Mental Health Service Use Among Children with Chronic Physical Illness

by

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Author's Declaration

This thesis consists of material all of which I authored or co-authored: See Statement of Contributions included in the thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Statement of Contributions

This thesis is the work of Lauren Gosse with the collaboration of her supervisor, Dr. Mark Ferro, and advisory committee members, Dr. Chris Perlman and Dr. Scott Leatherdale.

Abstract

Background: Children with chronic physical illness (e.g., diabetes, epilepsy) are significantly more likely to experience adverse mental health. While mental health service use (MHSU) amongst Canadian children has increased dramatically in the past two decades, the extent of service use among those with co-occurring physical and mental illness (i.e., multimorbidity) is relatively unknown. The cross-sectional design of previous research limits our understanding of how MHSU for children with chronic physical illness changes over time and the factors that predict differences in patterns of use. This study used longitudinal data to overcome limitations of previous work to better understand MHSU among children with chronic physical illness.

Objectives: This study described the frequency and patterns of MHSU among children and youth (herein children) with chronic physical illness, examined how patterns of MHSU for these children change over a 24-month period, and identified sociodemographic and health-related factors associated with patterns of MHSU among children with chronic physical illness.

Methods: Data come from a sample of 263 children aged 2-16 years who were diagnosed with a chronic physical illness from McMaster Children's Hospital. Univariate statistics described the mental health services used by children with multimorbidity. Latent class analysis was used to identify patterns of use (e.g., primarily hospital-based vs. community-based). Multinomial regression was used to model baseline sociodemographic and health factors associated with different patterns of MHSU.

Results: Across all timepoints, approximately one quarter of parents reported that their child had some form of contact with a health professional for their mental health (24.7%). Latent class analysis determined a two-class model with one class reporting any contact for their mental

health (11.4% at baseline; 16.4% at 24 months) while the other class reported no service use regarding their mental health (88.6% at baseline; 83.7% at 24 months). In a fully-adjusted model, child age (OR = 1.30 [1.15, 1.46]), presence of one or more mental illness (OR = 5.58 [2.19, 14.18]), level of disability (OR = 1.09 [1.02, 1.17]), and parental educational attainment (OR = 3.12 [1.56, 6.26]) differed significantly between classes.

Conclusion: Findings suggest that mental health service needs are pervasive in this group of children given both the proportion as well as the array of combinations of health care providers reported by children and their families. Latent class analysis showed a two-class solution that differed with regards to several sociodemographic and health-related factors between those who did and did not report service use. Future directives are required to parse the complex interactions children and their families must navigate. Larger, more diverse samples should be studied in order to replicate findings, and data linkages to health records should be undertaken in effort to mitigate the potential limitations of parent-reported service use.

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International classification diseases (ICD)

Diagnostic and statistical manual (DSM)

Mental health service use (MHSU)

Mini International Neuropsychiatric Interview for Children and Adolescents (MINI-KID)

World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0)

BACKGROUND

1.1 Prevalence of mental illness among children

Mental illnesses among children (herein individuals under 18 years of age) are increasingly common, affecting approximately 20% of this population[1]. The global peak onset age for a mental illness is 14.5 years across all versions of the international classification diseases (ICD) and diagnostic and statistical manual (DSM) criteria[2]. In Ontario, it has been estimated that between 18-20% of children meet the criteria for a mental illness over a 6-month period[3]. However, less than a third have self-reported that they have met with a mental health care provider[3]. These findings are similar to those of representative sample from 2002 to 2004 in the United States, which found that 36% of adolescents with a mental illness received mental health services[4].

The impact of mental illness can vary, with symptoms ranging from functional impairments to a decreased health-related quality of life[5]. The effects of early-onset mental illness also extend across the life course and have been previously associated with suboptimal outcomes related to educational attainment, relationships with others, frequency of accidents and injuries, and criminal behaviour[6,7]. Globally, mental illness, along with substance use disorders, are the leading cause of lifelong disability in youth, accounting for 45% of years lost because of disability among 10–24-year-olds[8,9].

The burden of mental illness is not only carried by children and their families, but also the health system with which they interact. In Ontario, there has been an annual $220 million increase in additional hospital costs from 2006 to 2016 to meet the child mental health crisis[10]. The burden of mental illness on families has an estimated economic impact of $421 million

annually in indirect healthcare costs[10]. Additionally, there has been a 72% rise in emergency department visits and 79% increase in hospitalizations for children from 2006 to 2017[10]. For policy makers to optimize health systems and their associated costs, and for clinicians to provide the best possible care for their patients, it is necessary to identify children at risk for mental illness to provide both timely and appropriate care that maximizes health outcomes while minimizing costs.

1.2 Child mental health services in Canada

Definitions of mental health service access and use vary in the literature. For example, the Canadian Mental Health Association defined mental health service access as timely availability to both medical (i.e., physicians, psychologists, etc.) and non-medical professionals (i.e., case workers, school counsellors, etc.)[11]. In contrast, the 2006 National Hospital Discharge Survey, defined MHSU as the frequency of discharges, days of care, and average length of stay in hospital[12]. However, it is important to recognize the difference between availability of services and reported use. Therefore, this study focused on service use specifically rather than the availability of services and included the reported use to both medical and non-medical professionals, as well as number of hospitalizations.

The Canada Health Act governs the health and wellbeing of all Canadians, with the aim of providing "reasonable access to resources and services free from financial or other barriers"[13]. The five program criteria of the Act include public administration, comprehensiveness, universality, portability, and accessibility. The administration and coordination of services are decentralized across the provinces and territories[13]. In Ontario, Community Health Centers and Family Health Teams deliver primary healthcare within the province[14,15]. While family doctors act as the primary first point of contact for most publicly-funded mental health services, many

have reported that they lack the resources or specialized mental health training to meet the growing demand for services[16–18]. This has led to a fragmented mental health care system for children in Ontario where services are siloed, and children and their families are unable to access the specialized care in a timely and appropriate manner[19–21].

In their Mental Health Action Report, the Canadian Alliance on Mental Illness and Mental Health states that everyone "deserve(s) timely access to the right combination of evidence-based services, treatments and supports"[22]. However, it has been previously noted that one of the shortcomings of the present healthcare system is the disconnection between mental health services to the rest of the healthcare system[23]. Therefore, one of the priorities expressed in the most recent Mental Health Action Report is the integration of mental health services both across the life cycle and across health services, from the hospital to tertiary, home, and community care[22].

There have been an increasing number of requests for health systems to be more responsive to the prevention and early identification of mental illness. For children in Ontario with a mental illness and no prior contact with outpatient services, there is a clear need for increased care—over half of this population first receive care through emergency health services[24]. Rates of first contact in the emergency department are highest among children and their families who do not have a primary care physician[24].

Previous findings have demonstrated that the perceived need for and use of mental health services has been increasing in Canada[25,26]. From 2006-2007 to 2017-2018, the relative increase in rates of emergency department visits for mental health conditions was 75% and the relative increase in rates for hospitalizations from these visits was 65%[27]. Mental health service use in

acute care settings (i.e., hospitalizations), which represent the most expensive types of service provision, have shown the greatest increase in recent decades[26].

However, despite the increase in perceived need, only one-third of children with a parent-identified mental illness report that they had contact with a mental-health service provider regarding their concerns[3]. And while 60% of this sample reported contact with service providers in general, most often through schools, the quality and effectiveness of such services have not been assessed[3,28]. And finally, although previous findings suggest a positive relationship between the number of mental illnesses experienced by children and frequency of MHSU, there is no consensus amongst researchers on the nature of the relationship between MHSU and comorbidities[29].

The type of comorbidities experienced by children seems to also influence their use of mental health services. Georgiades et al. found that children aged 4 to 17 years with comorbid internalizing (e.g., depression, anxiety) and externalizing disorders (e.g., attention-deficit hyperactivity, oppositional defiant) had increased MHSU compared to those with only internalizing or externalizing disorders[3]. However, those researchers could not determine whether their findings were due to participants having internalizing-externalizing comorbidities specifically, or simply having a greater number of mental illnesses[3]. Recent findings from an exploratory study of MHSU costs among children with mental illness found that costs were highest amongst children with internalizing-externalizing comorbidities in terms of total costs (β = 0.81; 95% CI: 0.17, 1.45), hospitalizations (β = 0.93; 95% CI: 0.03, 1.84) and health professional consults (β = 0.87; 95% CI: 0.04, 1.69) compared to children with internalizing disorders only[30].

1.3 Multimorbidity and mental health service use for Canadian children

One of the most pressing concerns for health systems worldwide are the increased prevalence and burden of chronic illnesses—both physical and mental—in children[31–36]. Children with chronic physical illness (e.g., diabetes, epilepsy) are significantly more likely to experience adverse mental health (herein multimorbidity), which in turn is associated with a number of negative sequelae, including decreased quality of life[37–40]. Ferro, Gorter and Boyle found that children with a chronic illness had significantly poorer depressive symptom trajectories and total reported symptoms in adolescence and early adulthood compared to their peers who did not have a chronic condition ($p<0.01$)[41]. Estimates show that 20-35% of children experience physical-mental illness, which typically persists throughout their life. The chronicity of multimorbidity represents a pressing public health concern as these children often require complex care management both within and across physical and mental health services as well as the coordination of education and social services[42,43].

While MHSU among Canadian children has increased dramatically in the past two decades, the extent of MHSU among those with multimorbidity is relatively unknown[26]. Epidemiological research has found that young people with multimorbidity reported increased MHSU versus those with only mental illness (OR = 12.54 [7.07, 22.25]) or substance use disorders (OR = 2.97 [1.75, 5.05])[44]. In terms of perceived need for MHSU being met, young people with multimorbidity were less likely to report their needs not being met compared to those with only mental illness (OR = 2.56 [1.24, 5.26]) or a substance-use disorder (OR = 2.48 [1.06, 5.82])[44]. Additionally, those with a physical illness without physical-mental multimorbidity were about one and a half times more likely to report MHSU compared to those without a physical illness (95% CI 1.2, 2.1)[44].

Regarding visits to the emergency department, a population-based cohort study of adults in Quebec found an increase in the odds of frequent visits for those with physical-mental multimorbidity (≥4 physical conditions) with both common (OR = 4.75 [4.60, 4.90]) and serious (OR = 3.37 [3.18, 3.57]) mental illness compared to those with no physical conditions[45]. However, this study did not identify whether frequent visits were specific to mental health services. Research in clinical samples has shown that children with multimorbidity were less likely to receive inpatient services (OR = 0.20 [0.05, 0.85]) and had a shorter duration in hospital for their mental health (OR = 0.74 [0.57, 0.91])[31]. Family functioning was found to mediate this relationship, such that better family functioning is associated with lower odds of using mental health services and a shorter duration in hospital ($\alpha\beta$ = 0.14 [0.01, 0.27]). These results may differ from population-based studies given that different age groups and types of services were measured.

1.4 Theoretical framework

The Andersen Model of Health Service Use theorizes that individual health service use is a function of one's predisposition to use services, the factors which enable or impede service use, and one's need for care[46]. The initial version of this model considered how certain predisposing characteristics, primarily hospital admissions and access to emergency care, would account for service use[46]. Enabling factors within this model are any factors which either allow or obstruct an individual to access services, such as family functioning or neighborhood environment[46,47]. Need factors consider the differentiation between perceived need by an individual and evaluated needs by healthcare professionals[46,48]. More recent versions differentiate between contextual and individual determinants of health service use[48]. Contextual characteristics are measured at the

aggregate level, rather than the individual level, and include community characteristics[48]. See Appendix A for the theoretical model based on Andersen's model of health of service use.

1.4.1 Predisposing factors

Predisposing factors in the theoretical model for this study included individual demographic (i.e., child age, sex, and parental marital status) and social (i.e., parental education) variables. Previous findings have suggested that age is a predisposing factor, such that older children are more likely to report MHSU[49,50]. Other child predisposing factors include sex, whereby females generally report more service use compared to males[51,52]. Additionally, parental factors such as marital status and education may also be predisposing in their child accessing services. Specifically, single-parent households may be associated with increased service use[53]. Additionally, while the research on parent education and their child's MHSU is limited, previous findings have shown that increased parental education may be associated with increased mental health literacy[54–56].

1.4.2 Enabling factors

Individual enabling factors included parental income and family functioning. Findings on household income are mixed; while evidence suggests an association between low household income and risk for mental illness it is unclear whether potential increased risk translates to increased MHSU or if this population may face additional barriers when seeking care[19,57,58]. Previous evidence suggests that better family functioning is associated with lower odds of using mental health services (OR = 0.20 [0.05, 0.85]) and a shorter duration in hospital (OR = 0.74 [0.57, 0.91])[31]. Additionally, contextual enabling factors included marginalization indices (i.e., residential instability, material deprivation, dependency, and ethnic concentration) as a measure

of community level factors. Previous research examining the association between multimorbidity and marginalization in an adult Canadian population found a higher prevalence of multimorbidity in the most deprived areas when compared to the least deprived[59]. However, findings were not specific to physical-mental multimorbidity and the association between marginalization and MHSU in this population remains relatively unknown.

1.4.3 Need factors

Need factors within this model included both perceived and evaluated needs. Physical functioning was self-assessed and therefore a perceived need, whereas mental illness was evaluated using a clinical diagnostic tool. Previous research supports increasing physical disability is associated with increased risk of mental health concerns[37–40]. Additionally, it would be expected that those who screen positive on a clinical diagnostic tool assessing for the presence of a mental illness would report more MHSU compared to those who did not.

STUDY RATIONALE AND RESEARCH OBJECTIVES

While mental health service use (MHSU) amongst Canadian children has increased dramatically in the past two decades, the extent of service use among those with co-occurring physical and mental illness (i.e., multimorbidity) is relatively unknown[26]. The cross-sectional design of previous research limits our understanding of how MHSU for children with multimorbidity changes over time and the factors that predict differences in patterns of use.

The overall goal of this project was to examine how children with multimorbidity interact with the health system and how their use of mental health services changes over a 24-month period. Identifying patterns of service use, how they may change over time, and sociodemographic and health-related factors that may influence these patterns, may help inform clinicians and policy makers regarding how this population of children interact with the healthcare system. Defining this population may aid healthcare professionals to ensure routine mental health screening and the coordination of holistic care. Findings may also support the integration of physical and mental health services, as previous findings across a wide-range of life-limiting disorders suggests improvements when services are better connected[60].

