaluated with all criteria in mind (i.e. representation of disorder as both dimensional and categorical, applicability to both general and clinical populations).

Implementing the 2014 Ontario Child Health Study provided the opportunity to develop and evaluate a measurement instrument of children's emotional and behavioural problems for use in the general population and mental health service settings that meets the prerequisites for parallel measurement in both groups. It also provides a representative, general population sample in which to establish population norms that increase the usefulness of this type of instrument. Practical prerequisites are that the instrument is as short as possible, assesses clinically relevant phenomenon (emotional and behavioural problems), identifies individuals with elevated problems, and is easy to administer, score and understand. Scientific prerequisites are that the instrument is valid and reliable and demonstrates psychometric adequacy for categorical (presence/absence) as well as dimensional (numeric scores) measurement.

The objectives of this paper are to: (1) describe the development of a brief version of the Ontario Child Health Study Emotional Behavioural Scales (OCHS-EBS-B) to meet the prerequisites outlined above; (2) present the psychometric properties of the OCHS-EBS-B for measuring child and youth mental health problems as dimensional phenomena in the general population; (3) demonstrate validity and reliability in a clinical sample. A partner paper (part II) addresses the psychometric properties of the OCHS-EBS-B for measuring child and youth mental health problems as categorical phenomena.

An important side note is that our objective of assessment is to classify children and youth based on reliable and valid measurement. In a clinical context, assessment is also used for diagnostic, treatment planning and rapport building purposes (Rutter & Taylor, 2008). These functions are not considered here—we focus strictly on the measurement objective of classification.

Methods

Participants

This report uses data from two studies. Study 1 includes a large, general population sample. A service-seeking subsample was identified to represent a clinical sample. Study 2 is a test-retest reliability study, which included two separate samples: (1) children recruited directly from schools to represent the general population, and (2) children recruited community-based children's mental health agencies to represent a clinical sample.

1. GENERAL POPULATION SAMPLE

The general population sample comes from the 2014 Ontario Child Health Study (OCHS), (Boyle, Georgiades, Duncan, et al., 2019) an epidemiological study of children and youth aged 4 to 17 years old and their families, designed by

researchers at McMaster University and conducted by Statistics Canada. Using the Canadian Child Tax Benefit file as the sampling frame, 15,796 dwellings were selected, 12,871 were eligible and 6,537 participated (50.8%). Dwellings were selected based on a complex 3-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 (<20th; 20th to 80th; >80th percentiles).

Within families, the primary parent/caregiver, their partner or spouse, and up to 4 children per family were interviewed resulting in 10,802 primary parent/caregiver reports on children aged 4 to 17 years old. Interviewers provided a brief description of the study and booked consenting families. All families were interviewed at their homes by trained Statistics Canada interviewers. All study procedures, including consent and confidentiality requirements, were approved by the Chief Statistician at Statistics Canada and were conducted according to the *Statistics Act* (Government of Canada, 1985) Families were interviewed between October 2014 and October 2015.

Item selection was conducted in a randomly selected 50% subsample (5,401/10,802 respondents). Item evaluation was conducted in the remaining 50% subsample following best practices in measurement development and evaluation (Boateng, Neilands, Frongillo, et al., 2018).

SERVICE-SEEKING SUBSAMPLE. The service-seeking subsample was created by identifying children according to two criteria. First, children had to be identified by parents/caregivers as visiting mental health or addictions services at a children's mental health agency in the past 6 months because of their child's mental health concerns (Georgiades, Duncan, Wang, et al., 2019). This represented 7.32% of the total sample. Second, they had to be identified as having a perceived need for professional help due to the connection between perceptions of need and service use (Wichstrøm, Belsky, & Jozefiak, 2014). Perceived need was defined as positive responses to two sequenced questions that ask whether the parent/caregiver thought that, in the past 6 months, the child had any emotional or behavioural problems, and if yes, needed any professional help with these problems. Those with perceived need represented 45.2% of those who had received agency services in the past 6 months. This purpose of this subsample was to approximate a clinic-recruited sample to evaluate the psychometric properties of the brief checklist to assess

children seeking services at community-based mental health agencies[1].

2. TEST-RETEST RELIABILITY SAMPLE

The test-retest reliability sample includes data from 283 parent–youth dyads aged 9 to 18 years from a general population sample (*n*=185) and mental health outpatient clinic sample (*n*=98). The general population sample came from a stratified random sample of elementary and high school students in Hamilton, Ontario. The clinical sample was recruited from two outpatient children's mental health centers; a university-based center and a community-based center. For both general population and clinic samples, a research team member recruited families by telephone and booked families for two sessions, 7 to 14 days apart. Eligible families were those where the youth had been living with the parent/caregiver for at least three months and where serious developmental disability or learning problems were absent. Eligible families were interviewed between December 2011 and December 2013. The study was approved by the Hamilton Integrated Research Ethics Board at McMaster University, the Research Ethics Committees at the School Boards and participating clinics. Full details about recruitment procedures, response rates, and characteristics of this sample are available elsewhere (Duncan, Georgiades, Wang, et al; 2017).

Concepts and Measures

2014 ONTARIO CHILD HEALTH STUDY EMOTIONAL BEHAVIOURAL SCALES (OCHS-EBS)

Items from the OCHS-EBS served as the item pool for the brief checklist. The OCHS-EBS are a 52-item checklist assessing seven DSM-5 disorders over the past 6 months. They demonstrate satisfactory reliability and validity when used as either dimensional (Duncan, Georgiades, Wang, et al., 2019) or categorical (Boyle et al., 2019b) measures. The seven disorders were selected for their high prevalence as reported in general population surveys and clinical settings. They include generalized anxiety disorder, separation anxiety disorder, major depressive disorder, social anxiety disorder, attention-deficit hyperactivity disorder, oppositional-defiant disorder and conduct disorder. Checklists were self-administered paper questionnaires completed by parents or caregivers of 4 to 17 year olds. Respondents

[1] These two criteria were used to ensure that this subsample represented children at a similar level of acuity to those recruited directly from clinic settings. Given the 6 month reference period for the question asking about visiting a mental health agency, this group includes children who were at the end of their service episode or treatment and so likely had some of their mental health needs met and would have reduced emotional and behavioural problems as a result. Adding a requirement for the presence of a perception of need for professional help with emotional and behavioural problems in the past 6 months we thought would reduce the number of children who were towards the end of services included in this sample. Symptom profiles of this group were compared with the clinical portion of the test-retest reliability sample to ensure similarity. This indicated to us that using this sample to approximate a clinical sample was appropriate.

rated how well individual symptoms described the child or youth in the past 6 months as: '0=never or not true', '1=sometimes or somewhat true' and '2=often or very true'.

MINI INTERNATIONAL NEUROPSYCHIATRIC INTERVIEW FOR CHILDREN AND ADOLESCENTS (MINI-KID)

Based on the adult MINI (Lecrubier, Sheehan, Willer, et al., 1997; Sheehan. Lecrubier, Sheehan, et al., 1998) the MINI-KID is a standardized diagnostic interview that assesses DSM-IV-TR disorders in children and youth aged 6 to 17 years. Evaluated in two studies (Sheehan et al., 2010, Duncan et al, 2017) the MINI-KID exhibits good test-retest reliability (kappa=0.56 to 0.87) for mood, anxiety, substance use, ADHD, behavioural and eating disorders based on joint caregiver-child interviews and adequate agreement with the Schedule for Affective Disorders and Schizophrenia for School-Aged Children-Present and Lifetime Version (K-SADS-PL) (Sheehan et al., 2010). The MINI-KID parent version was administered to the parent/caregiver of one randomly selected child per family. The MINI-KID training included reading and review of a manual and training video, review of example video interviews, and practice interviews. Interviewers were trained to ask the questions as worded; refrain from probing; encourage yes/no answers; and follow a protocol after "don't know" responses. An interviewer dictionary provided standard definitions for terms and phrases used.

The seven disorders were grouped into three categories to match the OCHS-EBS-B groupings: emotional (child classified with major depressive disorder, generalized anxiety, separation anxiety, or social phobia), behavioural (child classified with oppositional defiant or conduct disorder), and attention (child classified with attention-deficit/hyperactivity disorder).

Analysis

Development of Brief Version (OCHS-EBS-B)

Decisions about item selection were informed by (a) our theoretical understanding of emotional and behavioural disorders, and (b) empirical evaluation of item properties in a 50% subsample of a large-scale general population sample. All 52 OCHS-EBS items were eligible for selection. To achieve brevity, the number of measured constructs was reduced from seven to three. Disorders were collapsed into three commonly used groupings (Ogundele, 2018)—emotional, behavioural and attention problems. This was done to reduce the number of items needed in the final checklist and to ensure adequate representation of the full spectrum of emotional and behavioural problems. The emotional problem item pool was comprised of 27 items that described symptoms of major depressive disorder, generalized anxiety, separation anxiety and social phobia. The behavioural problem item pool was comprised of 17 items that described symptoms of conduct and

opposition-defiant disorder. Attention problems were distinguished from other behavioural problems due to the neuro-behavioural nature of attention-deficit hyperactivity disorder (Furman, 2005). This item pool included 8 symptoms of attention-deficit hyperactivity disorder.

Measurement development (the selection of items for each scale) and evaluation of the scales proceeded in separate steps. . In *step 1*, we empirically evaluated item properties in the measurement development 50% subsample using item response theory (IRT). The use of IRT provides a method of maximizing the reliability of measurement with the fewest number of items (Embretson & Steven, 2013; Baker, 2001). We conducted a multidimensional, two-parameter, logistic IRT model in Mplus 7.0 (Muthén & Muthén, 2016) to estimate item difficulty (β: indicates how much of the latent trait a child must have to get a certain score on a particular item) and discrimination (α: indicates how well an item distinguishes between children with and without the latent trait). Due to the highly positively skewed distribution of the item responses and to ensure sufficient power to estimate the two item parameters, items were recoded as dichotomous with '0=never or not true' and 1=sometimes or somewhat true/often or very true. Based on recommended cut-offs in IRT (Baker, 2001) we identified items with difficulty scores of over +/-3 for removal and items with discrimination scores of over 2 for inclusion. Baker (2001) identifies $\alpha > 1.7$ for highly discriminating items but we opted for a higher cut-off of 2 to ensure the instrument was as brief as possible. This resulted in the selection of 22 items: 6 emotional problem items, 9 behavioural problem items and 7 attention problem items.

In *step* 2, to ensure that the items selected met the assumptions required for both IRT item scoring and traditional Likert-style summed scale scoring, we used the measurement evaluation sample to assess the unidimensionality of the scales (a requirement for both approaches), the association between items and their hypothesized scales and the correlation between scores produced using both approaches. To examine the internal factor structure of the scales, we conducted a confirmatory factor analysis (CFA) in Mplus 7.0 (Muthén & Muthén, 2016) and used Pearson's *r* to examine the correlations between scale scores. We expected correlations of $r > 0.90$ between summated scores and IRT-based scores. We expected that items selected for each scale would represent each problem category as a unidimensional attribute, be associated with (load onto) their hypothesized scale at ≥ 0.60 (MacCallum, Widaman, Zhang, et al., 1999) and provide adequate model fit to the observed data. Indicators of model fit and their criteria included: the comparative fit index (CFI: > 0.95); and the root-mean-squared error of approximation (RMSEA: < 0.06) (Hu & Bentler, 1999). The chi-square test results of model fit are not used to assess model fit because large samples, such as the one used in this analysis, generate significant values even when there is satisfactory model fit (MacCallum et al., 1999).

Evaluation of Brief Version (OCHS-EBS-B)

Table 1 outlines the analytical strategy for psychometric evaluation. It presents the psychometric property being evaluated, the evaluation method and the study sample being used. The general population sample from Study 1 was randomly allocated into two subsets—50% of the sample in each subset. The first subset was used for item selection and the second subset was used for psychometric evaluation.