The specific research questions addressed in this thesis are:

1. What is the frequency and what types of mental health services are used by children with chronic physical illness?
2. Do patterns of MHSU among these children change over a 24-month period?
3. What sociodemographic and health-related factors predict patterns of MHSU among children with chronic physical illness?

METHODS

3.1 Study design and sample

The data for this project came from the Multimorbidity in Children and Youth Across the Life-course (MY LIFE); a prospective study that investigated the prevalence and determinants of multimorbidity (co-occurring mental and chronic physical illness), as well as the outcomes (including mental health service use) associated with multimorbidity among children aged 2-16 years[61,62]. Participants were recruited from outpatient clinics at McMaster Children's Hospital, which covers a wide geographic area including southwestern and central Ontario; the most sociodemographically diverse population in Canada's most populated province[62].

To be eligible for MY LIFE, child participants must have been (1) aged 2-16 years at the time of diagnosis and (2) diagnosed by a physician with a chronic physical illness. Participants were recruited from outpatient clinics at a pediatric hospital, specifically from the dermatology, endocrinology, gastroenterology, hematology, immunology, neurology, respirology, and rheumatology clinics at McMaster Children's Hospital. Chronic physical illnesses were defined as physical conditions that were expected to be present for at least 12 months and would result in (a) functional limitations, (b) a dependency to compensate for such limitations and/or (c) the need for additional health services[62]. Exclusion criteria included those with multiple physical illnesses (i.e., medical complexity) at time of recruitment as they were deemed a subgroup whose outcomes and healthcare use have been previously established[63–65]. Finally, families with insufficient English language skills were excluded as not all measurements have been validated in multiple languages for the study population. Parent reports were collected for all participating children. Children aged ≥10 years also provided self-reports. Data were collected at recruitment, 6-, 12-, and 24-months post-recruitment.

3.2 Procedure

All relevant ethical approvals were obtained prior to recruitment. Clinic nurses introduced the study to families and conducted an initial eligibility assessment. Interested children and their parent(s) were then invited to speak with research staff after to their medical appointment to learn more about the study and to verify eligibility. Families were then contacted by telephone by research staff a couple days later to schedule a time to complete the baseline assessment either at the hospital or in their home. In some instances, a study package was sent by mail when meeting in person was not possible. In March 2020, all data collection occurred using telephone and mail packages due to the COVID-19 pandemic. Additional information regarding the study procedure is available elsewhere[61].

In total, 610 potential participants were approached by clinic staff, of which 80 (13%) declined or had no interest, and 22 (3.6%) were deemed ineligible. From the 508 (83%) participants who were eligible to participate, 294 (58%) consented and 263 (52%) participants were enrolled (31 (6.1%) participants withdrew from the time between consent and data collection)[62].

3.3 Measures

3.3.1 Mental health service use

Parents reported on the MHSU for their children, which included questions adapted from the Canadian Community Health Survey (Mental Health)[66]. Items included a combination of closed and open-ended questions that asked whether children had been hospitalized for their mental health, had contact with a healthcare professional regarding their emotional and mental health, and the frequency of these events over the past 12 months. For this study, healthcare professionals included psychiatrists, family doctors, general practitioners, psychologists, nurses,

social workers, counsellors, case workers, psychotherapists, or any other health professionals consulted to help with their child's emotional or mental health. Additionally, parents were also asked to quantify out-of-pocket expenses for visits, medications, tests, and services associated with their child's emotional and mental health over the previous 12 months.

3.3.2 Child mental illness

The Mini International Neuropsychiatric Interview for Children and Adolescents (MINI-KID) is a clinical diagnostic interview that is designed to assess the presence of DSM-5 and ICD-10 mental illness in children within the past six months[67]. Responses to all questions are binary (yes/no); when screening questions are endorsed, the illness module is completed to assess whether the individual meets diagnostic criteria for the specified illness[67]. The assessment is given to both children ≥10 years of age with the subject for each question phrased as "you" and their parents with questions phrased as "he/she". The MINI-KID has demonstrated strong psychometric properties and has been found to be both reliable and valid in population and clinical samples of children[68,69]. The following modules were completed as they have been identified as the most commonly occurring mental illnesses among children: major depressive episode, generalized anxiety disorder, separation anxiety disorder, social anxiety disorder, specific phobia, attention-deficit hyperactivity disorder, oppositional defiant disorder, and conduct disorder[1,3].

3.3.3 Physical health and functioning

The World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0) 12-item questionnaire was used to assess level of functioning in children. It can be used across mental and physical illnesses and allows the computation of overall functioning scores over the past 30

days. The form consists of six domains: cognition, mobility, self-care, getting along, life activities, and participation[70]. Items are quantified on a 5-point scale from "0=none" to "4=extreme or cannot do" with participants able to select "do not know" or "not applicable" for each question[70]. This scale has been psychometrically validated across a variety of child populations[71,72]. The 12 item WHODAS 2.0 includes items that most strongly loaded on their respective domain-specific factor structure in the original 36-item questionnaire[73]. Findings have demonstrated that the 12-item version can explain 81% of the variance of the 36-item version[72]. Additionally, the 12-item version has been shown to be sufficient in measuring functional impairment in this sample from young children (2-9 years) to young (10-16 years) and older adolescents (15-19 years)[74,75]. The simple scoring method was followed; there was no weighting of individual items and the sum of items across all domains provided an estimate of disability, with higher scores indicating more impairment.

The Kaufman Brief Intelligence Test Second Edition (KBIT-2) is a measure of both verbal and non-verbal intelligence (IQ) in children as young as four years[76]. The measure consists of three subsets, two verbal and one non-verbal. When scoring across all subsets, participants receive either a pass (one point) or a failure (no points). For each subsection a basal level must be established wherein participants receive three consecutive points and is discontinued after four consecutive failures[76]. Scores are converted to age equivalents that include percentile ranks, descriptive categories, and confidence intervals. For this study, child composite IQ scores were calculated for each participant where $\geq$85 was average and above.

Both height and weight were taken at all timepoints, form which body mass index (BMI) was calculated. Percentiles were based on the Center for Disease Control, whereby a normal BMI ranged from the 5th to <85th percentile[77].

3.3.4 Family environment

The McMaster Family Assessment Device (FAD) was developed to measure individual perceptions of their family dynamics[78]. The 12-items from the General Functioning subscale, which were used in MY LIFE, represent aspects of communication, problem solving, behavioural control, affective responsiveness, and involvement and roles[79]. Responses are based on a four-point Likert scale ranging from "agreed" to "disagreed". Raw scores are summed after six items are reverse-coded, such that higher scores represent better overall family functioning[80]. Previous findings have demonstrated that the FAD has acceptable internal consistency (α=0.89)[80].

Parental stress, as measured by the Parental Stress Scale, was also used to measure family environment. The 18-item scale was used to assess parenting-related stress[81,82]. The items on the five-point scale range in scores from 18-90 with higher total scores representing greater level of parenting stress[82]. The scale has been found to be valid and reliable in a clinical sample of parents of children with chronic physical conditions[81]. Additionally, factor structure has demonstrated internal consistency (α=0.84)[81].

3.3.5 Community factors

The 2016 Ontario Marginalization Index is an area-based index used to examine differences in marginalization between geographic areas at several geographical levels[83]. The original factor analysis included 18 of 42 potential indicators from the 2001 Canadian census which were grouped across four dimensions including residential instability, material deprivation, dependency, and ethnic concentration[83]. Using participant postal codes, factor scores were assigned for each participant corresponding to their dissemination and census metropolitan areas. Dissemination areas are the smallest standard administrative boundary which represent between

400 to 700 individuals[84]. Postal codes were linked using 2017 Postal Code Conversion File (PCCF+) developed by Statistics Canada. From the 263 children in the study, seven (2.7%) were unable to be linked to one dissemination area through the PCCF+.

3.3.6 Sociodemographic factors

Sociodemographic characteristics included child and parent age, sex, ethnicity, and country of birth. Additionally, marital status, parental educational attainment, and before-tax household income were collected.

3.4 Statistical analysis

3.4.1. Objective 1: Define frequency and patterns of MHSU among children in the study sample.

Descriptive univariate statistics (mean, median, range, standard deviation) were calculated for number of consultations with a healthcare professional (as described earlier). Additional descriptive statistics included frequency and duration of previous mental health hospitalizations, as well as out of pocket expenses for child mental health.

3.4.2. Objective 2: Examine how patterns of MHSU for children with a chronic physical illness change over a 24-month period.

Use patterns for child mental health services were estimated using latent class analysis, a statistical modelling method used to identify unobserved groups within a population based on a set of chosen indicators[85,86]. As a variant of person-centered mixture modelling, the goal of latent class analysis is to classify individuals into groups based on their individual responses to these chosen indicators—individuals within a group are expected to be more alike one another than individuals classified in different groups[87,88]. The goal of computing and comparing latent class

models at baseline and 24-months was to determine if different latent subgroups emerged over time.

Model fit was examined for each class solution by assessing the bootstrap likelihood ratio test (BLRT), Akaike's information criterion (AIC), Bayesian information criterion (BIC), and entropy values. Previous findings have shown that a model that is one fewer in class profiles than the last model showing a nonsignificant BLRT is a better fitting model[89]. Similarly, smaller BIC values indicate better model fit, and entropy ranges from 0 to 1, with values closest to 1 indicating greater accuracy. It was determined a priori that classes sizes must be ≥5% of the total sample size for the selected model[90].

While there is no current consensus on how best to select indicator variables, current evidence suggests that using more indicator variables and those of higher quality may compensate for smaller sample sizes (i.e., <500 participants)[91,92]. For this study, indicator variables were (1) hospitalizations, (2) contact with healthcare professionals, and (3) time since diagnosis of physical illness. Exploratory modelling was used to determine whether frequencies or binary measures of hospitalization and healthcare contacts would be most appropriate for the data. For all modelling with binary measures hospitalization and healthcare contacts, time since diagnosis was categorized using quartiles to ensure equal distribution across groups.

3.4.3. Objective 3: Examine sociodemographic and health-related factors associated with patterns of MHSU among children with a chronic physical illness.

Logistic regression was used to examine sociodemographic and health-related factors associated with patterns of MHSU among children as results indicated that the best-fitting solution had two groups. Covariates were added in sequential blocks to determine their relative contribution to the prediction model. Odds ratios (ORs) and 95% confidence intervals (CIs) were

computed to determine which covariates were significantly associated with increased MHSU. The first block included child sociodemographic factors of age, a continuous predictor variable and sex, a binary predictor variable.

The second block added child health-related factors. These were child mental health as measured by the MINI-KID, child disability (WHODAS 2.0), child IQ and BMI. MINI-KID scores were coded as binary: having screened positive for at least one mental disorder or not. Composite IQ was coded as a binary variable for either average IQ and above (≥85) or below average IQ (≤84). BMI was coded as a binary variable with normal (5^{th} to $<85^{th}$ percentile) vs. all other categories ($<5^{th}$ percentile or $\geq 95^{th}$ percentile). Finally, child disability included the total WHODAS 2.0 score.

The third block added family factors to the model. Parental marital status was coded as a binary variable with partnered (married or common law) vs. not partnered (widowed, divorced, separated, or never married). Family functioning included total score on the McMaster Family Assessment Device. Parental income as measured by yearly household income before taxes which was coded as a binary variable, either above or below the median household income for >1-person Canadian households (≥ $90,000)[93]. Parental education attainment was binary coded for individuals having completed postsecondary education (i.e., university, college, professional or graduate training) to those who had not. In cases where the educational attainment of both parents was provided, the higher attainment was used.

The fourth and final block added predictors related to community-level factors. These variables were obtained from the 2016 Ontario Marginalization Index, an area-based index which can be used to explore inequalities between population groups or geographic areas based on four dimensions[83]. These dimensions included residential instability, material deprivation,

dependency, and ethnic concentration. Each dimension includes a factor score that has a mean of zero and a standard deviation of one[94]. Using participants factor scores, all four measures were coded as binary variables comparing low marginalization to high marginalization, where higher factor scores represent greater levels of marginalization. The average marginalization score for all participants for each dimension was calculated. Therefore, the high marginalization group included the half of participants who fell above the average factor score for each dimension. See Appendix B for all hypothesized models.

All analyses for the first and third objective were conducted using SAS Studio software (Version 9.0.4) (SAS Institute, Cary, NC) with a significance level of $\alpha = 0.05$. Analyses for the second objective were conducted using Mplus software (Version 8)[88].

3.5 Sample Size

Latent class analysis uses maximum likelihood estimation methods that function to estimate parameters under asymptotic theory, meaning that latent class analysis relies on the assumption that the study is operating with a sufficiently large sample size[95]. Sample size requirements in latent class analysis are dependent on several factors, including number of indicators, the structure of latent classes (i.e., both number of classes and structure of conditional response probabilities), and the possibility of covariates within the data[91,96]. There is currently no consensus on how best to estimate minimum sample sizes to assess the accuracy of class identification[85]. Previous methodological research has identified sample sizes of between 300 and 1000 participants as the adequate functional range for fit indices[89,97–99]. However, for simple latent class analysis models with well-delineated classes, a sample size as small as $n = 30$ may be sufficient[85].

Given the potential for missing data, the MY LIFE dataset handled item-level missingness using recommended imputation methods for individual measures. Missingness for physical disability, as measured by the WHODAS 2.0, was handled by using the mean of the available items to assign an item score when only one item was missing[70]. For BMI data, responses for missing timepoints were imputed based on categorization (i.e. normal or other weight categories) from other timepoints. For example, if a participant fell into the normal BMI category at both baseline and 12 months, if they did not respond at 6 months, a response of normal BMI was imputed. Considering family functioning, missing data for the FAD was handled through mean imputation by averaging the available items if less than 40% of data were missing[100]. Additionally, missing data in the Parental Stress Scale was handled through mean imputation whereby the available items were averaged if up to three items were missing.

At 24 months, four individuals had imputed scores and 32 were missing scores for the WHODAS 2.0 (12%). BMI categories were imputed for 25 individuals, with an additional 19 individuals missing BMI scores (7.2%). Seven parental stress scores were imputed, and an additional 30 scores were missing (11%). Finally, four FAD scores were imputed and an additional 30 were missing (11%).

RESULTS

4.1 Objective 1

4.1.1 Parent-reported mental health service use for their children

Parent-reported contacts with healthcare professionals for the mental health of their children across all four time points are reported in Table 1. Across all timepoints, 24.7% of parents reported that their child had some form of contact with a healthcare professional for their mental health (n = 65). Additionally, the type of healthcare professional most frequently contacted (amongst those who received mental health services) were social workers, which included counsellors, case workers, and psychotherapists (46.5%-64.9%). The least reported healthcare professional contact amongst parents were nurses (5.4%-11.6%).