1. MEAN, STANDARD DEVIATION AND INTERNAL CONSISTENCY

Means and standard deviations of OCHS-EBS-B summated scale scores were generated for two age groups (age 4 to 11 and age 12 to 17) and for male, female and overall in the general population. Internal consistency was calculated by age group and was expected to meet commonly accepted psychometric criteria (Bland & Altman, 1997; DeVellis, 2016) of Cronbach's alpha ≥ 0.70. These estimates represent population norms for Ontario children in these groups against which OCHS-EBS-B scale scores for individual children can be compared. These population estimates were generated in the whole 2014 OCHS sample in order to be fully representative of the Ontario population of children aged 4 to 17 and, by nature of being a representative sample, this includes children in the service-seeking subsample. Sampling weights to represent the probability of selection for the study and to compensate for non-response were used in all analyses.

2. TEST-RETEST RELIABILITY

Using data from the test-retest reliability study, test-retest reliability was estimated for the three OCHS-EBS-B scales in the general population and clinical samples for two age groups. Test-retest reliability was expected to meet commonly accepted psychometric criteria (Bland & Altman, 1997; DeVellis, 2016) of Pearson's $r \geq 0.70$.

3. INTERNAL CONVERGENT AND DISCRIMINANT VALIDITY

We assessed convergent and discriminant validity in both the general population and clinical samples using a variance-based[2] structural equation modelling version of the standard multitrait-multimethod (MTMM) approach to construct validation (Campbell & Fiske, 1959). This method improves on the original MTMM approach by using objective criteria to evaluate construct validity and provides more sophisticated measurement of constructs (Andrasik, 2005). Convergent validity compares the shared variance between the scale and the items

[2] Variance-based or SEM is best suited to exploring relationships between constructs whereas co-variance-based SEM is better suited to explaining relationships between indicators and constructs in the context of confirming a theoretical model.

within it in relation to their residual variance; it is assessed using the Average Variance Extracted (AVE) and is demonstrated when the value of AVE is ≥ 0.5 indicating that at least 50% of the total variance in the items quantified by their factor loadings is explained by the scale (Fornell & Larcker, 1981; Hair, Anderson, Babin, et al., 2010).

Discriminant validity focuses on association between items and their scales in relation to their association with other scales (Brown, 2006), is assessed by comparing the shared variance within each scale to the shared variance between scales and is demonstrated when the square root of AVE for a given scale is larger than the correlations between this scale and all others (Hair et al., 2010; Carter, 2016).

4. EXTERNAL CONVERGENT AND DISCRIMINANT VALIDITY

We compared OCHS-EBS-B emotional, behavioural and attention problem scores with independent MINI-KID disorder assessments of the same problem categories by estimating point-biserial correlations between instruments. Convergent validity is demonstrated by obtaining positive correlations between the same problem categories assessed by different instruments. Discriminant validity is demonstrated when different problem categories assessed by the same and different instruments are not correlated with each other. For example, we would expect the correlation between emotional problems assessed by the OCHS-EBS-B and the MINI-KID to be higher than the correlation between emotional problems assessed by the OCHS-EBS-B and behavioural problems assessed by the MINI-KID. To test this, we expect the correlations between instruments of the same domains to be statistically significantly higher than the between-instrument correlations for non-similar domains based on significance tests for differences between correlations outlined by Cohen & Cohen (1983) and Caci (2000). The calculations in these tests include the two correlations being compared (OCHS-EBS-B emotional vs. MINI-KID emotional and OCHS-EBS-B emotional vs. MINI-KID behavioural in the example above) and the remaining pairwise correlation that is not the primary objective of the comparison (MINI-KID emotional vs. MINI-KID behavioural in this example).

SAMPLES FOR ANALYSIS

In Study 1, the general population sample for analysis includes respondents with no missing data on scale items—10,572 parent/caregivers (97.9%) — randomly allocated into two subsets. The first subset was used for item selection and the second subset was used for psychometric evaluation. In the measurement evaluation subset, a service-seeking subsample of 362 parents/caregivers was identified. The total general population sample (100% of the sample) was used to calculate general population means and standard deviations as these represent

population norms. External validity analysis was restricted to one randomly selected child per family whose parent/caregiver completed a MINI-KID interview. This resulted in 3,019 parents/caregivers of 4 to 17 year olds in the general population sample measurement evaluation 50% subset. Given the reduction in the overall size of the available sample, the external validity analysis in the service-seeking subsample used the complete sample, not only those in the measurement evaluation 50% subset. This resulted in 387 parents/caregivers in the service-seeking subsample.

In Study 2, six respondents did not complete the retest interview and were removed from the analysis leaving 278 respondents (183 in the general population and 95 in the clinical sample) in the test-retest reliability sample.

Results

Development of Brief Version (OCHS-EBS-B)

Table 2 shows the selected OCHS-EBS-B items with their item difficulty and discrimination scores. Confirmatory factor analysis confirmed the unidimensionality of the scales. Table 2 also shows the factor loadings for scale items that were 0.72 or higher. All model fit criteria were met (results not shown). Pearson's *r* correlations between summated scale scores and IRT-based scores were 0.95 for attention problem scale scores and 0.92 for emotional and behavioural problem scale scores.

Evaluation of Brief Version (OCHS-EBS-B)

Table 3 presents summary statistics for the two studies: the full 2014 OCHS study sample weighted by their probability of selection, the service-seeking subsample identified in the 2014 OCHS and test-retest reliability study general population and clinical sample with the general population sample weighted by their probability of selection.

1. MEAN, STANDARD DEVIATION AND INTERNAL CONSISTENCY

Table 4 displays the problem scale means, standard errors and Cronbach's alpha for internal consistency by child sex for parent/caregiver reports on ages 4 to 11 and 12 to 17. Scale means and standard errors are based on the summated scale scores in in the full general population sample representing general population norms. Possible scale values range from 0 to 12 for emotional problems, 0 to 14 for attention problems, and 0 to 18 for behavioural problems. Statistics Canada data disclosure rules prevent us from presenting the actual score ranges as these represent individual data points. Internal consistency estimates were generated in the measurement evaluation 50% subset and were all over 0.70. Average internal

consistency was 0.86 for ages 4 to 11 and 0.83 for ages 12 to 17.

2. TEST-RETEST RELIABILITY

Table 4 displays the test-retest reliabilities for parent/caregiver reports on the three problem scales in a general population sample, a clinical sample and overall. All reliability estimates were over 0.81. Average test-retest reliability was 0.87 in both the general population and clinical samples.

3. INTERNAL CONVERGENT AND DISCRIMINANT VALIDITY

Table 5 presents the results of the SEM-based convergent and discriminant validity analysis in the measurement evaluation 50% subset of the general population sample and the service-seeking subsample. All Average Variance Extracted (AVE) values were over 0.5 demonstrating convergent validity. Discriminant validity is established for a scale when the square root of AVE is larger than the correlations between this scale and all other scales in the measurement model. This was demonstrated in all cases. CFI and RMSEA values demonstrated good model fit, according to our criteria.

4. EXTERNAL CONVERGENT AND DISCRIMINANT VALIDITY

Table 6 shows the correlations between the OCHS-EBS-B scale scores and MINI-KID grouped classifications in the general population and clinical samples. Correlations between instruments of the same problem groupings were 0.51, 0.53, and 0.52 for attention, behavioural and emotional problems, respectively, in the general population sample and 0.57, 0.61 and 0.65, respectively, in the clinical sample. Significance tests for differences between correlations (Cohen & Cohen, 1983; Caci, 2000) showed that convergent correlations were significantly higher than discriminant correlations in 8 out of 12 comparisons. The same two test failures occurred in both the general population sample and the clinical sample in the comparison of the correlation between MINI-KID Behavioural and OCHS-EBS-B Behavioural versus the correlation between MINI-KID Attention and OCHS-EBS-B Behaviour, and in the comparison of the correlation between MINI-KID Attention and OCHS-EBS-B Attention versus the correlation between MINI-KID Behaviour and OCHS-EBS-B Attention. Although the convergent validity correlations are numerically higher than the discriminant validity correlations in these comparisons, the statistical difference tests failed due to high within-instrument correlations between MINI-KID classifications of behavioural and attention problems in the general population (0.59) and clinical sample (0.55) (not presented).

Discussion

This study presents the development and evaluation of the OCHS-EBS-B. From the pool of 52 OCHS-EBS items, a subset of 22 items were selected based on theoretical understanding of emotional and behavioural disorders, and empirical evaluation of item properties using both classical test theory and IRT frameworks. We also compared the scores generated using both approaches (summated scores versus IRT-based scores) and find them highly correlated. This shows that a simplistic approach to scoring does not result in vastly different scores. The final three scales can be used to assess emotional, behavioural and attention problems in children and youth aged 4 to 17 by summing responses from parents/caregivers to form a scale score. This paper provides general population norms that can be used to compare scores of individual children to the distribution of scores in the general population in Ontario. Selected items have been formatted into a parent/caregiver instrument that includes scoring instructions and are provided in a supplemental appendix.

Used for dimensional measurement, the scales performed well against empirical psychometric criteria. In addition to demonstrating good internal consistency and high levels of test-retest-reliability, our results provide good evidence for internal and external convergent and discriminant validity. There were three external discriminant validity failures out of 12 comparisons and they were a result of within-instrument correlations in the MINI-KID, not the OCHS-EBS-B. These correlational difference tests take into account the correlations between different constructs within the same instrument. These failures were a result of the high correlation between MINI-KID classifications of behavioural and attention problems in both samples. This is not surprising because symptoms of attention-deficit hyperactivity disorder and aggressive, anti-social behavior found in conduct disorder and oppositional defiant disorder tend to be highly correlated (Kuhne, Schachar, & Tannock, 1997; Jensen, Marin, & Cantwell, 1997; Thapar, Harrington, & McGuffin, 2001). Furthermore, the MINI-KID interview makes use of a screening question that skips respondents into or out of three modules (ADHD, conduct disorder and opposition-defiant disorder). This issue speaks to potential problems with the internal discriminant validity of the MINI-KID. Our analysis demonstrate that the OCHS-EBS-B can discriminate between individuals with attention problems and those with behavioural problems. External discriminant analysis using other criterion measures may be warranted.

This study has a number of strengths. First, it evaluates the OCHS-EBS-B for dimensional measurement while a partner paper (Part II) evaluates the instrument for categorical (present/absent) measurement. Being able to derive both representations of disorder is critical if the instrument is to be useful to a variety of users (e.g. clinicians, researchers, decision-makers). Second, it compares an IRT approach to scaling versus a simple summated score approach. Third, it replicates the evaluation in a service-seeking subsample and a clinical sample to ensure its applicability to this setting. Fourth, the study makes use of SEM analysis, which

provide objective criteria to evaluate construct validity and more sophisticated measurement of constructs (Andrasik, 2005). Finally, the study capitalizes on the large sample size available in the 2014 Ontario Child Health Study and the resulting statistical power, which is particularly advantageous in IRT analysis and for conducting statistical tests of differences between correlations.

There are also a number of limitations. First, the study focuses only on a parent/caregiver-reported instrument. Low levels of informant agreement between parents and adolescents on emotional and behavioural problems (De Los Reyes & Kazdin, 2004) speaks to the importance of collecting information directly from older children. The data are available to pursue the development and evaluation of a brief instrument to measure the same three conditions based on youth assessments.

Third, children aged 4 to 8 are missing from the test-reliability sample and this sample does include a small number of 18 year olds. However, there is no evidence to indicate that the reliability of parent/caregiver assessments differs between children aged 4 to 8 years versus 9 to 11 years. All other psychometric properties were evaluated in age groups that included 4- to 8-year olds.

Fourth, part of the clinical evaluation was conducted in a sub-group of the general population sample that were identified by parents/caregivers as having received specialized services from a mental health agency in the past 6 months and as having a perceived need for professional help with emotional and behavioural services. Ideally, the clinical replication would be conducted in a sample recruited from mental health clinics. However, we think that this approach is an adequate approximation and provides a greater sample size for psychometric evaluation than the sample of 95 available in the test-retest reliability sample. The reliability of the 'service-seeking' classification was confirmed in a test-retest reliability subsample available in the OCHS (kappa=0.75) and the distribution of scale scores in the OCHS subsample was comparable to the distribution of scores in the true clinical sample that was part of the test-retest reliability sample.

Finally, although IRT approaches were used for item selection, scores were generated based on simple raw or summated scores, which do not take advantage of the IRT benefits of scaling (Thomas, 2011). IRT scale score generation and interpretation require advanced statistical literacy, expertise and, in most cases, computer software. In comparison, simple raw or summated scores are easier to generate, manipulate and interpret and are highly correlated with IRT-based scores (Thomas, 2011; 2019). We expect that the majority of users of this scale will be using summated scores. To preserve the potential benefits of IRT approaches and to balance the instrument prerequisites of brevity with ease of administration and score interpretation, we use IRT methods for item selection and traditional factor analytic methods to ensure the items selected meet the required item-scale assumptions. In addition to generating and psychometrically evaluating traditionally constructed

summed scale scores, we also generated IRT-based scores to compare with summed scale scores. We provide the discrimination parameters that can be used to weight items based on an IRT scaling framework.

Part of the appeal of brief assessments such as the OCHS-EBS-B is their suitability for use in monitoring outcomes to assess change over time. This was not part of the current evaluation and will be an important next step in future research for the OCHS-EBS-B to be used in this way. Further validation of the scales in other general population and clinical samples will also be an important next step.

Conclusion

In summary, this article describes the development, evaluation and properties of the OCHS-EBS-B to assess emotional, behavioural and attention problems in children and youth aged 4 to 17 years. Following item selection, scales were evaluated for dimensional measurement using a large general population study, clinical and retest reliability samples from Ontario, Canada. The evaluation indicates psychometric adequacy of the items and scales for dimensional measurement. Variance-based structural equation model and traditional MTMM analysis provide evidence of internal and external convergent validity. This instrument addresses the need for very brief, standardized, valid and reliable self-completed checklist assessments of child and youth mental health problems that can be: (1) used to represent child mental disorder as dimensional and categorical phenomena; (2) administered to parents/caregivers in both general population and clinical settings; and (3) used to monitor children's mental health need to support decision-making, planning and evaluation of children's mental health services.

Data Access. Data access available through Statistics Canada Research Data Centres.

Conflict of Interest Disclosure. The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Table 1. Analytical strategy for item and scale evaluation in both general and clinical population samples

Psychometric Property	Evaluation method	Study	Study sample	Groups	Sample size
Variability	Scale means & standard deviations	Study 1	Total sample	Age 4 to 11 (M, F, All)	*n*=6,247
				Age 12 to 17 (M, F, All)	*n*=4,315
Internal consistency	Cronbach's alpha	Study 1	50% subset	Age 4 to 11 Age 12 to 17	*n*=3,123 *n*=2,157
Test-retest reliability	Pearson's *r*	Study 2	General population	Age 9 to 11 Age 12 to 18	*n*=183
			Clinical	Age 9 to 11 Age 12 to 18	*n*=94
Internal convergent & discriminant validity	Confirmatory factor analysis	Study 1	50% subset	All	*n*=5.370
			Service-seeking subsample	All	*n*=362
External convergent & discriminant validity	Multi-trait multi-method matrix of point-biserial correlations	Study 1	50% subset	One randomly selected child per family	*n*=3,019
			Service-seeking subsample (total sample)	One randomly selected child per family	*n*=387

Table 2. Item difficulty and discrimination scores from multidimensional, two-parameter, logistic item response theory analysis (*n*=5,283) and factor loadings from confirmatory factor analysis for 22 OCHS-EBS-B items (*n*=5.370).

Disorder	Item	Item discrimination (β)	Item difficulty (α)	Factor loading
Emotional problems	Anxious or on edge	2.97	1.03	0.92
	Finds it hard to stop worrying	2.49	0.99	0.76
	Has trouble enjoying self	2.37	1.50	0.80
	Feels worthless or inferior	2.37	1.48	0.84
	Too fearful or anxious	2.18	0.97	0.88
	Nervous, high-strung or tense	2.10	0.93	0.90
Behavioural problems	Has been physically cruel to others	3.28	2.08	0.85
	Angry and resentful	2.79	1.15	0.85
	Loses temper	2.51	0.54	0.88
	Gets in many fights	2.36	2.10	0.72
	Cruelty, bullying or meanness to others	2.29	1.75	0.87
	Argues a lot with adults	2.24	1.02	0.76
	Gets back at people	2.22	1.87	0.80
	Destroys things belong to his/her family or other children	2.13	2.10	0.76
	Easily annoyed by others	2.06	0.79	0.78
Attention problems	Distractible, has trouble sticking to any activity	3.62	0.80	0.89
	Can't concentrate/pay attention for long	2.55	0.42	0.77
	Can't stay seated when required to do so	2.50	1.01	0.86
	Impulsive or acts without thinking	2.45	0.79	0.89
	Fails to finish things he/she starts	2.42	0.60	0.73
	Fidgets	2.16	0.82	0.83
	Difficulty awaiting turn in games or groups	2.05	1.17	0.81

Table 3. Sample characteristics

	General population sample[a]	*Service-seeking subsample*[a]	*Test-retest reliability sample*	
			General population sample[a]	*Clinical sample*
Youth				
n	10,802	711	185	98
Age, *M* (SD)	10.63 (4.07)	11.68 (3.94)	15.5 (1.98)	13.7 (2.26)
Male, %	51.3	55.3	36.2	56.1
OCHS-EBS-B scores, *M* (SE)				
Emotional problems	1.29 (0.05)	4.26 (0.25)	1.45 (0.06)	5.52 (0.29)
Behavioural problems	1.45 (0.05)	3.99 (0.23)	1.78 (0.07)	6.37 (0.37)
Attention problems	3.15 (0.06)	6.08 (0.22)	1.79 (0.06)	6.89 (0.36)
Parent/Caregiver				
n	6,537	450	185	98
Age, *M* (SD)	41.5 (7.2)	42.2 (7.4)	46.3 (7.1)	42.2 (7.28)
Male, %	11.8	6.7	17.3	7.1
Household Income <$40K, %	13.7	20.6	27.0	36.7
Single parent, %	20.6	38.1	23.8	36.7

M=Mean, OCHS-EBS-B=Brief version of the Ontario Child Health Study Emotional Behavioural Scales, SD=Standard deviation, SE=Standard error

[a]Weighted according to the probability of selection

Table 4. Variability of the OCHS-EBS-B scales by sex and age

	Mean (Standard Error)			Internal Consistency α
	All	Male	Female	
Age 4 to 11 (*n*=6,257)				
Emotional problems	1.11 (0.05)	1.18 (0.06)	1.04 (0.07)	.83
Behavioural problems	1.39 (0.05)	1.68 (0.77)	1.09 (0.06)	.81
Attention problems	3.43 (0.07)	3.90 (0.10)	2.93 (0.08)	.87
Age 12 to 17 (*n*=4,315)				
Emotional problems	1.52 (0.07)	1.44 (0.10)	1.60 (0.09)	.87
Behavioural problems	1.52 (0.06)	1.63 (0.09)	1.40 (0.07)	.83
Attention problems	2.81 (0.07)	3.17 (0.12)	2.42 (0.08)	.86

Note: The study sample was weighted based on the probability of selection. To account for the complex survey design, mean bootstrap weights were applied with an adjustment factor to produce accurate standard errors.

Table 5. Reliability of the OCHS-EBS-B scales parent/caregiver report by age group and general population and clinical sample

	Test-retest reliability of OCHS-EBS-B scores r [b]		
	Combined *n*=278	General population *n*=183	Clinical *n*=95
Age 9 to 11			
Emotional problems	.92	.94	.84
Behavioural problems	.89	.84	.88
Attention problems	.93	.89	.85
Age 12 to 18			
Emotional problems	.88	.85	.83
Behavioural problems	.89	.86	.90
Attention problems	.86	.81	.91

r= Pearson correlation coefficient

Note: All correlations significant at $P < 0.01$.

Table 6. Weighted scale AVE values, inter-factor correlations and fit indices for confirmatory factor analysis

	General population (*n*=5,370)			Clinical (*n*=362)		
	Average variance extracted (AVE) (√ AVE)	Inter-Factor Correlations		Average variance extracted (AVE) (√ AVE)	Inter-Factor Correlations	
		Emotional problems	Behavioural problems		Emotional problems	Behavioural problems
Emotional problems	0.74 (0.86)			0.72 (0.85)		
Behavioural problems	0.64 (0.80)	0.70		0.66 (0.81)	0.46	
Attention problems	0.67 (0.82)	0.64	0.74	0.68 (0.83)	0.59	0.59
	Model Fit Indices			Model Fit Indices		
χ^2 (*df*)	986.335 (*df*=206)	*P*<0.001		399.829 (*df*=206)	*P*<0.001	
CFI	0.972			0.935		
RMSEA	0.027			0.050		

AVE=average variance extracted; CFI=comparative fit index; *df*=degrees of freedom; RMSEA=root mean squared error of approximation, χ^2=chi-square; √=square root

Table 7. Multitrait-multimethod matrix showing point-biserial correlations between the *OCHS-EBS-B* scale scores and *MINI-KID* disorder classifications

Method		General Population (*n*=3,019)				Clinical (*n*=387)		
		MINI-KID				MINI-KID		
	Trait	Emotional	Behavioural	Attention		Emotional	Behavioural	Attention
OCHS-EBS-B	Emotional	.52	.36	.30	Emotional	.65	.20	.19
	Behavioural	.31	.53[a]	.39[a]	Behavioural	.31	.61[c]	.45[c]
	Attention	.30	.41[b]	.51[b]	Attention	.35	.45[d]	.57[d]

MINI-KID=Mini International Neuropsychiatric Interview for Children and Adolescents interview, OCHS-EBS-B=Ontario Child Health Study Emotional Behavioural Scales Brief checklist

Note: All correlations significant at $p < 0.01$; Convergent correlations significantly higher than discriminant correlations at $p < 0.001$ except for three comparisons—two in the general population marked with superscripts [a] and [b] and one in the clinical sample marked with [c] and [d].

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Ontario Child Health Study Emotional Behavioural Scales-Brief: Parent Version (of youth 4-17)

The statements below describe some of the feelings and behaviours of children and youth. For each statement, please select the response that best describes your child **now or within the past 6 months**. You may only select one response.

	Never or not true	Sometimes or somewhat true	Often or very true		Never or not true	Sometimes or somewhat true	Often or very true
Angry and resentful	0	1	2	Fidgets	0	1	2
Anxious or on edge	0	1	2	Finds it hard to stop worrying	0	1	2
Argues a lot with adults	0	1	2	Gets back at people	0	1	2
Can't concentrate, can't pay attention for long	0	1	2	Gets in many fights	0	1	2
Can't stay seated when required to do so	0	1	2	Has been physically cruel to others	0	1	2
Cruelty, bullying or meanness to others	0	1	2	Has difficulty awaiting turn in games or groups	0	1	2
Destroys things belonging to his/her family or other children	0	1	2	Has trouble enjoying self	0	1	2
Distractible, has trouble sticking to any activity	0	1	2	Impulsive or acts without thinking	0	1	2
Easily annoyed by others	0	1	2	Loses temper	0	1	2
Fails to finish things he/she starts	0	1	2	Nervous, high-strung or tense	0	1	2
Feels worthless or inferior	0	1	2	Too fearful or anxious	0	1	2

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OCHS-EBS-B Scoring Instructions

The items are scored as follow: Never or not true=0, Sometimes or somewhat true=1, Often or very true=2.

Emotional, Behavioural and Attention problem scores: Scale scores can be generated by summing together the following sets of items.

Total scale score: All 23 items can be summed together to generate a total score.