The number of participants who reported contact with multiple healthcare professionals at baseline, 24 months, and across all timepoints are reported in Appendix C (S2-S4). Of the 65 participants who reported contact with a healthcare professional across all timepoints, 73.8% of participants reported contact with multiple types of professionals (n = 48). At baseline, of the participants who reported any contact, 53.3% reported contact with multiple healthcare professionals (n = 16). At 24 months, 53.5% of participants reported contact with multiple healthcare professionals (n = 23).

Parent-reported hospitalizations for their children's emotional or mental health were most frequently reported at six months (n = 5; 2.0%) and declined at 12 months (n = 2; 0.8%) and at 24 months (n = 1; 0.4%). Of participants who reported any contact with a healthcare professional, the most parent-reported hospitalizations were at 12 months (n = 2; 5.4%). Not all children who were hospitalized also had contact with a healthcare professional regarding their emotional or mental health, specifically three participants at baseline and four participants at six

months. Of the total sample, 3.0% of parents reported that their child had been hospitalized over the previous 12 months (n = 8). Across all timepoints, there were twelve instances where parents reported that their child had been hospitalized, and of those, the mean number of hospitalizations was 1.42 (SD = 0.52) and the average length of stay was 6.83 days (SD = 5.34; median = 5.00; range = 16.00).

Out-of-pocket costs for child mental health services and products are shown in Figures 1-3. Across all timepoints, the average costs for services and products during the past 12 months was $235.06 (SD = 1026.40; median = 0; range = 10000.00). For parents who reported any contact with a healthcare professional for their child's mental health, the costs over the past 12 months were $539.33 (SD = 1347.20; median = 0; range = 10000.00). Participants with incomes above the median household income (MHI) reported more costs spent out of pocket compared to those who had income below the median only at 24 months post recruitment ($p = 0.048$) (Figure 1). For participants who reported any service use with incomes above MHI, there were no differences in out-of-pocket costs compared to those who had incomes below the median at any timepoint (Figure 2). Participants who scored positive on the MINI-KID for at least one psychiatric disorder (i.e., multimorbid) reported more costs spent out of pocket compared to those who did not (i.e., non-multimorbid) at baseline ($p<0.001$), 12 months ($p = 0.0019$), and 24 months ($p = 0.011$) (Figure 3).

4.2 Objective 2

4.2.1 Exploratory modelling

Exploratory modelling was used to determine whether frequencies or binary measures of hospitalization and contact with healthcare professionals would be most appropriate for the data. A latent profile analysis that included frequency of hospitalization and contact with healthcare

professionals, as well as time since physical illness diagnosis was conducted both at baseline and 24 months. Results from both timepoints indicated that a one-class solution best fit the data (Appendix D – S5 and S6). Therefore, a decision was made to proceed with binary measures of hospitalization and contact with healthcare professionals. Time since diagnosis was categorized using quartiles to ensure equal distribution across groups.

4.2.2 Latent class analysis of parent-reported mental health service use at baseline

Latent class analysis for mental health service use at baseline indicated that a two-class solution best fit the data (Table 2). Participants who reported hospitalizations were relatively evenly distributed between the two classes. Individuals in the first class (n = 30) reported any form of contact with a healthcare professional regarding emotional or mental health whereas those in the second did not report any contact (n = 233). Finally, time since physical illness diagnosis did not differ significantly between classes ($X^2 = 2.53$; $p = 0.47$).

4.2.3 Latent class analysis of parent-reported mental health service use at 24 months post recruitment

Latent class analysis at 24 months post recruitment indicated that a two-class solution best fit the data (Table 3). When considering a three-class solution at 24 months, BLRT values were not significant and BIC values increased, which is not preferred[85]. However, class sizes did not fall below 5%, which may support a three-class solution[85]. Considering the relatively small sample and that classes differed greatly in size, best practice suggests choosing a model that avoids possible instability and over-extraction[85]. Therefore, a two-class solution to best fit the data.

Individuals in the first class reported any form of mental health service use and included all individuals who reported hospitalization (n = 43), whereas those in the second class did not report any service use or hospitalizations within the previous 12 months (n = 220). The difference in reported hospitalizations was the major defining feature between the models at baseline and 24 months. Similar to the findings at baseline, time since diagnosis did not significantly differ between classes ($X^2 = 2.90$; $p = 0.41$).

Figure 4 shows the conditional item probability plot for the two-class latent model including all indicators of contact with a healthcare professional at 24 months post recruitment. All individuals who reported any form of mental health service use were in the first class. The second class can be defined as all other individuals who reported no form of mental health service use.

4.2.4 Comparing a nine-indicator model vs. an eight-indicator model

Given that the indicator "any form of mental health contact" could solely describe the class make-up for the two-class model, a model which included eight indicators was investigated that did not include this variable. When comparing both two-class models, they were not identical in the make-up of classes (Table 4). Compared to the eight-indicator model, the original model was better delineated between classes and included larger cell counts to ensure a more robust analysis. Therefore, a decision was made to proceed with models including nine indicators for mental health service use as it would aid in the interpretability of potential findings in the following analysis.

4.3 Objective 3

Results from the individual models assessing the associations between sociodemographic and health-related factors with MHSU are reported in S7 (See Appendix E). In Block 1 both child age (OR = 1.18 [1.09, 1.29]) and child sex (OR = 2.35 [1.16, 4.74]) were significantly associated with reporting MHSU. In Block 2, having screened positive for a least one mental disorder on the MINI-KID (OR = 3.18 [1.42, 7.11]), as well as total score on the WHODAS 2.0 (OR = 1.09 [1.03, 1.16]) were significantly associated with MHSU. In Block 3 parent stress, as reported by total score on the PSS, was significantly associated with service use (OR = 1.05 [1.00, 1.09]). In Block 4, none of the marginalization indices were significantly associated with MHSU.

Results from the sequential block models are reported in Table 5. In Model 1, both child age (OR = 1.23 [1.11, 1.36]) and MINI-KID score (OR = 5.06 [2.17, 11.82]) were significantly associated with reporting MHSU. In Model 2, child age (OR = 1.25 [1.12, 1.39]), MINI-KID score (OR = 4.97 [1.99, 12.41]), total WHODAS 2.0 score (OR = 1.08 [1.01, 1.16]), as well as parent education (OR = 7.37 [1.18, 45.96]) were significantly associated with reporting service use. In the fully-adjusted model, child age (OR = 1.26 [1.12, 1.42]), MINI-KID (OR = 4.90 [1.86, 12.95]), total WHODAS 2.0 score (OR = 1.09 [1.02, 1.17]), and parent education (OR = 7.44 [1.22, 45.45]) remained significantly associated with reporting MHSU.

Additionally, in attempt to validate the findings from this latent class analysis model, a model where the outcome measured included no reported MHSU compared to any reported MHSU was considered. The results from this model were identical to the latent class analysis model (See Table 5).

DISCUSSION

5.1 Objective 1

Across all timepoints, approximately one quarter of parents reported that their child had some form of contact with a healthcare professional for their mental health. However, it is important to note that for each individual timepoint, the proportion of parent-reported service use was lower, suggesting that different children were accessing services at different timepoints.

Additionally, almost three quarters of parents reported contact with multiple types of healthcare professionals across all timepoints. The proportion of parents reporting multiple contacts was comparable at baseline to that at 24-months. There were no specific combinations of providers that occurred more frequently and there appears to be no discernable pattern amongst parents for navigating the mental health system. Since this project was limited to parent-reported service use, it is speculated that families may be navigating the health system without specific direction from care navigators and may be reliant on accessing whichever services are available to them.

Care coordinators, or navigators, for mental health services may play an important role for parents and caregivers navigating mental health services for their children[101–103]. Specifically, long-term navigators are preferred where parents are able to form lasting connections[101]. There are also several factors which may predict strain for parents seeking navigation for mental health services, including greater severity of mental health symptoms, greater severity of child health, and lower levels of family functioning[104]. One such meta-analysis on the experiences of children navigating mental health systems highlighted complex pathways, waitlists and eligibility of available programs, and the challenges facing fragmented care[20].

Findings also suggest that children and their families may often have to seek out more than one type of healthcare provider to meet their needs. A cross-sectional study of 840 caregivers for children with a mental illness in Ontario described family doctors as a primary point of contact for mental health services, but that they were sometimes unable to provide additional mental health services due in part to the strain of limited visit time and lack of specialized training[101]. In this study, the most frequently reported healthcare professionals included social workers, counsellors, case workers and psychotherapists. Findings were unable to identify whether these healthcare professionals were accessed on an inpatient or outpatient basis, which may have broader implications for resource utilization.

One cross-sectional study of children receiving mental health services at a tertiary care centre in Ontario found that the majority received outpatient services. However, similar to the findings of this study, results could not differentiate types of service providers beyond inpatient and outpatient services[80]. Further research to parse access on an inpatient or outpatient basis is required as emergency department rates are increasing at a faster rate when compared to outpatient visits[26]. Considering the additional impact of physical disability, a summative increase in physical illness is associated with increased risk of frequent visits to the emergency department in adults[45]. Similarly, physical illness has been associated with a higher risk of onset usage of mental health services[105]. Increases in the rates of emergency department visits are of particular concern as it suggests that increasingly more children are using resource-intensive acute mental health services, often when their symptoms reach crisis levels[26].

Average length of stay in hospital was approximately one week but was highly variable within the sample. Health administrative data from Ontario from 2007-2011 found that nearly one in four psychiatric admissions occur in an adult psychiatric unit. The median length of

hospitalizations for both pediatric and adult units was five days (IQR = 2, 11). Additionally, adolescents admitted to an adult psychiatric unit did not significantly differ from those on a pediatric unit (RR = 0.95 [0.88–1.02])[106]. Considering the impact of a chronic physical illness, results from the United States found that children with epilepsy had a mean adjusted length of hospitalization that was 1.12 times greater than the general population for any mental health diagnosis (95% CI: 1.09-1.17). These children also had more than three times the incidence of longer length of hospitalization for suicide attempt or ideation (IRR: 3.74 [95% CI: 1.68-8.34])[107]. Findings from a Canadian hospital over a five-year period using case-matched analysis examined hospitalizations for physically ill patients with comorbid psychiatric conditions. Results found a near ten percent increase in length of hospitalizations for those with psychiatric comorbidities compared to those without (95% CI: 5.7-13.7; p<.001). They also described a near ten percent increase in costs per admission in these individuals compared to those without psychiatric comorbidities (95% CI = 5.9-13.4; p<.001)[108].

Similar to length of stay in hospital, reported out-of-pocket costs associated with child mental health were highly variable. Therefore, more attention should be given to the differences in costs between groups than the actual reported averages themselves. Participants with multimorbidity reported significantly higher out-of-pocket costs at most, but not all, timepoints compared to those without multimorbidity. Findings in children with comorbid mental disorders highlight hospitalizations as the largest expense for the health system, however the distribution for out-of-pocket costs is currently unknown (i.e., whether more costs are associated with acute crises or long-term care in the form of products and services)[30].

Comparisons between reported service use for participants above and below the median household income (MHI) were also tested. These groups only significantly differed at one time

point, which may have been partly due to small cell counts when comparing participants above and below MHI who reported any form of MHSU. Additionally, the data was not normally distributed, as many individuals reported spending no costs out of pocket and few reported high costs (i.e., over $1000). Although not significantly different, findings suggest that families who can afford to spend more out-of-pocket may be doing so to help meet their child's mental and emotional needs. A mixed methods approach is required to explore the factors which may influence increased out-of-pockets expenses and the decisions families may have to make when spending costs out of pocket for their children. For some families, it may be the difference in choosing between competing expenses.

5.2 Objective 2

5.2.1 Determining the final latent class analysis model

Latent class analysis was an iterative process that considered which models would be most meaningful in the analysis for the third objective of this study. Indicators of service use included hospitalizations, contact with a healthcare provider, and the frequency of those contacts. Additionally, time since diagnosis of a physical illness was included as an indicator as the time soon after diagnosis may be a critical time for declines in mental health and use of mental health services[109]. For children with type 1 diabetes, a population-based cohort study found that the risk psychiatric morbidity was tripled within 6 months after diabetic onset compared to the general population (95% CI 2.7-3.4)[109].

The initial combinations of models considered whether continuous or categorical measures for the indicators of interest would lead to the optimal latent models. Models representing continuous indictors (e.g., number of consultations with each healthcare professional), a latent profile analysis, did not delineate beyond a one-class solution. This may

have been in part due to the relatively small sample of individuals who reported using the same combinations of multiple services.

Proceeding with categorical and binary measures of the indicators of interest, a model including nine indicators determined a two-class solution best fit the data. At both baseline and 24 months, these models differed in that individuals in the first class reported any form of MHSU and included all individuals who reported hospitalization, whereas those in the second class did not report any service use or hospitalizations within the previous 12 months.

5.2.2 Additional exploratory models

A resource intensity model was also examined where clusters were qualitatively determined based on previous literature where the most resource intense contacts (i.e., psychologists and psychiatrists) were binned together and an allied healthcare professional contact was created that binned nurses, social workers, and others. The goal of these groups was to investigate if service use may be distinguishable between groups reporting utilizing the most resource intense services vs. any other service. Therefore, a model with four indicators including hospitalizations, contacts with a family doctor, psychiatrist/psychologist, and contacts with any allied healthcare professional was investigated. The model fit indices both at baseline and 24 months are reported in Appendix F (S8 and S9).

The final models clustered contacts such that a new category investigating contacts with a medical doctor (family doctors and psychiatrists) was explored. These models included a modified binned allied healthcare professionals which included psychologists along with nurses, social workers, and others. Therefore, a model with three indicators including hospitalizations, medical doctors, and allied healthcare professionals/psychologists was explored. The model fit indices at both baseline and 24 months are reported in Appendix F (S10 and S11).

It was determined that neither the resource intensity nor clustered-contacts models determined solutions more meaningful beyond the original nine-indicator model. Therefore, analysis of potential sociodemographic and health-related factors proceeded with the nine-indicator, two-class solution.

5.3 Objective 3

The third objective examined sociodemographic and health-related factors associated with patterns of MHSU among children with a chronic physical illness. Analyses compared those who reported contact with any healthcare professional or hospitalization for their emotional or mental health (i.e., reported any service use) to those who did not report any service use. Results from the fully adjusted model found that child age, child mental health, child physical disability, and parental education were significantly associated with reporting MHSU.

5.3.1 Child age

Child age was significantly associated with service use such that with each additional increase in age by year, the odds of reporting service use was approximately 30% greater in the fully-adjusted model. These findings support child age as an individual predisposing characteristic in the theoretical model where older children are more likely to report accessing services for their mental health. This is supported by previous research from a nationally representative sample from the United States which found that adolescents (aged 12-15 years) were more likely to use services than children (aged 8-11 years)[49]. However, other findings have described that the increase in service use in adolescents may plateau by 14-15 years[50]. Therefore, while increasing age was a predisposing factor for MHSU in our sample,

further research is warranted to determine whether this increase in service use continues into young adulthood or whether individuals at risk may plateau.

There is also support for child age as a predisposing factor for mental illness in a population of children with chronic physical conditions. Previous findings have found that six-month multimorbidity was more likely in older children, such that the odds of screening positive on the MINI-KID were 16% greater for each additional increase in age by year (95% CI 1.0, 1.3)[110]. These findings support the model in that increased prevalence of mental illness in a population of children with chronic physical conditions may precipitate the need for services.

5.3.2 Child mental illness

Screening positive for a least one mental disorder on the MINI-KID was significantly associated with service use such that the odds were nearly five-times greater in the fully-adjusted model. This was expected given that screening positive for a mental illness was an evaluated need within the theoretical model for reporting service use. It was also expected that those who need mental health services would score higher on the diagnostic tool to assess for mental health disorders compared to those who do not. However, not all individuals who screened positive on the MINI-KID also reported that they had accessed mental health services. This may be in part due to the limited time-frame of the MINI-KID (past 6 months). It is also possible that children who screened positive were not experiencing symptoms requiring treatment at that point in time or their illness was stable, and they were managing without services. Additionally, several children in the sample did not screen positive for a mental disorder and reported some form of MHSU during the study period.

These findings highlight that although some children may not be reaching the threshold of a formal diagnosis, they are still experiencing mental health symptoms and are seeking out

services to address their symptoms. They also align with previous findings that children with a physical illness without physical-mental multimorbidity were about one and a half times more likely to report MHSU compared to those without a physical illness (95% CI 1.2, 2.1)[44]. Presence of mental illness in this study was similarly measured with a clinical diagnostic tool; the World Health Organization Composite International Diagnostic Interview 3.0 (WHO-CIDI). Therefore, even though children were not meeting the threshold for diagnosis of a mental illness, they still reported greater service use compared to their peers who did not report a physical illness, suggesting increased physical illness is a perceived need for reporting MHSU.

5.3.3 Child physical disability

Child physical disability as measured by the WHODAS 2.0 scale significantly differed between classes. In the fully-adjusted model, the odds of reporting service use were 1.09 times greater for each additional one-point increase in disability score. These findings align with the theoretical model as increasing perceived physical disability is associated with increasing MHSU. Previous research supports these findings as increasing physical disability is associated with increased risk of mental health concerns[37–40]. Therefore, the increased risk for mental illness in this population, compared to individuals with lower levels of disability, would suggest that these individuals are reporting increased service use.

5.3.4 Mental health literacy

A relationship between parental educational attainment and mental health service use was observed, such that the odds of reporting service use were 7.44 times greater for parents with higher educational achievements in the fully-adjusted model. However, these odds produced a

wide confidence interval, which may be in part due to small cell counts as only 2 parents who reported service use did not complete post-secondary education.

Previous research has shown a relationship between higher educational attainment and increased mental health literacy when compared to those with less education[54–56]. It is theorized that more educational experience increases the opportunity to learn about mental health. Alternatively, inadequate mental health literacy has been found to be a primary source of treatment delay or avoidance[111]. However, given that our sample had a skewed proportion of parents who had higher education, these findings may not be generalizable to a wider population.

5.3.5 Marginalization Indices

There are several possibilities as to why results did not identify meaningful differences in marginalization and service use. For example, the higher proportion of white, Canadian born, highly educated, and partnered parents in the study sample may represent potential selection bias whereby area-level differences in marginalization did not vary enough to measure within this sample. Despite the findings from this study, it may be informative to further investigate the relationship between marginalization factors and access to mental health services in a more representative sample.

Considering the relationship between marginalization and service use, one sample of adult psychiatric patients in Ontario described that patients in more deprived areas were more frequently hospitalized for their illness compared to those in less deprived areas[112]. Thus, improvements in primary and community based-services may offer potential solutions in addressing these inequalities[112].

Previous research examining the association between multimorbidity and marginalization in an adult Canadian population found a higher prevalence of multimorbidity in the most

deprived areas when compared to the least deprived[59]. Furthermore, individuals in the most deprived areas displayed cases of multimorbidity an average of 10 years sooner compared to those in the least deprived areas[59]. However, findings were not specific to physical-mental multimorbidity and the association between marginalization and MHSU in this population remains relatively unknown.

Previous research has also more broadly examined the impact of marginalization on mental illness in children. Specifically, children in Ontario living in more marginalized neighborhoods in households below the poverty line reported fewer mental health problems compared to those living in households above the poverty line, suggesting that neighborhood income may modify the association between household poverty and child mental illness[113]. These findings highlight the importance of good person-context fit in addressing income inequality and the benefits of interventions that address positive social engagement[113].

5.4 Strengths and Limitations

Building on previous research in this population, the current study was able to capture a wide array of child chronic physical conditions from many specialty clinics. Evidence suggests that differences in risk for mental illness may be negligible across different physical conditions, and this study was able to conduct a broader analysis that may be applicable to a wider population of children[38,39,114,115].

Findings from the study should be interpreted with the knowledge that there were several limitations. Mental health service use was a parent-reported measure which may be prone to bias when considering the older children in our study. It is possible that parents may not be aware of all the services these children are accessing, especially within the school system. It should also

be taken into consideration that services parents consider benefitting their child's mental and emotional health may vary from one parent to another.

Average length of stay in hospital was highly variable within the sample. Given that the measure of hospitalizations did not include where individuals were hospitalized, it is unclear whether these visits were primarily acute in nature or were long-term and involving specialized support. Additionally, it was notable that not all participants who reported hospitalization for a mental health concern also reported having contact with a health service provider. Given the limitations of the current study, we are unable to parse as to whether these individuals were overlooked by the system or if there was error with the measurement tool, for example, if they misunderstood the scale and reported hospitalization for an issue concerning their physical health. It is also possible that those reporting hospitalization had a more serious psychopathology which required contact with providers in outpatient services that were not captured in the study.

Additionally, there was a relatively small sample who reported service use which may have limited the class delineation for latent class analysis. Finally, there is the potential for selection bias given the demographics of a higher proportion of white, Canadian born, highly educated, and partnered parents.

5.5 Implications and Future Directions

Findings on number of contacts with service providers was unable to assess whether service providers were accessed on an inpatient or outpatient basis and whether the interactions were long-term or primarily acute in nature. Future directives should examine this relationship to explore the complex interactions between children and their families and the healthcare system.

In effort to mitigate the potential limitations of parent-reported service use, future directives should examine agreement through data linkage with health records such as the

National Ambulatory Care Reporting System, the Discharge Abstract Database, and the Ontario Health Insurance Plan. Included in the greater research protocol for MY LIFE, parents were asked for their child's health insurance number, which 89.4% of sample provided[62]. Examining agreement of service use through linkages will help inform a family-centered model of care which integrates physical and mental services, as well as the optimization of current service delivery in this population.

Considering the impact of service use due to the COVID-19 pandemic will also be a future research priority in this population. Findings in this sample have described increased psychological distress in both children and their parents prior to the start of and during the global pandemic[42]. Exploring whether this measured increase in distress related to the additional seeking and need of services is warranted. Additionally, administrative population data in Ontario found a peak overall decline of 30% in hospitalizations and 37% in emergency department[116]. Similar declines in pediatric emergency visits have also been described in other countries[117]. Exploring how these trends continue to impact children and their families should be a research priority to inform system improvements in delivery of services as the delivery of virtual services expands beyond the initial lockdown pandemic period[118].

CONCLUSION

Findings suggest that mental health service needs are pervasive in this group of children given both the proportion as well as the array of combinations of health care providers reported by children and their families. Latent class analysis showed a two-class solution that differed with regards to several sociodemographic and health-related factors between those who did and did not report service use. Future directives are required to parse the complex interactions children and their families must navigate. Larger, more diverse samples should be studied in order to replicate findings, and data linkages to health records should be undertaken in effort to mitigate the potential limitations of parent-reported service use.

REFERENCES

1. Polanczyk GV, Salum GA, Sugaya LS, Caye A, Rohde LA. Annual Research Review: A meta-analysis of the worldwide prevalence of mental disorders in children and adolescents. J Child Psychol Psychiatry. 2015 Mar;56(3):345–65.

2. Solmi M, Radua J, Olivola M, Croce E, Soardo L, Salazar de Pablo G, et al. Age at onset of mental disorders worldwide: large-scale meta-analysis of 192 epidemiological studies. Mol Psychiatry [Internet]. 2021 Jun 2 [cited 2021 Oct 15]; Available from: http://www.nature.com/articles/s41380-021-01161-7

3. Georgiades K, Duncan L, Wang L, Comeau J, Boyle MH, 2014 Ontario Child Health Study Team. Six-Month Prevalence of Mental Disorders and Service Contacts among Children and Youth in Ontario: Evidence from the 2014 Ontario Child Health Study. Can J Psychiatry. 2019 Apr;64(4):246–55.

4. Merikangas KR, He J ping, Burstein M, Swendsen J, Avenevoli S, Case B, et al. Service Utilization for Lifetime Mental Disorders in U.S. Adolescents: Results of the National Comorbidity Survey–Adolescent Supplement (NCS-A). J Am Acad Child Adolesc Psychiatry. 2011 Jan;50(1):32–45.

5. Costello EJ, Mustillo S, Erkanli A, Keeler G, Angold A. Prevalence and Development of Psychiatric Disorders in Childhood and Adolescence. Arch Gen Psychiatry. 2003 Aug 1;60(8):837.

6. Costello EJ, Maughan B. Annual Research Review: Optimal outcomes of child and adolescent mental illness. J Child Psychol Psychiatry. 2015 Mar;56(3):324–41.

7. Patel V, Flisher AJ, Hetrick S, McGorry P. Mental health of young people: a global public-health challenge. The Lancet. 2007 Apr;369(9569):1302–13.

8. Erskine HE, Moffitt TE, Copeland WE, Costello EJ, Ferrari AJ, Patton G, et al. A heavy burden on young minds: the global burden of mental and substance use disorders in children and youth. Psychol Med. 2015 May;45(7):1551–63.

9. Gore FM, Bloem PJ, Patton GC, Ferguson J, Joseph V, Coffey C, et al. Global burden of disease in young people aged 10–24 years: a systematic analysis. The Lancet. 2011 Jun;377(9783):2093–102.

10. CMHO. Annual Report Card: The burden of kids mental illness on families and the economy. 2019.

11. Canadian Mental Health Association. Child and youth—access to mental health promotion and mental health care [Internet]. 2014. Available from: https://cmha. ca/documents/child-youth-accessmental-%0Dhealth-promotionmental- health-care

12. Buie V, Owings M, DeFrance C, Golosinskiy A. National Hospital Discharge Survey: 2006 summary. National Center for Health Statistics. Vital Health Stat. 2010;13(168).

13. Health Canada. Canada Health Act Annual Report. 2023 Mar. Report No.: 2021–2022.

14. Centre for Addiction and Mental Health. Mental Health and Primary Care Policy Framework. Centre for Addiction and Mental Health; 2016 Mar.

15. Hutchison B, Levesque JF, Strumpf E, Coyle N. Primary Health Care in Canada: Systems in Motion: Primary Health Care in Canada: Systems in Motion. Milbank Q. 2011 Jun;89(2):256–88.

16. Ashcroft R, Menear M, Silveira J, Dahrouge S, Emode M, Booton J, et al. Inequities in the delivery of mental health care: a grounded theory study of the policy context of primary care. Int J Equity Health. 2021 Jun 19;20(1):144.

17. Clatney L, MacDonald H, Shah SM. Mental health care in the primary care setting: Family physicians' perspectives. Can Fam Physician. 2008;54:884–9.

18. Lester H, Tritter JQ, Sorohan H. Patients' and health professionals' views on primary care for people with serious mental illness: focus group study. BMJ. 2005 May 14;330(7500):1122.

19. Kourgiantakis T, Markoulakis R, Lee E, Hussain A, Lau C, Ashcroft R, et al. Access to mental health and addiction services for youth and their families in Ontario: perspectives of parents, youth, and service providers. Int J Ment Health Syst. 2023 Mar 14;17(1):4.

20. MacDonald K, Ferrari M, Fainman-Adelman N, Iyer SN. Experiences of pathways to mental health services for young people and their carers: a qualitative meta-synthesis review. Soc Psychiatry Psychiatr Epidemiol. 2021 Mar;56(3):339–61.

21. Ontario Ministry of Children and Youth Services. Stepping stones: a resource on youth development. Toronto, ON; 2012.

22. Canadian Alliance on Mental Illness and Mental Health. Better access and system performance for mental health services in Canada. Canadian Alliance on Mental Illness and Mental Health; 2020 Jun.

23. Szigethy E. Psychiatry and Pediatrics: New Necessary Directions to Better Treat Adolescents. J Am Acad Child Adolesc Psychiatry. 2016 May;55(5):357–8.

24. Gill PJ, Saunders N, Gandhi S, Gonzalez A, Kurdyak P, Vigod S, et al. Emergency Department as a First Contact for Mental Health Problems in Children and Youth. J Am Acad Child Adolesc Psychiatry. 2017 Jun;56(6):475-482.e4.

25. Comeau J, Georgiades K, Duncan L, Wang L, Boyle MH, 2014 Ontario Child Health Study Team. Changes in the Prevalence of Child and Youth Mental Disorders and Perceived Need for Professional Help between 1983 and 2014: Evidence from the Ontario Child Health Study. Can J Psychiatry. 2019 Apr;64(4):256–64.

26. Gandhi S, Chiu M, Lam K, Cairney JC, Guttmann A, Kurdyak P. Mental Health Service Use Among Children and Youth in Ontario: Population-Based Trends Over Time. Can J Psychiatry. 2016 Feb;61(2):119–24.