Emotional problems (6 items)	Behavioural problems (9 items)	Attention problems (7 items)
Finds it hard to stop worrying	Angry and resentful	Can't concentrate, can't pay attention for long
Anxious or on edge	Gets back at people	Can't stay seated when required to do so
Has trouble enjoying self	Argues a lot with adults	Impulsive or acts without thinking
Nervous, high-strung or tense	Gets in many fights	Distractible, has trouble sticking to any activity
Feels worthless or inferior	Has been physically cruel to others	Fails to finish things they start
Too fearful or anxious	Cruelty, bullying or meanness to others	Fidgets
	Destroys things belonging to their family or other children	Has difficulty awaiting turn in games or groups
	Loses temper	
	Easily annoyed by others	

CHAPTER 4: 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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4.2 CONTEXT AND IMPLICATIONS OF THIS STUDY: The existing evidence on area-level variability in children's unmet need for mental health services is extremely limited. This study aims to identity area-level characteristics associated with children's unmet need for community-based mental health services that can inform strategies for reducing unmet need in the population. The study reports the estimated between-area variance in unmet need for unmet need for mental health services and identifies service arrangement, geographic and population characteristics of areas that are associated with unmet need. The study explores a new area, generates new knowledge in area-level variability in children's unmet need for mental health services and identifies challenges that still need to be addressed. The study discusses several policy implications of the findings and identifies strategies that could be used to address equitable access to mental health services.

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Abstract

Purpose: There is limited empirical evidence documenting the magnitude and correlates of area-level variability in unmet need for child mental health services. Research is needed to 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.

Methods: 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).

Results: 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.

Conclusions: 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.

Key words: Mental health, services, children and youth, unmet need, multilevel modelling, area-level variation

Area-level variation in children's unmet need for community-based mental health services: Findings from the 2014 Ontario Child Health Study

Childhood mental disorders contribute to substantial individual and social burden (Waddell, Schwartz, & Andres, 2018) 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, Shepherd, Schwartz, & Barican, 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 & 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 & 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, Crowther, Sledge, Rathbone & Soares-Weiser, 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, Ringel, & Adreyeva, 2003). There is one Canadian study of adults that focuses on area-level variation in mental health risk and service use in Toronto (Law & Perlman, 2018). Other studies of children's unmet need for mental health services focus on individual-level determinants (Kataoka, Zhang & Wells, 2002; Jensen et al., 2011) or on vulnerable groups such as children with special health care needs (Inkelas,

Raghavan, Larson, Kuo, & Ortega, 2007; Fulda, Johnson, Hahn, & Lykens, 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, 1991) 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 & 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, Belsky, & Jozefiak, 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, Bullock, & Goering, 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, Boyle, Abelson, & Waddell, 2018). 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, Boyle, Abelson, & Waddell, 2018). 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 & 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, Hsiao, Berman, & Reich, 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 & Gardner, 2017) and Canada where rural areas experience both health and service disadvantages (Pong, DesMeules, & Lagacé, 2009; DesMeules et al., 2006; Mitura & 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 & 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 & 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 & 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 6,537 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=6,537) was interviewed using the Mini International Neuropsychiatric Interview for Children and Youth (MINI-KID; Sheehan et al., 2010; Duncan et al., 2018). 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., 2018) 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, Tobon, & Shanley, 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, five Service Areas 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 & 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 2,500 which meets the minimum sample size requirement of 50 required to estimate unbiased level 2 standard errors (Maas & 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, Steele, Browne, & Prosser, 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, Steele, Browne, & Prosser, 2004). Significance is assessed against three levels: $p < .05$(*), .01(**) and .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 $p<.05$ 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 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 $p<.05$ 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 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 decreased 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 & Raudenbush (2009). 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 & 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 & 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 Figure 1 (e.g. Nippising/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, DesMeules, & Lagacé, 2009; DesMeules et

al., 2006; Mitura & 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., 2007; Howell & 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, Thiede, & Birch, 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 & 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, 2018) 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 & 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, Twigg, Holt, Lewis & Jones, 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.

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Table 1. Sociodemographic & Service Area Characteristics of Study Sample

Characteristics	Mean/% (SE)	
Children (n = 10,765) [1]		
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) [2]	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

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

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

Table 2. Cross-classification of Children's Mental Health Need and MCYS-Funded Community-Based Mental Health Service Use (*n*=10,765)

	With mental health need % (SE)		
Mental health service use	Yes	No	Total %
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)	

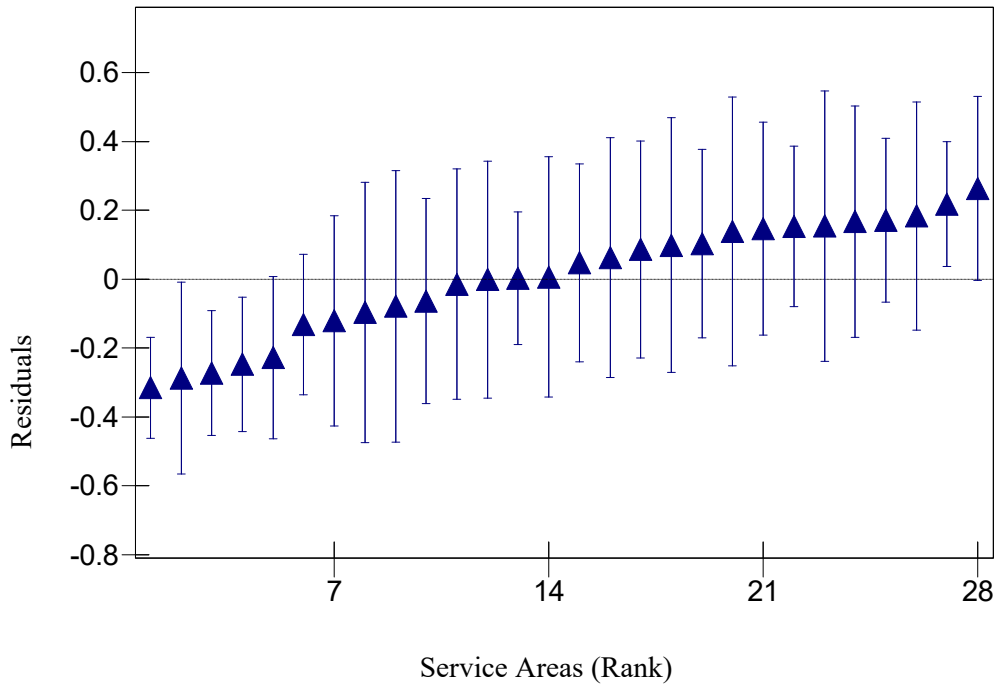
Table 3. Weighted Fixed Effect Estimates and 95% Confidence Intervals for Binary Logistic Multilevel Models of Children's Unmet Need for Community-Based Mental Health Services (n=10,654)[a]

Service Area Characteristics	Unadjusted OR (95%CI)[b]
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 ($10,000s)	0.89 (0.84-0.94)**

Note. *p <0.05, **p <0.01, ***p <0.001, OR=Odds ratio, CI=confidence interval

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

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



Rank	Service Areas		
1	Toronto	15	Dufferin/Wellington
2	Essex	16	Stormont, Dundas and Glengarry
3	Peel	17	Frontenac/Lennox and Addington
4	York	18	Prescott and Russell
5	Halton	19	Hamilton
6	Durham	20	Kenora/Rainy River
7	Middlesex	21	Lanark/Leeds and Grenville
8	Brant	22	Niagara
9	Lambton	23	Renfrew
10	Elgin/Oxford	24	Haldimand-Norfolk
11	Hastings/Prince Edward/Northumberland	25	Simcoe
12	Thunder Bay	26	Nippising/Parry Sound/Muskoka
13	Waterloo	27	Ottawa
14	Greater Sudbury/Manitoulin/Sudbury	28	Haliburton/Kawartha Lakes/Peterborough

Figure 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).

Appendix. Supplementary table of Service Area characteristics

Service Area	*Service Area Characteristics*					
	% children's unmet need for mental health services	*Service arrangements*		*Geographic*		*Population*
		Dollar per capita expenditures	No. of agencies	% Rural population	Public transport dissatisfaction	Mean household income (CAD$)
Brant	12.3	35.21	4	15.6	2.2	83,028
Dufferin/Wellington	14.1	73.90	2	24.6	1.9	101,786
Durham	14.6	63.41	7	8.4	2.0	106,886
Elgin/Oxford	17.0	66.61	3	33.3	1.8	81,748
Essex	14.5	191.23	5	12.4	2.2	85,824
Frontenac/Lennox and Addington	16.9	161.85	2	34.7	1.9	85,246
Greater Sudbury/Manitoulin/Sudbury	11.5	230.35	6	30.8	2.0	83,669
Haldimand-Norfolk	21.1	53.76	2	54.7	2.7	78,563
Haliburton/Kawartha Lakes/Peterborough	14.8	74.22	10	47.7	2.1	139,315
Halton	18.0	125.66	12	4.4	1.8	87,775
Hamilton	14.2	309.47	16	6.5	2.1	82,073
Hastings/Prince Edward/Northumberland	20.9	245.08	7	48.4	3.1	79,823
Kenora/Rainy River	20.7	197.01	4	62.2	2.8	89,571
Lambton	9.4	114.87	5	27.9	2.3	83,455
Lanark/Leeds and Grenville	20.6	60.14	3	59.8	2.1	83,802
Middlesex	19.8	170.18	13	9.6	2.1	81,842
Niagara	29.5	278.68	5	12.8	2.4	80,540
Nipissing/Parry Sound/Muskoka	18.5	29.67	3	53.0	2.1	106,372
Ottawa	15.6	63.36	14	6.9	1.9	104,466

Peel	14.6	1155.94	9	1.8	2.0	90,427
Prescott and Russell	21.2	120.90	2	47.7	2.4	79,574
Renfrew	30.2	23.29	1	46.1	3.7	92,558
Simcoe	16.8	622.23	4	26.3	2.5	72,831
Stormont, Dundas and Glengarry	20.3	28.05	3	47.8	2.8	77,260
Thunder Bay	16.6	417.50	5	30.1	1.7	83,431
Toronto	10.5	145.53	85	0.0	1.8	102,721
Waterloo	12.3	81.05	9	5.8	2.0	95,459
York	14.1	68.73	10	4.0	2.1	122,446

CHAPTER 5: CHILDREN'S MENTAL HEALTH NEED AND EXPENDITURES IN ONTARIO: FINDINGS FROM THE 2014 ONTARIO CHILD HEALTH STUDY

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5.2 CONTEXT AND IMPLICATIONS OF THIS STUDY: This study examined the alignment between service expenditures for children's mental health services and population need. Two other contributions include: (1) the quantification of the value of adjusting for need in addition to population size in formula-based expenditure allocations, and (2) the comparison of two different definitions of need—assessed need as the presence of a mental disorder, and perceived need as the subjective perception of a mental health problem. The study finds benefits in adjusting for mental health need in allocating expenditures based on either definition of need.

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Children's Mental Health Need and Expenditures in Ontario: Findings from the 2014 Ontario Child Health Study

Besoins et dépenses de santé mentale des enfants en Ontario : résultats de l'Étude sur la santé des jeunes Ontariens 2014

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Abstract

Objective: To estimate the alignment between the Ontario Ministry of Children and Youth Services (MCYS) expenditures for children's mental health services and population need, and to quantify the value of adjusting for need in addition to population size in formula-based expenditure allocations. Two need definitions are used: "assessed need," as the presence of a mental disorder, and "perceived need," as the subjective perception of a mental health problem.

Methods: Children's mental health need and service contact estimates (from the 2014 Ontario Child Health Study), expenditure data (from government administrative data), and population counts (from the 2011 Canadian Census) were combined to generate formula-based expenditure allocations based on 1) population size and 2) need (population size adjusted for levels of need). Allocations were compared at the service area and region level and for the 2 need definitions (assessed and perceived).