27. Canadian Institute for Health Information. Child and youth mental health in Canada [Internet]. 2019 [cited 2023 May 26]. Available from: https://www.cihi.ca/sites/default/files/image/infographic-youth-mentalhealth-2019_en.svg?language=en&order=2

28. Waddell C, Georgiades K, Duncan L, Comeau J, Reid GJ, O'Briain W, et al. 2014 Ontario Child Health Study Findings: Policy Implications for Canada. Can J Psychiatry. 2019 Apr;64(4):227–31.

29. Jörg F, Visser E, Ormel J, Reijneveld SA, Hartman CA, Oldehinkel AJ. Mental health care use in adolescents with and without mental disorders. Eur Child Adolesc Psychiatry. 2016 May;25(5):501–8.

30. Ferro MA, Lipman EL, Browne DT. Mental Health Care Costs Among Youth with Comorbid Mental Disorders. J Behav Health Serv Res [Internet]. 2021 Apr 6 [cited 2021 Apr 28]; Available from: http://link.springer.com/10.1007/s11414-021-09751-7

31. Ferro MA, Lipman EL, Van Lieshout RJ, Boyle MH, Gorter JW, MacMillan HL, et al. Mental–Physical Multimorbidity in Youth: Associations with Individual, Family, and Health Service Use Outcomes. Child Psychiatry Hum Dev. 2019 Jun;50(3):400–10.

32. Jerrell JM, McIntyre RS, Tripathi A. A Cohort Study of the Prevalence and Impact of Comorbid Medical Conditions in Pediatric Bipolar Disorder. J Clin Psychiatry. 2010 Nov 15;71(11):1518–25.

33. OECD. Health Reform: Meeting the Challenge of Ageing and Multiple Morbidities. aris: OECD Publishing; 2011.

34. Salisbury C. Multimorbidity: redesigning health care for people who use it. The Lancet. 2012 Jul;380(9836):7–9.

35. Tsiachristas A, van Ginneken E, Rijken M. Tackling the challenge of multi-morbidity: Actions for health policy and research. Health Policy. 2018 Jan;122(1):1–3.

36. WHO. Global Status Report on Noncommunicable Diseases 2014: Description of the Global Burden of NCDs, their Risk Factors and Determinants. Geneva: World Health Organization; 2014.

37. Barker MM, Beresford B, Bland M, Fraser LK. Prevalence and Incidence of Anxiety and Depression Among Children, Adolescents, and Young Adults With Life-Limiting Conditions: A Systematic Review and Meta-analysis. JAMA Pediatr. 2019 Sep 1;173(9):835.

38. Butler A, Van Lieshout RJ, Lipman EL, MacMillan HL, Gonzalez A, Gorter JW, et al. Mental disorder in children with physical conditions: a pilot study. BMJ Open. 2018 Jan;8(1):e019011.

39. Ferro MA. Major depressive disorder, suicidal behaviour, bipolar disorder, and generalised anxiety disorder among emerging adults with and without chronic health conditions. Epidemiol Psychiatr Sci. 2016 Oct;25(5):462–74.

40. Jones LC, Mrug S, Elliott MN, Toomey SL, Tortolero S, Schuster MA. Chronic Physical Health Conditions and Emotional Problems From Early Adolescence Through Midadolescence. Acad Pediatr. 2017 Aug;17(6):649–55.

41. Ferro MA, Gorter JW, Boyle MH. Trajectories of Depressive Symptoms in Canadian Emerging Adults. Am J Public Health. 2015 Nov;105(11):2322–7.

42. Ferro MA, Meyer SB, Yessis J, Reaume SV, Lipman E, Gorter JW. COVID-19-Related Psychological and Psychosocial Distress Among Parents and Youth With Physical Illness: A Longitudinal Study. Front Psychiatry. 2021 Oct 28;12:761968.

43. Tegethoff M, Belardi A, Stalujanis E, Meinlschmidt G. Association Between Mental Disorders and Physical Diseases in Adolescents From a Nationally Representative Cohort: Psychosom Med. 2015 Apr;77(3):319–32.

44. Reaume SV, Luther AWM, Ferro MA. Physical Morbidity and Mental Health Care Among Young People. J Adolesc Health. 2021 Mar;68(3):540–7.

45. Gaulin M, Simard M, Candas B, Lesage A, Sirois C. Combined impacts of multimorbidity and mental disorders on frequent emergency department visits: a retrospective cohort study in Quebec, Canada. Can Med Assoc J. 2019 Jul 2;191(26):E724–32.

46. Andersen R, Newman JF. Societal and Individual Determinants of Medical Care Utilization in the United States. Milbank Meml Fund. 1973;51:95–124.

47. Andersen RM. Revisiting the Behavioral Model and Access to Medical Care: Does it Matter? J Health Soc Behav. 1995 Mar;36(1):1.

48. Andersen RM. National Health Surveys and the Behavioral Model of Health Services Use. Med Care. 2008 Jul;46(7):647–53.

49. Merikangas KR, He J ping, Burstein M, Swanson SA, Avenevoli S, Cui L, et al. Lifetime Prevalence of Mental Disorders in U.S. Adolescents: Results from the National Comorbidity

Survey Replication– Adolescent Supplement (NCS-A). J Am Acad Child Adolesc Psychiatry. 2010;49(10).

50. Ringeisen H, Miller S, Munoz B, Rohloff H, Hedden SL, Colpe LJ. Mental Health Service Use in Adolescence: Findings From the National Survey on Drug Use and Health. Psychiatr Serv. 2016 Jul;67(7):787–9.

51. Vingilis E, Wade T, Seeley J. Predictors of adolescent health care utilization. J Adolesc. 2007 Oct;30(5):773–800.

52. Bergeron E, Poirier LR, Fournier L, Roberge P, Barrette G. Determinants of Service Use among Young Canadians with Mental Disorders. Can J Psychiatry. 2005 Sep;50(10):629–36.

53. Ryan SM, Jorm AF, Toumbourou JW, Lubman DI. Parent and family factors associated with service use by young people with mental health problems: a systematic review: Family factors associated with service use. Early Interv Psychiatry. 2015 Dec;9(6):433–46.

54. Lee HY, Hwang J, Ball JG, Lee J, Albright DL. Is health literacy associated with mental health literacy? Findings from Mental Health Literacy Scale. Perspect Psychiatr Care. 2020 Apr;56(2):393–400.

55. Kaneko Y, Motohashi Y. Male Gender and Low Education with Poor Mental Health Literacy: A Population-based Study. J Epidemiol. 2007;17(4):114–9.

56. Reavley NJ, McCann TV, Jorm AF. Mental health literacy in higher education students: Mental health literacy in higher education students. Early Interv Psychiatry. 2012 Feb;6(1):45–52.

57. Gupta RPS, De Wit ML, McKeown D. The impact of poverty on the current and future health status of children. Paediatr Child Health. 2007 Oct;12(8):667–72.

58. Kinge JM, Øverland S, Flatø M, Dieleman J, Røgeberg O, Magnus MC, et al. Parental income and mental disorders in children and adolescents: prospective register-based study. Int J Epidemiol. 2021 Nov 10;50(5):1615–27.

59. Moin JS, Moineddin R, Upshur REG. Measuring the association between marginalization and multimorbidity in Ontario, Canada: A cross-sectional study. J Comorbidity. 2018 Jan 1;8(1):2235042X1881493.

60. Fazel M, Townsend A, Stewart H, Pao M, Paz I, Walker J, et al. Integrated care to address child and adolescent health in the 21st century: A clinical review. JCPP Adv [Internet]. 2021 Dec [cited 2023 May 29];1(4). Available from: https://onlinelibrary.wiley.com/doi/10.1002/jcv2.12045

61. Ferro MA, Lipman EL, Van Lieshout RJ, Gorter JW, Shanahan L, Boyle M, et al. Multimorbidity in Children and Youth Across the Life-course (MY LIFE): protocol of a Canadian prospective study. BMJ Open. 2019 Nov;9(11):e034544.

62. Ferro MA, Lipman EL, Lieshout RJV, Timmons B, Shanahan L, Gorter JW, et al. Cohort Profile: Multimorbidity in Children and Youth Across. MY LIFE. 2021;12.

63. Berry JG, Hall M, Neff J, Goodman D, Cohen E, Agrawal R, et al. Children With Medical Complexity And Medicaid: Spending And Cost Savings. Health Aff (Millwood). 2014 Dec;33(12):2199–206.

64. Cohen E, Berry JG, Camacho X, Anderson G, Wodchis W, Guttmann A. Patterns and Costs of Health Care Use of Children With Medical Complexity. PEDIATRICS. 2012 Dec 1;130(6):e1463–70.

65. Cohen E, Patel H. Responding to the rising number of children living with complex chronic conditions. Can Med Assoc J. 2014 Nov 4;186(16):1199–200.

66. Statistics Canada. Canadian Community Health Survey (CCHS) – Mental Health [Internet]. 2011 [cited 2023 May 29]. Available from: https://www23.statcan.gc.ca/imdb/p3Instr.pl?Function=getInstrumentList&Item_Id=119788&UL=1V&

67. Sheehan DV, Sheehan KH, Shytle RD, Janavs J, Bannon Y, Rogers JE, et al. Reliability and Validity of the Mini International Neuropsychiatric Interview for Children and Adolescents (MINI-KID). J Clin Psychiatry. 2010 Mar 15;71(03):313–26.

68. Boyle MH, Duncan L, Georgiades K, Bennett K, Gonzalez A, Van Lieshout RJ, et al. Classifying child and adolescent psychiatric disorder by problem checklists and standardized interviews: Classification by Checklists and Interviews. Int J Methods Psychiatr Res. 2017 Dec;26(4):e1544.

69. Duncan L, Georgiades K, Wang L, Van Lieshout RJ, MacMillan HL, Ferro MA, et al. Psychometric evaluation of the Mini International Neuropsychiatric Interview for Children and Adolescents (MINI-KID). Psychol Assess. 2018 Jul;30(7):916–28.

70. Üstün TB, Chatterji S, Kostanjsek N, Rehm J, Kennedy C, Epping-Jordan J, et al. Developing the World Health Organization Disability Assessment Schedule 2.0. Bull World Health Organ. 2010 Nov 1;88(11):815–23.

71. Kimber M, Rehm J, Ferro MA. Measurement Invariance of the WHODAS 2.0 in a Population-Based Sample of Youth. Federici S, editor. PLOS ONE. 2015 Nov 13;10(11):e0142385.

72. Tompke BK, Tang J, Oltean II, Buchan MC, Reaume SV, Ferro MA. Measurement Invariance of the WHODAS 2.0 Across Youth With and Without Physical or Mental Conditions. Assessment. 2020 Oct;27(7):1490–501.

73. Rehm J, Üstün T, Saxena S, Nelson C, Chatterji S. On the development and psychometric testing of the WHO screening instrument to assess disablement in the general population. Int J Methods Psychiatr Res. 1999;8(2):110–22.

74. Ferro MA, Dol M, Basque D, Elgie M. Validating the 12-item proxy-administered World Health Organization Disability Assessment Schedule (WHODAS) 2.0 in young children with chronic physical illness in Canada. Disabil Rehabil. 2022 Sep 10;1–8.

75. Ferro MA, Elgie M, Dol M, Basque D. Measurement invariance of the 12-item self-administered World Health Organization Disability Assessment Schedule (WHODAS) 2.0 across early and late adolescents in Canada. Disabil Rehabil. 2022 Sep 9;1–7.

76. Bain SK, Jaspers KE. Test Review: Review of Kaufman Brief Intelligence Test, Second Edition: Kaufman, A. S., & Kaufman, N. L. (2004). Kaufman Brief Intelligence Test, Second Edition. Bloomington, MN: Pearson, Inc. J Psychoeduc Assess. 2010 Apr;28(2):167–74.

77. Kuczmarski RJ, Ogden CL, Guo SS, Grummer-Strawn LM, Flegal KM, Mei Z, et al. 2000 CDC growth charts for the United States. Hyattsville, Md: Public Health Service, Centers for Disease Control and Prevention, National Center for Health Statistics; 2002. 190 p. (DHHS publication).

78. Epstein NB, Baldwin LM, Bishop DS. The McMaster Family Assesment Device. J Marital Fam Ther. 1983 Apr;9(2):171–80.

79. Byles J, Byrne C, Boyle MH, Offord DR. Ontario Child Health Study: Reliability and Validity of the General Functioning Subscale of the McMaster Family Assessment Device. Fam Process. 1988 Mar;27(1):97–104.

80. Oltean II, Perlman C, Meyer S, Ferro MA. Child Mental Illness and Mental Health Service Use: Role of Family Functioning (Family Functioning and Child Mental Health). J Child Fam Stud. 2020 Sep;29(9):2602–13.

81. Zelman JJ, Ferro MA. The Parental Stress Scale: Psychometric Properties in Families of Children With Chronic Health Conditions: The Parental Stress Scale. Fam Relat. 2018 Apr;67(2):240–52.

82. Berry J, Jones W. The Parental Stress Scale: Initial Psychometric Evidence. J Soc Pers Relatsh. 1995;12(3):463–72.

83. Matheson FL, van Ingen T. 2016 Ontario Marginalization Index. Toronto, ON: St. Michael's Hospital; 2018.

84. Statistics Canada. Dictionary, Census of Population, 2016: Census of Population, 2016. Ottawa, ON, CA: Statistics Canada; 2018.

85. Nylund-Gibson K, Choi AY. Ten frequently asked questions about latent class analysis. Transl Issues Psychol Sci. 2018 Dec;4(4):440–61.

86. Magnusson D. The Person Approach: Concepts, Measurement Models, and Research Strategy. New Dir Child Adolesc Dev. 2003;2003(101):3–23.

87. Jung T, Wickrama KAS. An Introduction to Latent Class Growth Analysis and Growth Mixture Modeling: Latent Trajectory Classes. Soc Personal Psychol Compass. 2008 Jan;2(1):302–17.

88. Muthen B, Muthen LK. Integrating Person-Centered and Variable-Centered Analyses: Growth Mixture Modeling With Latent Trajectory Classes. Alcohol Clin Exp Res. 2000 Jun;24(6):882–91.

89. Nylund KL, Asparouhov T, Muthén BO. Deciding on the Number of Classes in Latent Class Analysis and Growth Mixture Modeling: A Monte Carlo Simulation Study. Struct Equ Model Multidiscip J. 2007 Oct 23;14(4):535–69.

90. Geiser C. Data Analysis with MPlus. New York: Guilford Press; 2012.

91. Wurpts IC, Geiser C. Is adding more indicators to a latent class analysis beneficial or detrimental? Results of a Monte-Carlo study. Front Psychol [Internet]. 2014 Aug 21 [cited 2021 Oct 17];5. Available from: http://journal.frontiersin.org/article/10.3389/fpsyg.2014.00920/abstract

92. Finch WH, Bronk KC. Conducting Confirmatory Latent Class Analysis Using M *plus*. Struct Equ Model Multidiscip J. 2011 Jan 13;18(1):132–51.

93. Statistics Canada. Immigration and ethnocultural diversity: Key results from the 2016 Census. [Internet]. 2017. Available from: https://www150.statcan.gc.ca/n1/daily-quotidien/170913/dq170913a-eng.htm

94. Van Ingen T, Matheson FI. The 2011 and 2016 iterations of the Ontario Marginalization Index: updates, consistency and a cross-sectional study of health outcome associations. Can J Public Health. 2022 Apr;113(2):260–71.

95. Park AL, Moskowitz AL, Chorpita BF. Community-Based Providers' Selection of Practices for Children and Adolescents With Comorbid Mental Health Problems. J Clin Child Adolesc Psychol. 2018 Sep 3;47(5):796–807.

96. Yang C. Evaluating latent class analyses in qualitative phenotype identification. Comput Stat Data Anal. 2006;50:1090–104.

97. Collins LM, Wugalter SE. Latent Class Models for Stage-Sequential Dynamic Latent Variables. Multivar Behav Res. 1992 Jan;27(1):131–57.

98. Morgan GB. Mixed Mode Latent Class Analysis: An Examination of Fit Index Performance for Classification. Struct Equ Model Multidiscip J. 2015 Jan 2;22(1):76–86.

99. Tueller S, Lubke G. Evaluation of Structural Equation Mixture Models: Parameter Estimates and Correct Class Assignment. Struct Equ Model Multidiscip J. 2010 Apr 13;17(2):165–92.

100. Ryan C, Epstein NB, Keitner GI, Miller IW, Bishop DS. Evaluating and Treating Families: The McMaster Approach. 1st Edition. New York, NY: Routledge; 2005. 304 p.

101. Markoulakis R, Chan S, Levitt A. The needs and service preferences of caregivers of youth with mental health and/or addictions concerns. BMC Psychiatry. 2020 Dec;20(1):409.

102. Luke A, Doucet S, Azar R. Paediatric patient navigation models of care in Canada: An environmental scan. Paediatr Child Health. 2018 May 11;23(3):e46–55.

103. Bieling PJ, Madsen V, Zipursky RB. A 'navigator' model in emerging mental illness?: Navigators in EI. Early Interv Psychiatry. 2013 Nov;7(4):451–7.

104. Song K, Markoulakis R, Levitt A. Predictors of strain for Canadian caregivers seeking service navigation for their youth with mental health and/or addictions issues. Health Soc Care Community. 2022 Feb;30(2):735–43.

105. Matheson FI, Smith KLW, Moineddin R, Dunn JR, Glazier RH. Mental health status and gender as risk factors for onset of physical illness over 10 years. J Epidemiol Community Health. 2014 Jan;68(1):64–70.

106. McRae S, Edwards J, Speechley KN, Sukhera J, Zou G, Anderson KK. The prevalence and impact of adolescent hospitalization to adult psychiatric units. Early Interv Psychiatry. 2022 Jul;16(7):752–9.

107. Thibault DP, Mendizabal A, Abend NS, Davis KA, Crispo J, Willis AW. Hospital care for mental health and substance abuse in children with epilepsy. Epilepsy Behav. 2016 Apr;57:161–6.

108. Ansari H, Santiago-Jiménez M, Saab H, De Souza C, Szatmari P, Monga S. Association Between Comorbid Psychiatric Disorders and Hospital Resource Use in Physically Ill Pediatric Inpatients: A Case-Matched Analysis. J Am Acad Child Adolesc Psychiatry. 2021 Mar;60(3):346–54.

109. Butwicka A, Frisén L, Almqvist C, Zethelius B, Lichtenstein P. Risks of Psychiatric Disorders and Suicide Attempts in Children and Adolescents With Type 1 Diabetes: A Population-Based Cohort Study. Diabetes Care. 2015 Mar 1;38(3):453–9.

110. Ferro MA, Qureshi S, Van Lieshout RJ, Lipman EL, Georgiades K, Gorter JW, et al. Prevalence and Correlates of Physical-mental Multimorbidity in Outpatient Children From a Pediatric Hospital in Canada. Can J Psychiatry. 2022 Aug;67(8):626–37.

111. Andrade LH, Alonso J, Mneimneh Z, Wells JE, Al-Hamzawi A, Borges G, et al. Barriers to mental health treatment: results from the WHO World Mental Health surveys. Psychol Med. 2014 Apr;44(6):1303–17.

112. De Oliveira C, Mason J, Jacobs R. Examining equity in the utilisation of psychiatric inpatient care among patients with severe mental illness (SMI) in Ontario, Canada. BMC Psychiatry. 2021 Dec;21(1):420.

113. Boyle MH, Duncan L, Georgiades K, Wang L, Comeau J, Ferro MA, et al. The 2014 Ontario Child Health Study Emotional Behavioural Scales (OCHS-EBS) Part II: Psychometric Adequacy for Categorical Measurement of Selected *DSM-5* Disorders. Can J Psychiatry. 2019 Jun;64(6):434–42.

114. Ferro MA. Adolescents and young adults with physical illness: a comparative study of psychological distress. Acta Paediatr. 2014 Jan;103(1):e32–7.

115. Ferro MA, Boyle MH. Longitudinal Invariance of Measurement and Structure of Global Self-Concept: A Population-Based Study Examining Trajectories Among Adolescents With and Without Chronic Illness. J Pediatr Psychol. 2013 May 1;38(4):425–37.

116. Saunders NR, Toulany A, Deb B, Strauss R, Vigod SN, Guttmann A, et al. Acute mental health service use following onset of the COVID-19 pandemic in Ontario, Canada: a trend analysis. CMAJ Open. 2021 Oct;9(4):E988–97.

117. Dopfer C, Wetzke M, Zychlinsky Scharff A, Mueller F, Dressler F, Baumann U, et al. COVID-19 related reduction in pediatric emergency healthcare utilization – a concerning trend. BMC Pediatr. 2020 Dec;20(1):427.

118. Matheson BE, Bohon C, Lock J. Family-based treatment via videoconference: Clinical recommendations for treatment providers during COVID -19 and beyond. Int J Eat Disord. 2020 Jul;53(7):1142–54.

Table 1: Parent-reported healthcare professional contact for children's emotions or mental health over 24 months.

Timepoint	N	Psychiatrist	Family doctor	Psychologist	Nurse	Social worker	Other
Baseline	30 (11.5%)*	4 (13.3%)	13 (43.3%)	13 (43.3%)	3 (10.0%)	16 (53.3%)	5 (16.7%)
6 months	33 (13.0%)*	10 (30.3%)	16 (48.9%)	15 (45.5%)	3 (9.1%)	18 (54.6%)	4 (12.1%)
12 months	37 (15.0%)*	12 (32.4%)	12 (32.4%)	17 (46.0%)	2 (5.4%)	24 (64.9%)	5 (13.5%)
24 months	43 (18.5%)*	8 (18.6%)	17 (39.6%)	16 (37.2%)	5 (11.6%)	20 (46.5%)	8 (18.6%)
# of individuals	65 (24.7%)*	22 (8.4%)*	31 (11.8%)*	32 (12.2%)*	9 (3.4%)*	45 (17.1%)*	13 (4.9%)*

Due to missing data, cells may not sum to total sample size.

*Percentage of total sample.

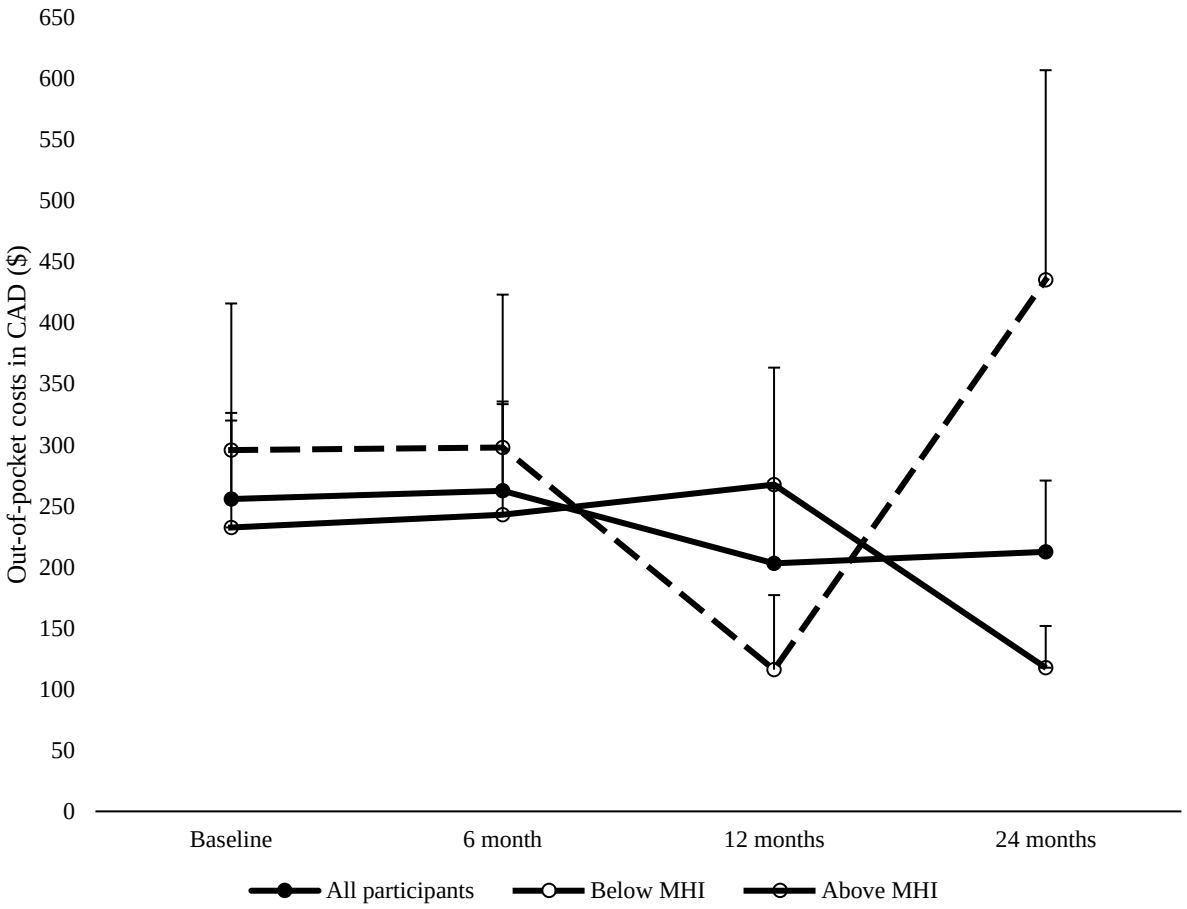


Figure 1. Out-of-pocket costs in Canadian dollars for mental health services and products (All participants).

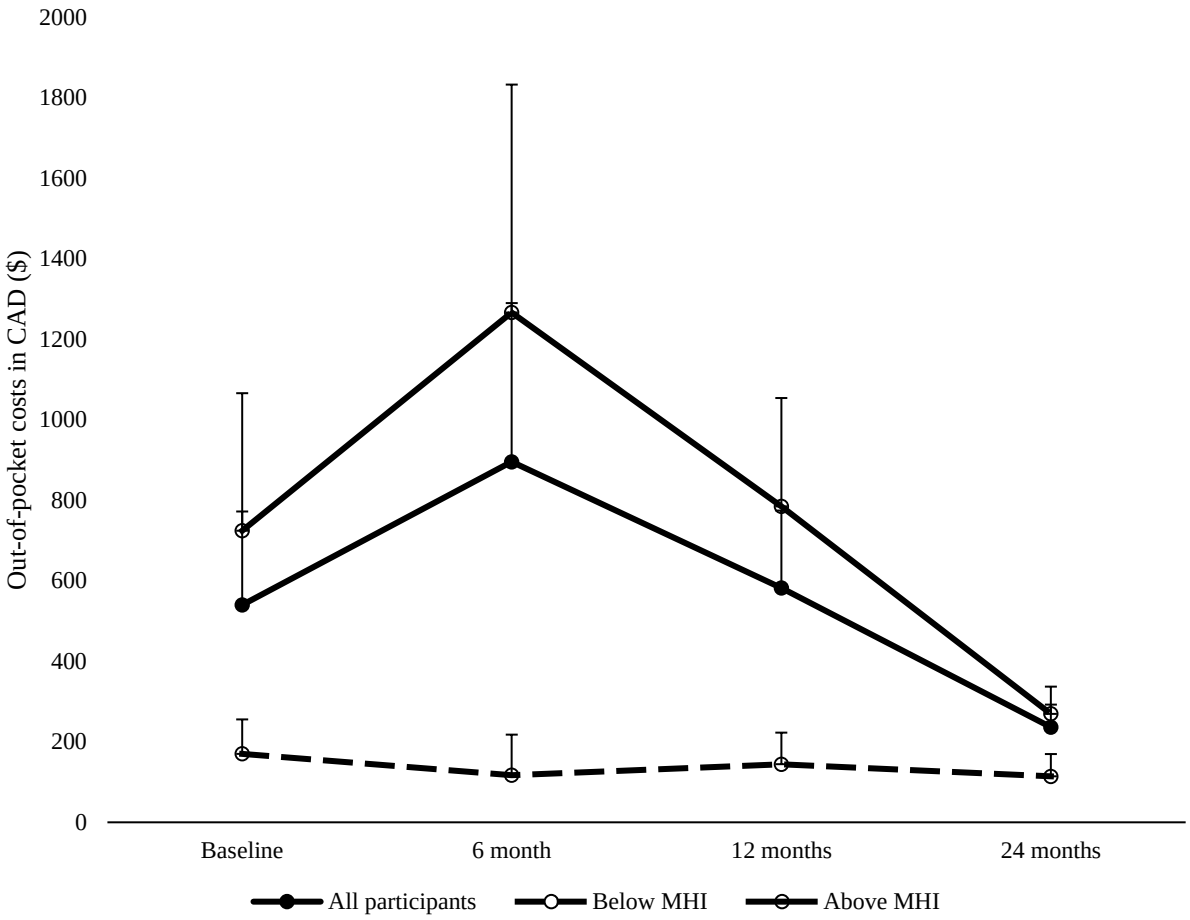


Figure 2. Out-of-pocket costs in Canadian dollars for mental health services and products (Participants with any healthcare professional contact).