Results: Comparisons were made for 13 of 33 MCYS service areas and all 5 regions. The percentage of MCYS expenditure reallocation needed to achieve an allocation based on assessed need was 25.5% at the service area level and 25.6% at the

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region level. Based on perceived need, these amounts were 19.4% and 27.2%, respectively. The value of needs-adjustment ranged from 8.0% to 22.7% of total expenditures, depending on the definition of need.

Conclusion: Making needs adjustments to population counts using population estimates of children's mental health need (assessed or perceived) provides additional value for informing and evaluating allocation decisions. This study provides much-needed and current information about the match between expenditures and children's mental health need.

Abrégé

Objectif : Estimer la correspondance entre les dépenses du ministère des Services à l'enfance et à la jeunesse (MSEJ) de l'Ontario allouées aux services de santé mentale des enfants et les besoins de la population, et quantifier la valeur de l'ajustement aux besoins ainsi qu'à la taille de la population pour des dépenses attribuées selon une formule. Deux définitions des besoins sont utilisées: un « besoin évalué » en fonction de la présence d'un trouble mental, et un « besoin perçu » étant la perception d'un besoin d'aide professionnelle.

Méthodes : Les estimations des besoins de santé mentale des enfants et des contacts avec les services (tirées de l'Étude sur la santé des jeunes Ontariens 2014), les données sur les dépenses (tirées des données administratives du gouvernement) et les dénombrements de la population (tirés du Recensement canadien de 2011) ont été combinés pour produire des attributions de dépenses selon une formule en fonction a) de la taille de la population et b) du besoin (taille de la population ajustée aux niveaux du besoin). Les attributions ont été comparées dans le secteur des services et au niveau de la région et dans les 2 définitions du besoin (évalué et perçu).

Résultats : Des comparaisons ont été effectuées dans 13 des 33 secteurs de services du MSEJ et dans toutes les 5 régions. Le pourcentage de réattribution des dépenses du MSEJ nécessaire pour obtenir une allocation basée sur le besoin évalué était de 25,5% au niveau du secteur des services et de 25,6% au niveau de la région. Selon le besoin perçu, ces chiffres étaient de 19,4% et de 27,2%, respectivement. La valeur de l'ajustement aux besoins oscillait entre 8,0% et 22,7% des dépenses totales, selon la définition du besoin.

Conclusion : Effectuer des ajustements aux besoins selon la taille de la population en utilisant les estimations dans la population des besoins de santé mentale des enfants (évalués ou perçus) offre une valeur ajoutée pour éclairer et évaluer les décisions en matière d'allocation. Cette étude procure de l'information actuelle et très nécessaire sur la correspondance entre dépenses et besoins de santé mentale des enfants.

Keywords

mental health need, children, services, expenditures, Ontario, funding formula

The Ontario Ministry of Children and Youth Services (MCYS) was responsible for funding services addressing the mental health needs of children and youth aged 0 to 17 (herein "children") until August 2018.[1] Although additional services are provided by the Ministries of Health and Education (in primary care, hospital settings, and schools) and by private providers, advocacy, charity and self-help groups,[2] total expenditure allocations to children's mental health services and the proportion of public and private sector allocations are unknown. Also unknown is Ontario's overall capacity to care for children with mental health needs, as service planning and provision is not coordinated across sectors.[3] Accordingly, this work focuses exclusively on MCYS expenditures in children's mental health services and excludes expenditures in child welfare, primary care, hospitals, schools and private settings.

There are 5 MCYS administrative regions in Ontario (West, Central, East, North, and Toronto) comprising 33 service areas that are geographically bounded in one or more Statistics Canada Census Divisions. Within service areas, MCYS contracts with individual service agencies to provide programs targeting the early identification of mental health problems, as well as individual-, family-, and group-based interventions for these problems.[4] MCYS service areas and regions formed our target allocation units (TAUs), with individual agency expenditures aggregated to both the area and region levels.

To date, limited information is publicly available on how MCYS has approached expenditure allocation decisions; although, the introduction of a funding formula has been considered.[5,6] Governments commonly use these types of formulas, as they are believed to maximize the usefulness of tax dollars for the public good by distributing resources according to need, thereby creating equitable capacities for care.[7] Although formula-based allocations consider the principle of equity (distributing resources according to need), they do not consider the relationship between the allocation and outcomes (i.e., how expenditure allocations get used once distributed, service effectiveness, among others).

At a minimum, we expect children's mental health need to be a function of the number of children living in a particular area. Beyond this, Bradshaw[8] developed a typology of need that we can apply: normative (presence of mental disorder); felt (parent/youth 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).[9] With no single definition of need in children's mental health, and evidence that the presence of disorder is only a partial determinant of service use,[10] we defined the concept of need in 2 ways: "assessed" (the presence of mental disorder) and "perceived" (subjective perceptions of mental health need), based on data from a large population survey.

In the absence of periodic, general population surveys, the systematic collection of data on children's mental health need would require significant time, resources, and commitment to implement. It is therefore important to quantify how well a simple population-based allocation approximates a needs-based allocation. Small allocation differences would signify that using easily available population counts to generate expenditure allocations is more cost-effective and preferable. However, evidence from the Canadian health sector suggests these approaches can differ considerably.[11] In addition to understanding how MCYS expenditures align with population- and needs-based allocations, we also aim to quantify the value in adjusting for need over and above population size.

To our knowledge, this is the first study anywhere to use an allocation formula to evaluate expenditure allocations in children's mental health. Only 2 studies in Canada have examined allocations for children's mental health at all. In Québec, Blais and colleagues[12] reported no significant regional differences in need indicators but large differences in mental health resources and services in 1992 to 1993. In Ontario, Boyle and Offord[13] reported large discrepancies in expenditures and service use that could not be explained by children's mental health need.

The objectives of the current study are to: 1) evaluate the extent to which expenditures for MCYS children's mental health services in Ontario are aligned with population- and needs-based expenditure allocations; 2) quantify the value of using a needs-based formula as opposed to a simple, population-based formula; and 3) estimate the impact of the TAU and definition of children's mental health need on our findings. We addressed 3 questions. First, what percentage of 2015-2016 MCYS expenditures would need to be reallocated to achieve a needs-based expenditure allocation? Second, what percentage of expenditures would need to be reallocated to move from a population-based allocation to a needs-based allocation? Finally, to what extent does the TAU and definition of need influence the results?

Methods

Data

This study combines aggregate data from: 1) the 2014 Ontario Child Health Study (OCHS);[14] 2) MCYS expenditures for the 2015-2016 fiscal year, obtained from the Client Services Branch of MCYS; and 3) the 2011 Census population counts of children.[15] The 2014 OCHS is a province-wide, cross-sectional, epidemiological study of children's mental health. A probability sample of 6,537 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 3-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 about the child and by computer-assisted interviews from children aged 12 to 17. Detailed accounts of the survey design, content, training, and data collection are available elsewhere.[14,16]

Concepts and Measures

Children's mental health need

Assessed need. One randomly selected child from each family ($n = 6,537$) and their parent was interviewed using the Mini International Neuropsychiatric Interview for Children and Youth (MINI-KID).[17,18] Youth aged 12 to 17 were also interviewed. Children meeting the criteria for one or more disorders in the past 6 months,[19] according to parent or youth report, were classified with assessed need. The remaining children ($n = 4,265$) were classified based on a total scale score from the OCHS Emotional Behavioural Scales (OCHS-EBS)[20] converted to a binary disorder classification. The OCHS-EBS contains a 52-item checklist that is self-reported by parents about children of all ages and by youth aged 12 to 17 to assess mental health disorder symptoms over the past 6 months. The OCHS-EBS demonstrates satisfactory reliability and validity when used as either a dimensional[20] or categorical[21] measure. A total scale score cut-off was selected and applied to produce a prevalence of one or more disorders that matched the same disorder prevalence assessed by the MINI-KID interview. Assessed need was coded as present (1) when the child was identified with one or more disorders, based on parent or youth report; and otherwise, as absent (0).

Perceived need. Perceived need was defined as a positive response to a question asking whether the parent (for ages 4 to 17) or youth (for ages 12 to 17) thought that, in the past 6 months, the child had any emotional or behavioural problems. Perceived need was coded as present (1) if the parent or youth answered yes to this question; and otherwise, absent (0).

Analysis

Selection and evaluation of target allocation units. Due to extensive clustering in the 2014 OCHS, we assessed the coverage and representativeness of the data in each TAU to identify those areas and regions eligible for inclusion. Survey respondents were grouped according to administrative boundaries and were assessed for adequate coverage. Adequacy was

Step 1		
Total population (from 2011 Census)	2,693,795	
	With mental disorder	Without mental disorder
Proportion of the population with & without disorder	.22	.78
Total population with & without disorder	591,947	2,101,847
Proportion with & without disorder with service contact	.12	.02
Total population with & without disorder with service contact	69,850	33,630
Average number of contacts	2.93	1.92
Total number of contacts for those with & without disorder	204,660	64,569
Total number of service contacts	269,229	
Step 2		
Total expenditure	$341,367,552	
Per contact expenditures for those with service contact	$341,367,552 ÷ 269,229 = $1,268	
. . . allocated to those with disorder	204,660 x $1,268 = $259,497,894	
. . . allocated to those with without disorder	64,569 x $1,268 = $81,869,658	
Step 3		
Per capita expenditures distributed in the total population		
. . . allocated to those with disorder	$259,497,894 ÷ 591,947 = $438.38	
. . . allocated to those with without disorder	$81,869,658 ÷ 2,101,547 = $38.95	

Figure 1. Outline of the process used to generate dollar per capita allocations based on population size adjusted for children's mental health need, defined as the presence of mental disorder and weighted by the likelihood that children with and without mental disorder will be in contact with services. This example uses the assessed need definition and rounded estimates. The process was repeated using the perceived need definition.

defined as an unweighted sample size over 100, a weighted sample size over 20,000, and household weighted sample estimates of the percentage of single-parent families within 5% of the 2011 Census and an average income within 20%. Without existing guidelines for assessing coverage adequacy, cut-offs were selected based on statistical power requirements and observed differences between Census and survey estimates on socio-demographic variables.[16]

Expenditure allocation formulas

Population-based. This formula divided total MCYS expenditures by the 2011 Census count of children aged 0 to 17 in Ontario to estimate an average 2015-2016 dollars per capita amount, which came to $341,367,552 ÷ 2,683,795 = $127. To generate total expenditure allocations for each TAU, this amount was multiplied by the number of children in each area.

Needs-based. This formula included 3 steps, as summarized for assessed need in Figure 1. The process outlined here for assessed need was repeated using perceived need for professional help as the definition of need. In step 1, we adjusted our formula for imperfect targeting of services by splitting overall expenditures between children with and without mental health need (assessed need based on the presence of mental disorder in the first expenditure allocation and perceived need in the second). This was done by estimating the proportion of children with and without mental disorder, who had mental health agency service contact, based on parent responses to the question, "In the past 6 months, did you, another family member or <child> see or talk to anyone from any mental health or addictions agency because of concerns about his/her mental health?" Proportions were multiplied by the 2011 Census population counts to estimate the numbers of children in the general population with and without mental disorder who had service contact (69,850 and 33,630 children, respectively). We also adjusted the formula for the differential number of service contacts among those with and without mental disorder in recognition that more resources may be required to serve those with a mental disorder v. those without. This was done by estimating the average number of service contacts based on parent responses to the question "In the past 6 months, how many times in total did you, another family member, or <child> see or talk to anyone from this/these agency/ies about your concerns?" These averages were multiplied by the number of children with and without mental disorder with service contact to estimate the total number of service contacts by children in the general population with and without disorder (204,661 and 64,570 contacts, respectively).

In step 2, we divided total expenditures ($341,367,552) among service contacts (204,661 + 64,570 = 269,231) and multiplied that amount ($1,268) by the number with and without disorder that had service contact. In step 3, we divided these totals among the total number of children in the population with and without disorder. This resulted in

Table 1. Number of Children, Prevalence of Assessed and Perceived Need by Selected Service Areas and Regions, and Summary Statistics of Coverage Evaluation Comparing Weighted Survey Estimates with 2011 Census Estimates of Proportion of Single Parent Families and Household Income.