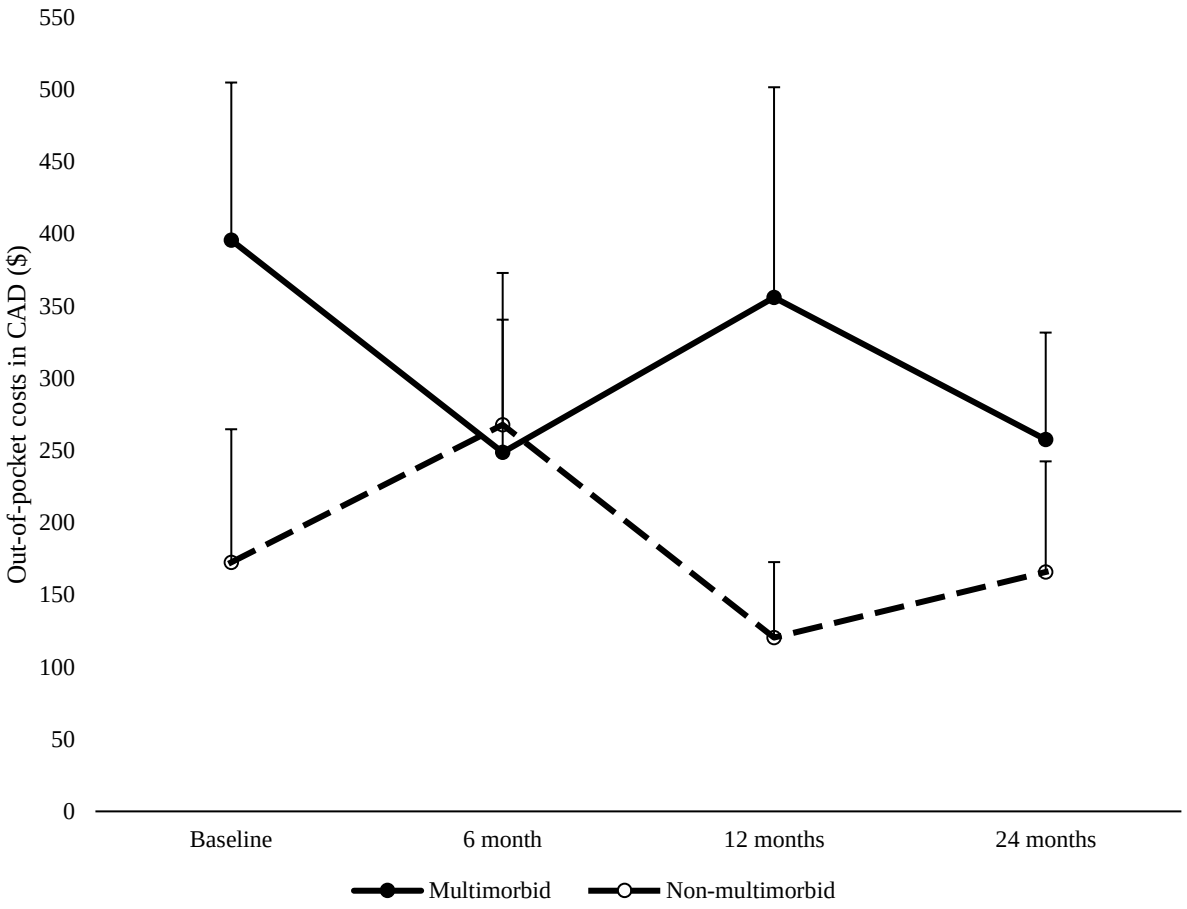


Figure 3. Out-of-pocket costs in Canadian dollars for mental health services and products by physical-mental multimorbidity status.

Table 2: Model Fit Indices for Latent Class Analysis at Baseline.

Solution	BIC	AIC	BLRT *p*-value	Entropy	Class sizes
1 Class	1469.3	1430.0	-	-	100%
2 Classes	**1275.9**	**1193.8**	**<.001**	**.998**	**Class 1: 11.4%** **Class 2: 88.6%**
3 Classes	1311.9	1186.9	<.001	.991	Class 1: 6.5% Class 2: 4.9% Class 3: 88.6%

Note: Bold indicates the best-fitting model. *BIC = Bayesian information criterion; BLRT = bootstrap likelihood ratio test*. BIC and AIC values decreased as the number of classes increased, indicating better model fit with increased classes (not including the 3-class model). BLRT values are significant for both the 1-class and 2-class models, also suggesting increased classes represent a better model fit. However, BIC and AIC values increased, and class size declined (i.e. classes with <5% of sample) for the 3-class model and as such may be unstable. Therefore, the 2-class model was the best model for our data.

Table 3: Model Fit Indices for Latent Class Analysis at 24 months.

Solution	BIC	AIC	BLRT *p*-value	Entropy	Class sizes
1 Class	1588.6	1549.3	-	-	100%
2 Classes	**1373.2**	**1291.1**	**<.001**	**.919**	**Class 1: 16.4%** **Class 2: 83.7%**
3 Classes	1410.2	1285.1	.0128	.937	Class 1: 6.1% Class 2: 83.7% Class 3: 10.3%

Note: Bold indicates the best-fitting model. *BIC = Bayesian information criterion; BLRT = bootstrap likelihood ratio test*. BIC and AIC values decreased as the number of classes increased, indicating better model fit with increased classes (not including the 3-class model). BLRT values are significant for the 2-class model, also suggesting increased classes represent a better model fit. Additionally, a good relative entropy (>0.80) was obtained.

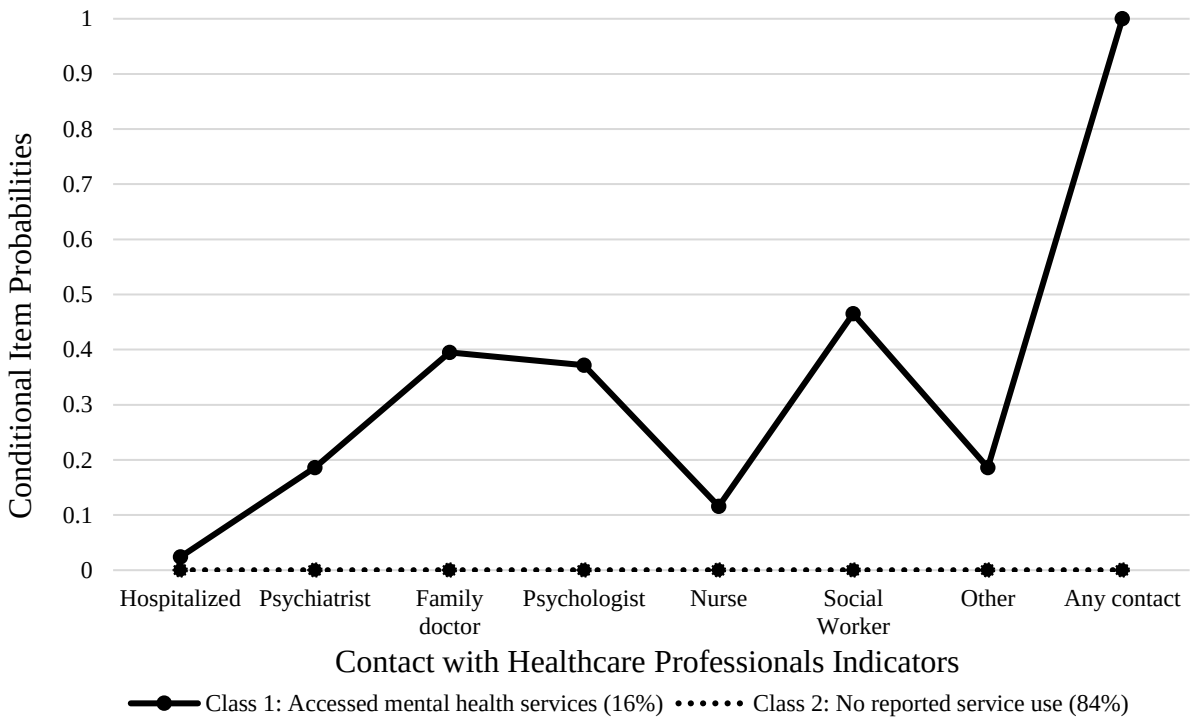


Figure 4. Conditional item probability plot

Table 4: Comparing conditional item probability estimates for 2-classs models with 9 indicators vs. 8 indicators at 24 months.

	9 indicators (w/ HPANY)		8 indicators (w/out HPANY)	
	Class 1	Class 2	Class 1	Class 2
Hospitalization	0.024	0	0.027	0
Psychiatrist	0.186	0	0.211	0
Family Doctor	0.395	0	0.438	0.002
Psychologist	0.372	0	0.262	0.031
Nurse	0.116	0	0.132	0
Social worker	0.465	0	0.442	0.017
Other	0.186	0	0.211	0
Any HCP	1.00	0	-	-
TIMEBIN1	0.213	0.260	0.215	0.258
TIMEBIN2	0.199	0.258	0.217	0.253
TIMEBIN3	0.220	0.263	0.208	0.264
TIMEBIN4	0.368	0.219	0.360	0.225

Note: Family doctors includes general practitioners; Social workers include counsellors, case workers, and psychotherapists; Other includes any other allied healthcare professional not previously mentioned; Any HCP includes any combination(s) of healthcare providers; TIMEBIN = time from diagnosis binned categories.

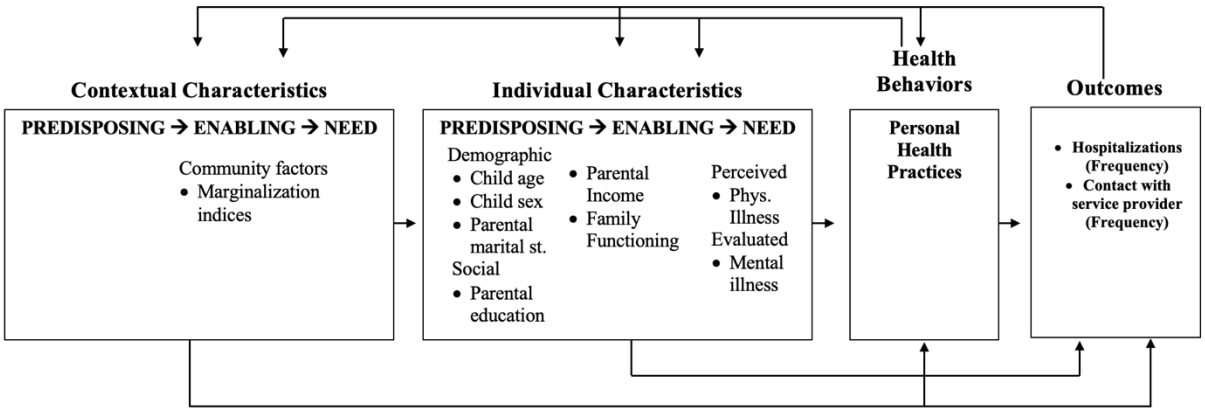
Table 5: Associations between mental health service use and sociodemographic and health-related factors (Sequential block models).

		Model 1 (Block 1+2)	Model 2 (Block 1+2+3)	Model 3 (Fully-adjusted)
Covariates		OR (95% CI)	OR (95% CI)	OR (95% CI)
Child age		1.23*** (1.11, 1.36)	1.25*** (1.12, 1.39)	1.26*** (1.12, 1.42)
Female child		1.61 (0.73, 3.52)	2.26 (0.96, 5.31)	2.11 (0.87, 5.12)
Positive MINI-KID		5.06*** (2.17, 11.82)	4.97*** (1.99, 12.41)	4.90** (1.86, 12.95)
WHODAS 2.0		1.05 (0.99, 1.11)	1.08* (1.01, 1.16)	1.09* (1.02, 1.17)
Parent stress		-	1.02 (0.98, 1.07)	1.02 (0.98, 1.07)
> Parental post-secondary education		-	7.37* (1.18, 45.96)	7.44* (1.22, 45.45)
> Median Household Income ($90,000)		-	2.08 (0.75, 5.80)	2.12 (0.70, 6.39)
Marginalization indices				
	Greater instability	-	-	1.02 (0.38, 2.70)
	Greater deprivation	-	-	1.46 (0.59, 3.64)
	Greater dependency	-	-	0.72 (0.26, 1.99)
	Higher ethnic concentration	-	-	0.50 (0.19, 1.36)
C-Statistic		0.83	0.87	0.88

Significant at *$p < .05$, **$p < .01$, ***$p < .001$.

Note: MINI-KID = having screened positive for a least one mental disorder on the Mini International Neuropsychiatric Interview for Children and Adolescents. WHODAS = World Health Organization Disability Assessment Schedule 2.0. All marginalization indices were binary measures, where the reference group was low marginalization.

APPENDIX A: THEORETICAL MODEL BASED ON ANDERSEN MODEL OF HEALTH SERVICE USE



S1. Theoretical model based on Andersen model of health service use.

Note: Personal health practices include characteristics such as diet and exercise but are not included within the scope of this study.

APPENDIX B: HYPOTHESIZED MODELS FOR OBJECTIVE 3

Model 1: Child Sociodemographic – Child age + Child sex (Block 1)

$$\eta_i^{(j)} = \beta_0^{(j)} + \beta_1^{(j)} X_{1i} + \beta_2^{(j)} X_{2i}$$

$$MHSU_i^{(j)} = \beta_0^{(j)} + ChildAGE_1^{(j)} X_{1i} + ChildSEX_2^{(j)} X_{2i}$$

Where:

$\eta_i^{(j)} = log\left(\frac{\Pr(Y_i=j)}{\Pr(Y_i=\text{Ref})}\right)$ is the log-odds of $Y_i = j$ (w.r.t 0=No MHSU [Ref]) for subject *i*;

$j \neq$ No MHSU; and "No MHSU" is the reference category; "log" is the natural log;

X_{1i} is the observed continuous predictor variable for child age (in years) for the ith subject;

X_{2i} is the observed binary predictor variable for child sex (0=female, 1=male) for the ith subject;

$\beta_0^{(j)}$, $\beta_1^{(j)}$and $\beta_2^{(j)}$are the (fixed) unknown regression coefficients denoting intercept, child age, and child sex, respectively.