				Coverage Evaluation		
		% Children with Mental Health Need				
MCYS Region and Service Area	No. Children 0 to 17	Assessed	Perceived	Weighted Sample Size (Rounded to Base 50)	Absolute % Difference in Estimates of Single Parent Families	Absolute % Difference in Estimates of Household Income[a]
West	568,135	23.4	32.0	108,050	1	9
Haldimand-Norfolk	22,255	31.2	22.1	23,300	3	9
Niagara	83,590	26.3	30.2	127,950	2	9
Middlesex	90,385	20.9	37.6	29,300	2	7
Central	940,505	21.8	25.9	750,950	1	7
Dufferin/Wellington	60,175	24.8	31.6	33,650	2	0
Waterloo	113,435	24.4	17.9	147,750	1	6
Halton	119,390	14.1	38.3	57,650	3	16
York	238,150	15.2	32.8	138,700	4	3
Peel	313,990	18.3	28.6	233,800	2	8
East	535,130	23.7	31.1	485,200	3	10
Lanark/Leeds and Grenville	31,450	30.0	38.0	43,900	5	11
Hastings/Prince Edward/Northumberland	45,190	21.8	25.7	26,850	3	7
Durham	141,325	19.2	27.2	136,550	1	11
Ottawa	182,170	21.3	50.4	132,400	3	11
North	161,260	33.6	46.7	108,050	2	6
Nipissing/Parry Sound/Muskoka	32,890	34.9	38.4	29,000	1	15
Toronto	488,765	15.5	17.9	388,250	3	12

[a]Absolute differences in income were calculated by subtracting the 2014 OCHS income estimate from the 2011 Census income estimate and then dividing this amount by the 2011 Census income estimate to generate a proportion. Multiplying by 100 gives a %. (e.g., $18,000-$20,000=$2000, $2,000/$20,000= 0.1, 0.1 × 100 = 10%)

dollar per capita allocations of $438 for children with mental disorder and $39 for those without.

We then multiplied Census population counts from each TAU by the aggregate proportions of children with and without mental disorder in each TAU based on 2014 OCHS data (see Table 2 for assessed and perceived need estimates and population counts). We multiplied these numbers by the dollar per capita amounts to generate total expenditure allocations for each TAU.

Statistical analysis. All survey estimates were weighted using standardized weights to reflect the probability of selection. Total overall weighted estimates of both assessed and perceived children's mental health need and service contact in addition to TAU-specific weighted estimates were generated. We did not adjust for age and sex, as the age and sex distributions of MCYS services and expenditures are unknown, and we expect age and sex differences in mental health need to be evenly distributed across the province. Population counts and MCYS expenditures are based on a 0 to 17 age group to align with the age group that MCYS agencies serve. Estimates of need are based on a 4 to 17 age group, the target population of the 2014 OCHS. However, excluding 0- to 4-year-olds in our assessments of need would not affect prevalence estimates differently across TAUs. Our service area analysis included only expenditures and population counts from eligible service areas. Our regional analysis used expenditures and counts from all regions.

Our analysis compared needs-based expenditure allocations with 2015-2016 MCYS expenditures and with population-based allocations. To quantify the amount of MCYS expenditures that would need to be reallocated to achieve a needs-based expenditure allocation, we calculated the differences between allocations, summed the absolute differences, and calculated this as a percentage of total expenditures. To quantify the value in adjusting for need in addition to population size, we followed the same procedure comparing needs-based allocations to population-based allocations. We then compared allocation differences at the service area and region levels, and repeated the analysis using perceived need instead of assessed need.

Results

Thirteen service areas and all 5 regions met the adequacy criteria, shown in Table 1 along with estimates of need and child population counts. As Toronto is both a service area and region, we included it as a region only due to its size. Unweighted sample sizes are suppressed for confidentiality reasons.

Table 2 presents MCYS expenditures and the 3 formula-based expenditure allocations: 1) population-based in the second column, 2) assessed needs-based in the third column,

Table 2. Table of Total Expenditures and Allocations for Selected Service Areas and Regions.

MCYS Region and Service Area	MCYS Expenditures	Population-based Allocation	Assessed Needs-based Allocation	Perceived Needs-based Allocation
West	$72,246,178	$71,996,145	$74,989,469	$81,388,441
Haldimand-Norfolk	$2,172,879	$2,180,762	$2,983,205	$3,087,113
Niagara	$9,424,423	$8,190,963	$9,864,967	$11,600,549
Middlesex	$14,521,891	$8,856,804	$9,060,159	$10,032,389
Central	$82,878,481	$119,184,232	$118,144,457	$110,887,754
Dufferin/Wellington	$4,674,442	$5,896,533	$6,796,540	$6,959,004
Waterloo	$9,823,075	$11,115,468	$12,675,822	$13,583,433
Halton	$14,182,012	$11,698,997	$9,336,397	$11,387,454
York	$17,897,615	$23,336,260	$19,449,850	$16,242,701
Peel	$22,097,003	$30,767,802	$28,857,068	$21,746,378
East	$65,614,461	$67,813,630	$71,225,966	$74,821,183
Lanark/Leeds and Grenville	$5,725,664	$3,081,778	$4,093,527	$4,277,347
Hastings/Prince Edward/Northumberland	$7,370,543	$4,428,157	$4,659,232	$6,210,662
Durham	$9,477,283	$13,848,402	$13,387,925	$14,227,762
Ottawa	$21,281,697	$17,850,793	$18,507,710	$19,204,827
North	$44,240,846	$20,435,457	$27,734,040	$33,048,576
Nipissing/Parry Sound/Muskoka	$5,827,074	$3,222,883	$4,803,200	$5,915,981
Toronto	$76,387,586	$54,537,865	$49,273,620	$41,221,598

and 3) perceived needs-based in the fourth column. For example, in the West region, actual MCYS expenditures were $72,246,178 compared with a population-based allocation of $71,996,145; an assessed needs-based allocation of $74,989,469; and a perceived needs-based allocation of $81,388,441. Figures 2 and 3 graph the same information. For service areas, total MCYS expenditures ranged from $2.2 M (Haldimand-Norfolk) to $22.1 M (Peel). For regions, expenditures ranged from $44.2 M in the North to $82.8 M in the Central region.

Table 3 shows allocation differences, the sum of the absolute total differences, and the percentage of total expenditures represented by this amount. The percentages in columns 1 and 2 represent the proportion of MCYS expenditure reallocation required for a distribution commensurate to population size adjusted for need. These amounts were 25.5% and 25.6% for service areas and regions, respectively, based on an assessed need definition, and 19.4% and 27.2%, respectively, based on a perceived need definition. The percentages in columns 3 and 4 represent the allocation difference between population-based and needs-based allocations expressed as a percentage of total expenditures. Based on an assessed needs-based allocation, this difference was 11.9% and 8.0% of total expenditures for service areas and regions, respectively. Based on a perceived needs-based allocation, this difference was 22.7% and 17.0%, respectively.

Discussion

This study is the first to use a formula-based approach to: 1) evaluate the extent to which government expenditures to children's mental health services align with the number of children and their levels of need, and 2) quantify the value of adjusting for need, over and above the number of children. Our findings suggest that 26% of MCYS expenditures would need to be reallocated to achieve a distribution commensurate to the levels of assessed need in the population. To avoid penalizing areas with lower need, a policy option would be to employ incremental funding adjustments over time to higher need areas (negative differences in Table 3). In our data, this represents 12.8% of expenditures, translating to new expenditures of $18.4 M across the 13 service areas or $43.6 M across the 5 regions in 2015-2016 funds.

There is substantial variation in the alignment of needs-based allocations with MCYS expenditures. For example, these differences were small in the West and East regions and large in the Central, North, and Toronto regions. The higher MCYS expenditures in the North might reflect greater service delivery costs. This could also be the case in Toronto, along with comparatively lower levels of need due to the high proportion of immigrants in the Toronto region (83% in our sample); children of immigrants have been found to have lower levels of mental health need.[19,22] Lower levels of MCYS expenditures in the Central region may be due to expenditure allocations falling behind population growth. Census population counts for this region show a 19% population increase from 2006 to 2016 compared with growth ranging from 0% to 9% in the other regions for the same period.[23,24]

Is there value in making needs-adjustments to population counts when evaluating allocation decisions? Our findings suggest that there is. Depending on the definition of need used, the difference between needs-based and population-based allocations ranged from 8% to 23% (15% on average) or from $17,240,440 to $58,025,938 ($33,881,979 on average) in 2015-2016 dollars, which is consistent with previous

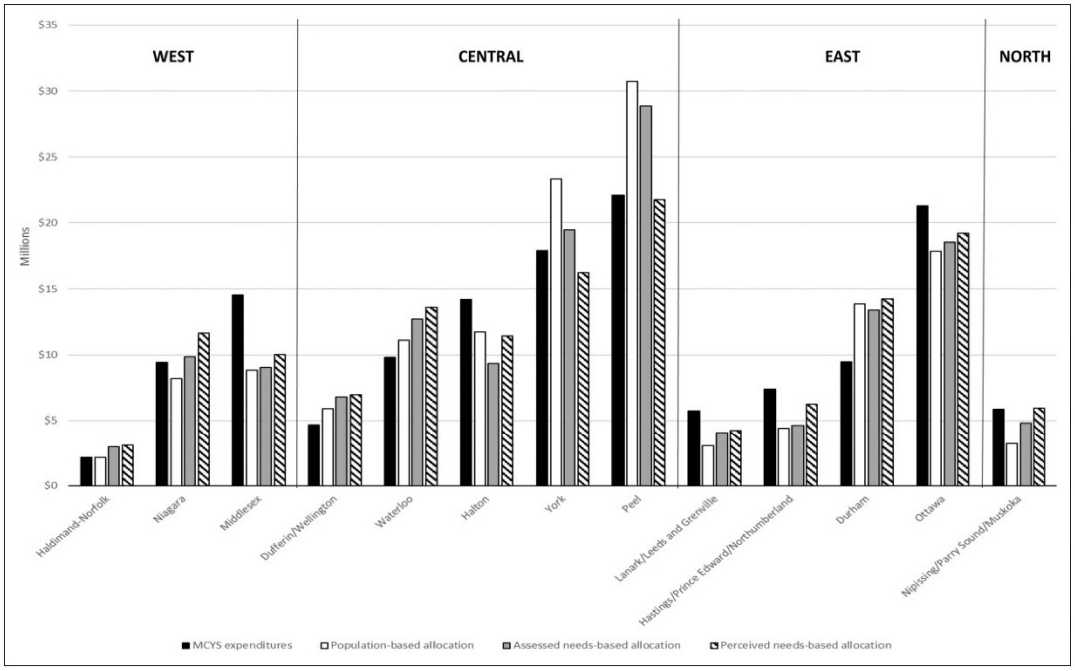

Figure 2. Graph of allocations to MCYS service areas based on expenditures, population-based allocations, and needs-based allocations.

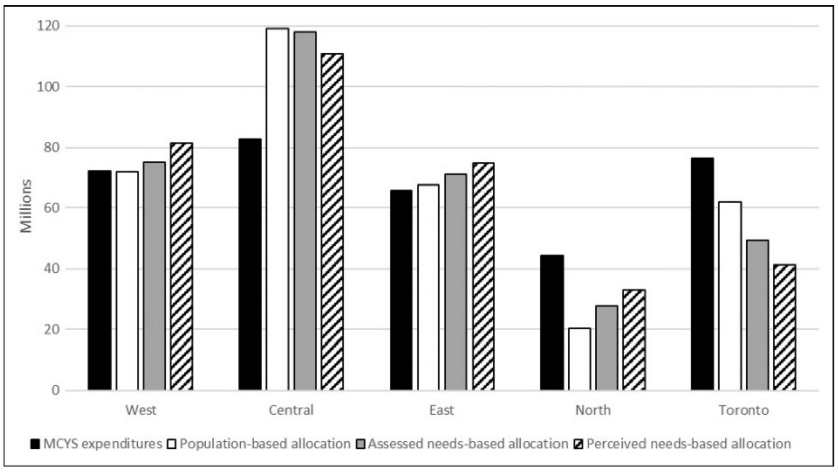

Figure 3. Graph of allocations to MCYS regions based on expenditures, population-based allocations, and needs-based allocations.

findings from the health care sector.[11] This suggests that going from population- to needs-based allocations would have considerable value based on the reallocation estimates.