Assumption: for any $i \neq k, (X_i, Y_{1i}) \perp (X_j, Y_{1j})$;

* Note: This is not a true odds ratio because for any *j*, $\Pr(Y_i = j) + \Pr(Y_i = 0) \neq 1$.

Model 2: Child Health – Mental illness (MINI-KID) + Physical illness (WHODAS) + BMI + IQ (Block 2)

$$\eta_i^{(j)} = \beta_0^{(j)} + \beta_1^{(j)} X_{1i} + \beta_2^{(j)} X_{2i} + \beta_3^{(j)} X_{3i} + \beta_4^{(j)} X_{4i} + \beta_5^{(j)} X_{5i} + \beta_6^{(j)} X_{6i}$$

$$MHSU_i^{(j)} = \beta_0^{(j)} + ChildAGEX_{1i} + ChildSEX_2^{(j)} X_{2i} + MINIKID_3^{(j)} X_{3i} + WHODAS_4^{(j)} X_{4i} + BMI_5^{(j)} X_{5i} + IQ_6^{(j)} X_{6i}$$

Where:

X_{3i} is the observed binary predictor variable for child mental illness (0=no presence of mental illness(s), 1=presence of one or more mental illness(s)) for the ith subject;

X_{4i} is the observed continuous predictor variable for child physical illness for the ith subject;

X_{5i} is the observed binary predictor variable for BMI (0=normal BMI, 1=abnormal BMI) for the ith subject;

X_{6i} is the observed binary predictor variable for IQ (0=above average, 1=below average) for the ith subject;

$\beta_3^{(j)}$, $\beta_4^{(j)}$, $\beta_5^{(j)}$ and $\beta_6^{(j)}$ are the (fixed) unknown regression coefficients denoting MINI-KID, WHODAS, BMI and IQ scores, respectively.

Model 3: Family Factors – Marital status + Parental educational attainment + Yearly income before taxes + Parental stress + Family functioning (FAD) (Block 3)

$$\eta_i^{(j)} = \beta_0^{(j)} + \beta_1^{(j)} X_{1i} + \beta_2^{(j)} X_{2i} + \beta_3^{(j)} X_{3i} + \beta_4^{(j)} X_{4i} + \beta_5^{(j)} X_{5i} + \beta_6^{(j)} X_{6i} + \beta_7^{(j)} X_{7i} + \beta_8^{(j)} X_{8i} + \beta_9^{(j)} X_{9i} + \beta_{10}^{(j)} X_{10i} + \beta_{11}^{(j)} X_{11i}$$

$$MHSU_i^{(j)} = \beta_0^{(j)} + ChildAGE_1^{(j)} X_{1i} + ChildSEX_2^{(j)} X_{2i} + MINIKID_3^{(j)} X_{3i} + WHODAS_4^{(j)} X_{4i} + BMI_5^{(j)} X_{5i} + IQ_6^{(j)} X_{6i} + MaritalStatus_7^{(j)} X_{7i} + Education_8^{(j)} X_{8i} + Income_9^{(j)} X_{9i} + ParentStress_{10}^{(j)} X_{10i} + FAD_{11}^{(j)} X_{11i}$$

Where:

X_{7i} is the observed binary variable for marital status (0=not partnered, 1=partnered) for the ith subject;

X_{8i} is the observed binary variable for parental educational attainment (0=did not complete post-secondary education, 1=completed post-secondary education) for the ith subject;

X_{9i} is the observed binary predictor variable for yearly income before taxes (0=below median household income, 1=equal to or above median household income) for the ith subject;

X_{10i} is the observed continuous predictor variable for parental stress for the ith subject;

X_{11i} is the observed continuous predictor variable for family functioning for the ith subject;

$\beta_7^{(j)}, \beta_8^{(j)}, \beta_9^{(j)}, \beta_{10}^{(j)}$ and $\beta_{11}^{(j)}$ are the (fixed) unknown regression coefficients denoting marital status, educational attainment, income, parental stress, and family functioning, respectively.

Model 4: Community Factors – Marginalization Indices (Block 4)

$$\eta_i^{(j)} = \beta_0^{(j)} + \beta_1^{(j)} X_{1i} + \beta_2^{(j)} X_{2i} + \beta_3^{(j)} X_{3i} + \beta_4^{(j)} X_{4i} + \beta_5^{(j)} X_{5i} + \beta_6^{(j)} X_{6i} + \beta_7^{(j)} X_{7i} + \beta_8^{(j)} X_{8i} + \beta_9^{(j)} X_{9i} + \beta_{10}^{(j)} X_{10i} + \beta_{11}^{(j)} X_{11i} + \beta_{12}^{(j)} X_{12i} + \beta_{13}^{(j)} X_{13i} + \beta_{14}^{(j)} X_{14i} + \beta_{15}^{(j)} X_{15i}$$

$$MHSU_i^{(j)} = \beta_0^{(j)} + ChildAGE_1^{(j)} X_{1i} + ChildSEX_2^{(j)} X_{2i} + MINIKID_3^{(j)} X_{3i} + WHODAS_4^{(j)} X_{4i} + BMI_5^{(j)} X_{5i} + IQ_6^{(j)} X_{6i} + MaritalStatus_7^{(j)} X_{7i} + Education_8^{(j)} X_{8i} + Income_9^{(j)} X_{9i} + ParentStress_{10}^{(j)} X_{10i} + FAD_{11}^{(j)} X_{11i} + Instability_{12}^{(j)} X_{12i} + Deprivation_{13}^{(j)} X_{13i} + Dependancy_{14}^{(j)} X_{14i} + Ethinic\ concentration_{15}^{(j)} X_{15i}$$

Where:

X_{12i} is observed binary predictor variable for ethnic concentration (0=low marginalization, 1=high marginalization) for the i[th] subject;

X_{13i} is the observed binary predictor variable for ethnic concentration (0=low marginalization, 1=high marginalization) for the i[th] subject;

X_{14i} is the observed binary predictor variable for ethnic concentration (0=low marginalization, 1=high marginalization) for the i[th] subject;

X_{15i} is the observed binary predictor variable for ethnic concentration (0=low marginalization, 1=high marginalization) for the i[th] subject;

$\beta_{12}^{(j)}, \beta_{13}^{(j)}, \beta_{14}^{(j)}$ and $\beta_{15}^{(j)}$ are the (fixed) unknown regression coefficients denoting marginalization indices for residential instability, material deprivation, dependency, and ethnic concentration, respectively.

APPENDIX C: MULTIPLE HEALTHCARE PROFESSIONALS CONTACT COMBINATIONS

S2: Participants who reported contact with multiple healthcare professionals at baseline.

Health professional combination	
Family doctor + Psychologist	4 (13.3%)*
Family doctor + Psychologist + Nurse + Social Worker	2 (6.7%)*
Psychiatrist + Social Worker	2 (6.7%)*

All other combinations only included one participant.

*Percentage of sample who reported contact with any health professional regarding emotional or mental health at baseline.

S3: Participants who reported contact with multiple healthcare professionals at 24 months.

Health professional combination	
Nurse + Other	2 (4.7%)*
Family doctor + Social Worker	5 (11.6%)*
Family doctor + Psychologist	4 (9.3%)*
Psychiatrist + Psychologist + Social Worker	2 (4.7%)*

All other combinations only included one participant.

*Percentage of sample who reported contact with any health professional regarding emotional or mental health at 24 months.

S4: Participants who reported contact with multiple healthcare professionals across all timepoints.

Health professional combination	
Psychologist + Social Worker	5 (7.7%)*
Family doctor + Social Worker	6 (9.2%)*
Family doctor + Psychologist	6 (9.2%)*
Psychiatrist + Social Worker	5 (7.7%)*
Psychiatrist + Psychologist + Other	3 (4.6%)*
Psychiatrist + Family doctor + Psychologist	3 (4.6%)*
Psychiatrist + Family doctor + Psychologist + Social Worker	2 (3.1%)*
Psychiatrist + Family doctor + Psychologist + Nurse + Social worker + Other	2 (3.1%)*

All other combinations only included one participant.

*Percentage of sample who reported contact with any health professional regarding emotional or mental health across all timepoints.

APPENDIX D: MODEL FIT INDICES FOR LATENT PROFILE ANALYSES

S5: Model Fit Indices for Latent Profile Analysis at Baseline.

Solution	BIC	AIC	BLRT *p*-value	Entropy	Class sizes
1 Class	**7794.23**	**7729.93**	**-**	**-**	**100%**
2 Classes	5676.53	5576.51	<.001	100%	Class 1: 99.6% Class 2: 0.4%
3 Classes	4774.15	4638.41	<.001	100%	Class 1: 99.2% Class 2: 0.4% Class 3: 0.4%

S6: Model Fit Indices for Latent Profile Analysis at 24 months.

Solution	BIC	AIC	BLRT *p*-value	Entropy	Class sizes
1 Class	**8928.85**	**8866.73**	**-**	**-**	**100%**
2 Classes	7675.52	7578.89	<.001	100%	Class 1: 99.6% Class 2: 0.4%
3 Classes	6377.55	6246.41	<.001	100%	Class 1: 97.9% Class 2: 0.4% Class 3: 1.7%

Note: Bold indicates the best-fitting model. *BIC = Bayesian information criterion; BLRT = bootstrap likelihood ratio test*. BIC and AIC values decreased as the number of classes increased, indicating better model fit with increased classes. BLRT values are significant for both the 1-class and 2-class models, also suggesting increased classes represent a better model fit. However, class size fell below 5% for both the 2-class and 3-class model. Therefore, latent profile analysis would suggest a one-class solution.

APPENDIX E: RESULTS FOR INDIVIDUAL BLOCKS

S7: Associations between mental health service use and sociodemographic and health-related factors (Individual blocks).

		Block 1	Block 2	Block 3	Block 4
Covariates		OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Child age		1.18*** (1.09, 1.29)	-	-	-
Female Child		2.35* (1.16, 4.74)	-	-	-
Positive MINI-KID		-	3.18** (1.42, 7.11)	-	-
WHODAS		-	1.09** (1.03, 1.16)	-	-
Abnormal BMI		-	0.78 (0.34, 1.78)	-	-
K-BIT < 85		-	0.62 (0.10, 3.88)	-	-
Parent stress		-	-	1.05* (1.00, 1.09)	-
FAD		-	-	1.03 (0.96, 1.11)	-
Partnered parent		-	-	1.01 (0.30, 3.38)	-
>Parental post-secondary education		-	-	2.06 (0.44, 9.66)	-
>Median Household Income ($90,000)		-	-	1.99 (0.82, 4.84)	-
Marginalization indices					
	Greater instability	-	-	-	0.81 (0.39, 1.66)
	Greater deprivation	-	-	-	1.00 (0.46, 2.01)
	Greater dependency	-	-	-	0.98 (0.46, 2.09)
	Higher ethnic concentration	-	-	-	0.51 (0.24, 1.09)
C-statistic		0.73	0.77	0.65	0.59

Significant at *$p < .05$, **$p < .01$, ***$p < .001$
Note: MINI-KID = having screened positive for a least one mental disorder on the Mini International Neuropsychiatric Interview for Children and Adolescents. WHODAS = World Health Organization Disability Assessment Schedule 2.0. All marginalization indices were binary measures, where the reference group was low marginalization.

APPENDIX F: MODEL FIT INDICES FOR ADDITIONAL EXPLORATORY MODELS

S8: Model Fit Indices for Latent Class Analysis of Resource Intensity Models at Baseline.

Solution	BIC	AIC	BLRT p-value	Entropy	Class sizes
1 Class	433.838	419.564	-	-	100%
2 Classes	**384.491**	**352.376**	**<.001**	**0.932**	**Class 1: 7.6%** **Class 2: 92.4%**
3 Classes	409.367	359.411	0.007	0.948	Class 1: 0.4% Class 2: 7.3% Class 3: 92.4%

S9: Model Fit Indices for Latent Class Analysis of Resource Intensity Models at 24 months.

Solution	BIC	AIC	BLRT p-value	Entropy	Class sizes
1 Class	456.373	442.569	-	-	100%
2 Classes	**441.030**	**409.971**	**<.001**	**0.687**	**Class 1: 81.5%** **Class 2: 18.5%**
3 Classes	463.432	415.118	0.667	0.995	Class 1: 86.7% Class 2: 10.7% Class 3: 2.6%

Note: Bold indicates the best-fitting model. *BIC = Bayesian information criterion; BLRT = bootstrap likelihood ratio test*. BIC and AIC values decreased as the number of classes increased, indicating better model fit with increased classes (not including the 3-class model). BLRT values are significant for the 2-class model, also suggesting increased classes represent a better model fit. Additionally, a good relative entropy (>0.80) was obtained at baseline. However, this entropy was not replicated for a 2-class solution at 24 months.

S10: Model Fit Indices for Latent Class Analysis of Clustered Contacts Models at Baseline.

Solution	BIC	AIC	BLRT *p*-value	Entropy	Class sizes
1 Class	356.685	345.980	-	-	100%
2 Classes	**318.602**	**293.624**	**<.001**	**0.996**	**Class 1: 5.3%** **Class 2: 94.7%**
3 Classes	340.473	301.221	0.4286	0.484	Class 1: 5.3% Class 2: 88.6% Class 3: 6.1%
4 Classes	362.746	309.221	1.00	0.818	Class 1: 1.1% Class 2: 0% Class 3: 5.3% Class 4: 93.5

S11: Model Fit Indices for Latent Class Analysis of Clustered Contacts Models at 24 months.

Solution	BIC	AIC	BLRT *p*-value	Entropy	Class sizes
1 Class	386.666	376.313	-	-	100%
2 Classes	**352.102**	**327.944**	**<.001**	**0.985**	**Class 1: 7.7%** **Class 2: 92.3%**
3 Classes	373.906	335.944	1.00	0.922	Class 1: 0.4 % Class 2: 7.3% Class 3: 92.3%

Note: Bold indicates the best-fitting model. *BIC = Bayesian information criterion; BLRT = bootstrap likelihood ratio test*. BIC and AIC values decreased as the number of classes increased, indicating better model fit with increased classes. BLRT values are significant for both the 1-class and 2-class models, also suggesting increased classes represent a better model fit. However, at baseline, while class size did not fall below 5% for the 3-class model, AIC and BIC values increased, the BLRT-p value was non-significant, and the obtained entropy was relatively poor. Therefore, the 2-class model was the best model for our data.