If Ontario proceeds with a formula-based funding approach, efforts should be made to include needs-adjustments. Implementing adjustments for children's mental health need means confronting 2 challenges. The first is achieving consensus on the definition and measurement of children's mental health need. The second is identifying a cost-efficient method for obtaining

Table 3. Table of Allocation Differences and Reallocations at the Service Area and Region Level.

	Difference between MCYS Expenditures V.:		Difference between Population-based Allocation V.:	
MCYS Region and Service Area	Assessed Needs-based Allocation	Perceived Needs-based Allocation	Assessed Needs-based Allocation	Perceived Needs-based Allocation
West				
Haldimand-Norfolk	−$810,326	−$914,234	$802,443	$906,351
Niagara	−$440,544	−$2,176,126	$1,674,003	$3,409,586
Middlesex	$5,461,732	$4,489,502	$203,355	$1,175,586
Central				
Dufferin/Wellington	−$2,122,098	−$2,284,562	$900,007	$1,062,471
Waterloo	−$2,852,747	−$3,760,358	$1,560,355	$2,467,965
Halton	$4,845,615	$2,794,558	−$2,362,599	−$311,543
York	−$1,552,235	$1,654,914	−$3,886,409	−$7,093,558
Peel	−$6,760,065	−$350,625	−$1,910,735	−$9,021,425
East				
Lanark/Leeds and Grenville	$1,632,137	$1,448,317	$1,011,749	$1,195,569
Hastings/Prince Edward/Northumberland	$2,711,311	$1,159,881	$231,075	$1,782,505
Durham	−$3,910,642	−$4,750,479	−$460,477	$379,360
Ottawa	$2,773,987	$2,076,870	$656,916	$1,354,034
North				
Nipissing/Parry Sound/Muskoka	$1,023,874	-$88,907	$1,580,317	$2,693,098
Total absolute differences	$36,897,314	$27,949,334	$17,240,440	$32,853,051
Reallocation (percentage of total expenditures)	25.5%	19.4%	11.9%	22.7%
Regions				
West	−$2,743,291	−$9,142,263	$2,993,325	$9,392,297
Central	−$35,265,976	−$28,009,273	−$1,039,775	−$8,296,479
East	−$5,611,505	−$9,206,722	$3,412,336	$7,007,553
North	$16,506,806	$11,192,280	$7,298,583	$12,613,119
Toronto	$27,113,966	$35,165,988	−$12,664,468	−$20,716,490
Total absolute differences	$87,241,545	$92,716,516	$27,408,487	$58,025,938
Reallocation (percentage of total expenditures)	25.6%	27.2%	8.0%	17.0%

reliable population estimates of need for MCYS service areas.

In reference to the first challenge, children's mental health need was defined as the presence of mental disorder identified by parents or their children. Acknowledging that many service providers do not use DSM disorder classifications to define children's mental health need, we replicated our analysis using parent and child subjective perceptions of need. Compared with assessed need, perceived need more directly captures mental health concerns and is associated more closely with actual service demand.[25] Differences between assessed and perceived need in their patterns of recommended expenditures indicate that a consensus on the definition and measurement of children's mental health need is a prerequisite for developing a needs-based formula.

In reference to the second challenge, decision makers must devise strategies to minimize the costs of obtaining reliable estimates of children's mental health need associated with data collection, sampling, and survey timing. Periodic, in-person, household surveys like the 2014 OCHS would provide affordable and reliable estimates at the provincial level but not at the individual service area level; producing reliable estimates at the service area level could be more costly. One difficulty for policymakers is that sampling small areas is more informative for service planning and evaluation because it can identify differences in need not discernible by sampling large areas. In addition, the interval between surveys—5, 10, or 20 years—will influence overall cost. However, the ideal interval for discerning population changes in children's mental health need has not been identified.

Limitations

This study is not without limitations. One, limited sample size and coverage restricted the analysis to 13 of the 33 MCYS service areas in Ontario. The regional replication of our findings provides confidence that the interpretation of our findings applies to the other 20 areas, and that a

general formula-based approach can be applied to other provinces and jurisdictions. Two, a 4-year gap exists between the 2014 OCHS and the 2011 Census. However, correlations between variables assessing the same phenomena in the 2014 OCHS and the 2011 Census are high, obviating concerns about census timing.[16] More relevant and not addressable here are concerns about the quality of the Census data due to extensive non-response.[26] Three, reliance on MCYS expenditures excluded resources contributed by other sectors (namely health and education) for the reasons outlined in the Introduction. Understanding the distribution of service expenditures across sectors and the capacity to care that these resources create, is an important area for further research when such information can be made available. Finally, this work focused only on service expenditures and puts aside important issues about service costs, effectiveness, efficiency, and outcomes that warrant exploration. Despite these limitations, we believe that this work provides a useful approach to using 2014 OCHS data to inform and evaluate government expenditure allocation decisions that could be modified to incorporate other estimates of need or additional relevant information. The availability of the 2014 OCHS data presents numerous opportunities for similar and further work in this much-neglected area.

Conclusion

This study combines estimates from general population survey data, Census data and government expenditures data to compare needs-based allocations with actual MCYS expenditures and a population-based allocation. Our findings suggest that an expenditure reallocation was needed in 2015-2016 to ensure resources were distributed according to need. Our findings also suggest there is value in including estimates of need, in addition to population size, in formula-based expenditure decisions.

The lack of a needs-based approach to expenditure decisions in children's mental health reflects a lack of available data. Policymakers would benefit from identifying data collection opportunities or exploring the potential usefulness of alternative indicators of need that are systematically collected. The availability of this data would provide an opportunity to inform and evaluate funding allocation decisions and establish much-needed understanding about the funding required to serve children with mental health needs and their families. Ensuring the usefulness of this data would also require addressing certain challenges including: 1) achieving consensus on the definition of mental health need; 2) finding commitment, resources, and capacity within governments to collect and use this kind of data; and 3) coordinating initiatives and funding across the various sectors involved with children's mental health.

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Data Access

Data access available through Statistics Canada Research Data Centres.

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CHAPTER 6: CONCLUSION

6.1 Discussion

Children's mental health problems are a major public health concern. Recent evidence found that the prevalence of mental disorders is high and service reach for children with mental disorders is low (Georgiades et al., 2019). There is little or no evidence that government responses to these challenges have been effective in getting mental health services to those children who need them. Provincial governments have been criticised for funding poorly organised services that are inefficient and unable to evaluate the effectiveness of the services they provide (Canadian Institute for Health Information, 2015). The Ontario government, in particular, has faced criticisms for its inadequate response to children's mental health needs in the province (Office of the Provincial Advocate for Children and Youth, 2012; Auditor of General of Ontario, 2018). Two key impediments underlie this inadequate response: (1) the absence of practical, scientifically sound measurement tools to monitor mental health need among children in the general population and those receiving mental health services from community-based agencies; and (2) the failure to develop and implement a systematic approach to collecting and using data on children's mental health needs to evaluate government response to these needs. Each of these points is discussed in turn.

Measurement Tools. Measurement tools that could be used to monitor children's mental health need do not exist. The Brief Child and Family Phone Interview checklist (BCFPI: Cunningham, Boyle, Hong, Pettingill & Bohaychuk, 2009) was developed for use in clinical settings and mandated in children's mental health agencies for a number of years before the government ended financial support for the instrument, leaving agencies with the financial burden of paying for the instrument if they wanted to continue using it. As a result, use of the tool has declined. While the BCFPI might be useful from a population monitoring perspective, it was not developed and evaluated specifically for this purpose. Other instruments such as the InterRAI Child and Youth Mental Health Assessment (ChYMH; Stewart & Hamza, 2017) have been developed for use in intake assessment in clinical settings but is a lengthy assessment that relies on clinician ratings, which makes it inappropriate for population monitoring purposes. A need exists for practical and scientifically valid instruments that can be used by service providers and epidemiologists to measure and classify child mental disorder as both dimensional and categorical phenomena (Boyle et al., 2019a). Papers 1 and 2 in this thesis respond to this need.

Evaluation. Researchers have recommended a public health strategy to improve children's mental health (Waddell, McEwen, Shepherd, Offord & Hua, 2005) and even outlined a children's mental health information system that could be used to inform a population health approach (Boyle et al., 2019). This type of

approach is critical in order to: (1) determine the levels of need in the population; (2) attend to the issues raised by mental disorders; and (3) evaluate the responsiveness of mental health systems (Aoun, Pennebaker, & Wood, 2004). Implementing a population health approach to children's mental health and evaluating service responses ensures that the principles of accountability (Deber, 2014) and equity (Lane, Sarkies, Martin & Haines, 2017) guide decision-making in mental health policies and programs. Accountability means governments are responsible for meeting defined objectives and that they are answerable to the populations they intend to serve. Equity means that those with equal needs have equal access to services that are of equal quality, and are able to use services equally (Whitehead, 1992). Although governments readily identify with these principles, they have been reluctant to develop and implement evaluation strategies to test the extent to which these principles are upheld. As a result, evidence gaps exist in our knowledge about: (1) children's unmet need for mental health services in the general population; and (2) funding equity in the geographic allocation of resources to children's mental health service agencies in Ontario. Papers 3 and 4 in this thesis address these evidence gaps.

Uniting the four papers in this thesis is the development and application of rigorous statistical research methods, which can serve as a foundation for rational policy development and planning in children's mental health services. In their 2015 report on children's mental health care in Canada, the Canadian Institute of Health Information concluded that, "overall, better data and information are needed to understand how community mental health services contribute to the overall mental health system for children and youth". Through the use of advanced statistical techniques applied to high quality epidemiologic data, this thesis provides the tools to collect better data and generates new information about how well children's mental health services address the needs of children in Ontario.

6.2 Contributions

These papers represent important, original, relevant and impactful contributions. What follows is a brief discussion of the contributions of each paper. Papers 1 and 2 are discussed in relation to the need for measurement tools that they fulfill. Papers 3 and 4 are discussed in relation to the evidence gaps they address. I summarise the need or evidence gap that exists, how the need or evidence gap is addressed by the work in this thesis and how the results are actionable. The section ends with a summary of the methodological contributions made by the thesis as a whole.

Paper 1

Need: Tolerance for lengthy assessment instruments continues to decline in epidemiological research. There is also an absence of instruments that would be

suitable for use for standardized assessments of mental disorder in clinical settings. There is a need for practical and scientifically valid instruments that can be used to classify childhood mental disorder as both dimensional and categorical phenomena in epidemiological research and in clinical settings.

How this need is addressed by this paper: Paper 1 develops and evaluates a checklist for dimensional measurement of seven DSM-5 disorders. It provides good coverage of common DSM-5 disorders, it is relatively brief (52-items), easy to administer and score and practical to use. It meets scientific standards of reliability and validity and it is accompanied by a partner paper that evaluates the same checklist for categorical measurement (Boyle et al., 2019b). It also provides population norms that can be used to compare against individual scale scores.

How the results are actionable: The paper provides a parent and youth version of a self-report instrument that can be used in the assessment of mental health disorder. It also provides population norms that can be used to compare individual child scores with scores of children in the general population. The instrument is being made available to service providers as part of a larger mental health questionnaire for children and youth designed to be used as an intake assessment. We are in the process of piloting its use in a variety of local agencies.

Paper 2

Need: A brief, practical and scientifically valid instrument that can be used by to classify mental health problems as both dimensional and categorical phenomena for the purposes of population monitoring. Following the development of the OCHS-EBS in paper 1, we identified a need for even briefer measures that are psychometrically sound (Cairney & Streiner, 2010) and draw on a subset of items in the OCHS-EBS so that common measures are available in both general population and clinical settings (Boyle et al., 2019a) to serve population monitoring purposes and form the basis of a children's mental health information system.

How this need is addressed by this paper: Paper 2 develops and evaluates a very brief checklist for dimensional measurement of emotional, behavioural and attention problems. Like the OCHS-EBS, this brief version is easy to administer and score, practical to use, meets scientific standards of reliability and validity. As an item-subset of the OCHS-EBS, it represents a lower respondent burden while providing coverage of the core domains of children's mental health problems. A partner paper that evaluates the same checklist for categorical measurement will be submitted for publication at the same time.

How the results are actionable: The paper provides a parent version of a self-report instrument that can be used in the assessment of emotional, behavioural and attention problems. A co-authored paper outlines a children's mental health

information system that could serve the information and data needs of a population health approach to addressing children's mental health needs. This instrument could be used in this system.

Paper 3

Evidence gap: The extent to which community-based mental health services are delivered to children with a mental health need and between-area variations in children's unmet need for mental health services in Ontario is unknown. Ensuring that services get to the children that need them is a fundamental requirement for a responsive mental health system.

How this evidence gap is addressed by this paper: This paper uses a population approach to document how many children with a mental disorder have unmet need for community-based mental health services, whether these numbers vary between service areas, and whether there are area-level factors associated with unmet need that are amenable to policy intervention.

How the results are actionable: This paper finds that areas with fewer service agencies, rural areas and areas with unsatisfactory public transit have higher levels of unmet need. The potential access barriers identified could be addressed through policy change at the area or agency level. This paper serves as an example to policymakers and other researchers of how available data can be used to evaluate unmet need for services and ensure service equity.

Paper 4

Evidence gap: Whether there is funding equity in the geographic allocation of resources to children's mental health service agencies in Ontario is unknown. Kindig & Stoddart (2003) view the evaluation of resource allocation as a requirement of a population health perspective.

How this evidence gap is addressed by this paper: Paper 4 shows that taking a population-based or needs-based approach to allocating expenditures would result in a different distribution of resources when compared to how resources are actually distributed by the government. This means that the current allocation process is not equitable or efficient. For resources to be used efficiently, they need to be allocated to those individuals with the greatest need. Some resource allocation would be required to align expenditures with need, whether need is defined as assessed need (mental disorder) or perceived presence of emotional or behavioural problems.

How the results are actionable: There appears to be no rational approach to the allocation of funding of children's mental health services in Ontario. This paper offers some direction by providing an approach to developing a needs-based

funding formula using existing data. Reallocation of resources represents a special challenge to policymakers who may be reluctant to withdraw funding in order to reallocate it elsewhere but this paper provides the evidence showing why this is needed. A long-term approach could be used to ensure that, over time, allocations are moving in a more equitable direction rather than making large, immediate changes to funding allocations.

Methodological contributions. In each paper, innovative and advanced statistical techniques in health research methodology were employed that represent unique contributions in their respective research areas. Measurement papers 1 and 2 use structural equation modelling (SEM) techniques and stringent psychometric criteria to demonstrate that the OCHS-EBS instrument is valid and reliable for needs assessment. Where possible, we used objective evaluation criteria based on empirical testing. Specifically, we implemented a variance-based SEM version of the standard multi-trait multimethod approach and implemented statistical tests for differences between correlations. Both of these approaches are rarely taken in the evaluation of measures of psychopathology. Paper 2 uses Item Response Theory in the selection of items. Paper 3 applies multilevel regression models to individual level data where children are clustered within areas. As discussed in the paper, analyses of this type have relied on ecological models, which are criticised for creating difficulties in making valid inferences. To our knowledge, this is the first paper to take a more appropriate approach that is not subject to the same criticism. Paper 4 combines survey, Census and administrative data to create different expenditure allocation formulas that were then applied to estimates of need, service and population counts for individual Service Areas in Ontario. While not analytically advanced, the number of data sources, estimates and algorithms used in developing the formula was extensive.

6.3 Overall limitations

Although this thesis makes some original contributions in an under-developed research area, there are some important overarching limitations to consider. Details on the specific limitations of each paper are included in each their Discussion sections. Limitations can be caused by problems relating to methodological issues that could bias our findings and inferences (problems of internal validity) or problems to do with the generalisability of our findings and inferences (external validity). Here, I comment on one primary limitation that affects both internal and external validity and one that is specific to generalisability.

In Ontario, the provision of children's mental health services is complex (Boydell, Bullock, & Goering, 2009) making research in this area challenging. Although the federal government holds responsibility for setting and administering national standards and for transferring funds to provinces for use in supporting provincially determined services, service provision decisions are made at the

provincial level (College of Family Physicians of Canada, 2016) and often by multiple government agencies working in isolation from one another. Within jurisdictions there are often multiple organisations and agencies responsible for mental health services with insufficient coordination between the overseeing government ministries involved (Canadian Institute for Health Information, 2015).

In this thesis, we attempted to delineate and measure Ministry of Children and Youth Services (MCYS)-funded and community-based children's mental health services as distinct from services provided by the Ministry of Health and Education in Ontario. However, this is not an easy task and relied on survey questions that asked parents whether they had visited a specialized community-based agency—using a geographically tailored list of agency names as a prompt (Reid et al., 2015). This approach invariably includes measurement error. A better approach would have been to link the survey data to administrative data held within agencies to access data about service contacts. Unfortunately, in Ontario, administrative data collected from children's mental health agencies is extremely limited. Service users do not have a unique identifier, like a health card number, so it is impossible to link survey children with the mental health services they have accessed. In addition to measurement error, the inability to link survey children to their use of mental health services also means that it was impossible to adjust for mental health services provided by other sectors. The lack of service co-ordination across sectors leads us to believe that there is unlikely to be compensatory service use of services in other sectors in the MCYS areas under study. As a result, we felt that our restricted focus on MCYS was a reasonable approach to address our research questions.

A limitation in the generalizability of our results is to do with informant discrepancies in the assessment of child mental disorder. It is well known that discrepancies exist among different informants (e.g., parents, children, teachers) in their ratings of child mental health problems (De Los Reyes & Kazdin, 2005). In paper 3, we include only parent assessments of need as reports of service use were only available from parents and it was important to keep the informant consistent. In paper 4, we use parent and youth reports on both assessed and perceived need in order to derive population estimates of mental health need. In evaluating the impact this might have had on our results, evidence suggests that both parent and youth ratings are related to the presence of *any* problem or disorder. Differences across informants emerge when attempting to distinguish between emotional and behavioural disorders. Youth ratings of problems are more strongly associated with diagnostic assessments of emotional disorders and parent ratings are more strongly associated with diagnostic assessments of behavioural disorders (Aebi et al., 2017). As we collapse across emotional and behavioural disorders to assess need, we expect that the difference between using only parent or youth ratings or both will be minimal. We can evaluate this empirically as part of future work.

6.4 Future research

The work in this thesis identifies several knotty issues that need further thought and attention. Five areas for future research are identified. First, there is a limitation in the field reflected in a lack of previous research, theoretical frameworks or conceptual models. While the area of children's mental health need is well examined, children's mental health services research relating to unmet need and resource allocation is extremely limited. Where possible, we have borrowed from approaches used in other health fields or in adult mental health but, in most cases, they are not fully transferable. There are vast opportunities to expand our knowledge about service responses to children's mental health need to understand the scope and scale of the problems that exist.

Second, all of the papers use data from the 2014 OCHS. Replication of the findings in other samples would be beneficial. A possible threat to our findings is the moderate response rate in the 2014 OCHS (50.8%). This was addressed through the derivation of sampling weights by Statistics Canada to take into account the survey design and non-response. However, relying on the same sample for all the papers in this thesis means that any selection or response biases that exist in the data will be reflected in all papers. Although the sample size, survey design and concept coverage of the 2014 OCHS represent advantages over other studies of this nature, replication of the results and approaches using other data sets will be important to determine the robustness of the findings.

Third, although the majority of children's mental health treatment services are provided in the community (Canadian Institutes for Health Information, 2015), other sectors provide services in Ontario, namely, the Ministries of Health and Education. Ideally, the funding, planning and management of mental health sectors would be better integrated so that the resulting services provided could be formally integrated and coordinated. This would make evaluation more straightforward and increase the practical impact of their results. In 2018, MCYS was restructured, renamed the Ministry of Children, Community and Social Services and responsibility for children's mental health service provision in Ontario was moved to the Ministry of Health and Long-Term Care, which is also going through a process of reorganization. The prospects for greater integration and coordination might be increased under this arrangement but the implications of these changes are far from clear at the time of writing. In the meantime, it will be possible to incorporate additional resource allocation data from other sectors to get a better picture of the overall resource and funding provision to children's mental health services in Ontario. We have already received human resource allocation data from the Ministry of Health and have an agreement to receive similar data from the Ministry of Education to begin some of this work. Building an evidence base in this area might encourage governments to embrace population approaches to the assessment of children's mental health needs and the evaluation of service responses to these needs across sectors.

Fourth, an assumption we make in papers 3 and 4 that is not completely explicit is that receiving mental health services will address children's mental health needs. This is a question of service effectiveness and is not one that is addressed in this thesis but is in need of attention. Taking into account the effectiveness of services within specific areas might alter decisions around resource allocation.

Finally, opportunities for future research also exist in measurement development and evaluation. Evaluation is needed of how well the OCHS-EBS instrument performs in clinical populations. Similarly, development of a youth version of the OCHS-EBS-B instrument is also needed. For both instruments, consideration should be given to the creation of a teacher version. Continued evaluation in different population and in samples from different sources would be beneficial.

6.5 Knowledge translation

Knowledge translation describes activities involved in moving research from the world of academia into the hands of people, governments and organizations who can put it to practical use. The knowledge in this thesis has been translated in different ways. First, papers 1 and 4 have been published in Open Access form so they are available to anyone who wants to read them. Second, paper 4 has been posted on the OCHS website (https://ontariochildhealthstudy.ca/ochs/results/) along with a research brief that make the findings accessible to a lay audience. Third, Paper 1 has been posted on the OCHS website in an area devoted to the OCHS-EBS tools and documentation. Additional information and resources on scoring and implementing the tool are contained there as well (https://ontariochildhealthstudy.ca/ochs/research-2/ochs-scales/). Fourth, both of these tools are being used as part of intake assessments being piloted in children's mental health agencies in Hamilton in an effort to introduce a population health approach to children's mental health needs assessment at the local level. Fifth, papers 3 and 4 were written in consultation with ministry partners who were invited to read and review the papers, in addition to discussing the findings. Follow-up meetings with ministry partners are ongoing as policymaker engagement is critical for research results to have an impact.

6.6 Conclusion

This thesis tackles the important questions of: (1) how can we measure children's mental health need, and (2) how we can use population data collected using these measures to evaluate service response to children's mental health need. The thesis contributes evidence supporting the validity and reliability of two measures for assessing child psychiatric disorder according to DSM-5 criteria and mental health problems understood more broadly as emotional, behavioural and attention problems. Data collected using these measures is then combined with

Census and administrative data to evaluate children's unmet need for mental health services and the extent to which expenditures are allocated according to need in Ontario. These studies provide new evidence in both of these areas and represent an attempt to expand what is a limited area of research. They provide examples to policymakers of the types of analyses that can be used to evaluate children's mental health services when epidemiological data is available. Findings from this thesis can: (1) inform systematic approaches to the measurement of mental health need; (2) motivate future research in the area of children's mental health service system responsiveness; and (3) be used to develop population health frameworks for policy evaluation and planning in the children's mental health system that will ultimately improve the ability for children's mental health services to respond to the needs of children and their families.

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