2019-08-20

Cumulative Risk and Mental Health Outcomes in Children Prenatally Exposed to Alcohol

Ritter, Chantel M.

UNIVERSITY OF CALGARY

Cumulative Risk and Mental Health Outcomes in Children Prenatally Exposed to Alcohol

by

Chantel M. Ritter

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE

DEGREE OF MASTER OF SCIENCE

GRADUATE PROGRAM IN EDUCATIONAL PSYCHOLOGY

CALGARY, ALBERTA

AUGUST, 2019

Abstract

Fetal alcohol spectrum disorder (FASD) is caused by exposure to alcohol in utero and is the leading cause of birth defects and developmental disabilities. The timing, frequency, and dosage of alcohol consumed during the prenatal period contribute to the heterogeneous presentation of FASD, which includes physical, adaptive, behavioural, and social-emotional difficulties. Difficulties are often solely attributed to the effects of alcohol, yet alcohol is rarely the only explanatory factor for outcomes. Specifically, prenatal alcohol exposure (PAE) often co-occurs with other substances, as well as other environmental factors such as lack of prenatal care or poverty/malnutrition. Children and youth with FASD often experience adverse experiences postnatally, such as abuse or neglect. These factors may cumulatively interact to alter individual trajectories of children with PAE. The purpose of this study is to examine the relationship between cumulative risk factors (both prenatally and postnatally) on mental health outcomes of children exposed to alcohol prenatally. Additionally, the study aims to investigate what/if clinical neurocognitive factors further explain the variance associated with mental health outcomes, given the high prevalence of neurocognitive difficulties in this population. Results demonstrate that although PAE frequently co-occurs with a variety of other prenatal factors, in our sample, PAE was the most significant predictor of mental health symptoms, as measured by the Kiddie Schedule for Affective Disorders and Schizophrenia – Present and Lifetime Version (KSADS-PL). Our findings also show that postnatal threat or deprivation occurring after two years of age significantly predicted executive dysfunction. A hierarchical multiple regression was run to determine if the addition of postnatal experiences and EF to PAE significantly predicted symptom count. It was found that postnatal risks and executive functioning abilities better explained total mental health symptom count than PAE alone. The research and practice

implications of the present study findings are discussed, in addition to strengths, limitations, and for future research directions.

DEDICATION

In loving memory of my favourite person in the world, Auntie Margaret.

Dedicated to the wonderful families that made this work possible.

Acknowledgements

My supervisor, Dr. Carly McMorris, for her continued support, encouragement, mentorship, and friendship. Thank you for being my role model to look up to, learn from, and be inspired by every day.

Dr. Catherine Lebel, Dr. Ben Gibbard, and Ms. Chris Tortorelli for their knowledge and expertise within the scope of our larger project.

My hard-working parents, Harold and Denise, whose selflessness in the pursuit of my passion has supported me both emotionally and financially. It would not have been possible to get this far without your love and encouragement.

My core classmate crew of Amanda, Andrea, Laura, and Andrew. Thank you for the unconditional love and laughter through our program and personal hardships.

Lastly, the families I have met with children of unique needs and talents, thanks for confirming my passion and path each and every day.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

Fetal alcohol spectrum disorder (FASD) is caused by prenatal exposure to alcohol (PAE). It is the leading cause of birth defects and developmental disabilities (Millar et al., 2017). The timing, frequency, and dosage of alcohol consumed in the prenatal period all contribute to the heterogeneous presentation of FASD. FASD is associated with deficits in daily living skills, motor skills, physical health, learning, memory, attention, communication, emotional regulation, mental health, and social skills (Harding, Flannigan, & McFarlane, 2019). These difficulties are often attributed solely to PAE, yet alcohol rarely occurs in isolation. That is, PAE often co-occurs with other substances, as well as environmental factors such as lack of prenatal care, poverty/malnutrition, or housing insecurity during the prenatal period (Lebel et al., 2019). Furthermore, environmental risk factors may be sustained in the postnatal environment, such that children may be exposed to various types of maltreatment including abuse (physical, sexual, and/or emotional), neglect, poverty, witness to domestic violence, and multiple caregiver transitions (Lebel et al., 2019; Mukherjee, Cook, Norgate, & Price, 2019). Taken together, it may be the accumulation of these prenatal and postnatal exposures that may better explain difficulties often seen in children with FASD, rather than PAE alone.

Prenatal and postnatal exposures can also vary in other factors including timing in the child's life, frequency, and chronicity of the risk factor. Risk factors occurring in isolation (i.e., PAE alone, or trauma alone) have been identified to result in developmental difficulties including mental health problems (Fergusson, Horwood, & Lynskey, 1998; Pei, Denys, Hughes, & Rasmussen, 2011). However, these exposures may have a cumulative impact on learning, behavioural, and mental health development. This study aims to be able to better explain mental health outcomes in children exposed to multiple early risks. In particular, using Lebel and

colleagues (2019) characterization tool, which considers various factors including dosage, timing, and frequency of many prenatal and postnatal exposures, this study will investigate whether other prenatal and postnatal exposures have effects on mental health beyond alcohol exposure. First, the proposed study aims to investigate the association between prenatal cumulative risk factors and mental health symptoms in a sample of children and youth exposed to alcohol prenatally. Second, it aims to investigate the association between postnatal cumulative risk factors and mental health symptoms. Third, it aims to investigate if clinical neurocognitive factors further explain the variance associated with mental health outcomes of children with PAE. Results from this will highlight the importance of considering multiple risk factors when treating children and youth exposed to alcohol prenatally.

The current study is separated into five chapters. Chapter one provides a general overview of the concepts to be addressed within the study. Chapter two offers a detailed overview of the existing literature and key concepts related to the current project, including FASD diagnosis, FASD clinical presentation, and cumulative risk, along with the current project's research questions and hypotheses. Chapter three outlines the methodology used to address the research questions. Chapter four describes the results. Finally, chapter five discusses the implications of the results alongside limitations of the study, future directions, and concluding comments.

Chapter 2: Literature Review

FASD is a lifelong disability caused by prenatal alcohol exposure (PAE). It is associated with birth defects, physical and developmental disabilities, and behavioural and mental health difficulties (Williams & Smith, 2015). The type and degree of fetal damage depends on the amount, frequency and timing of the exposures, alongside other factors such as genetics, nutrition, and other drug exposures (Ungerer, Knezovich, & Ramsay, 2013). According to the Diagnostic and Statistical Manual of Mental Disorders – Fifth Edition (DSM-5; American Psychiatric Association [APA], 2013), the diagnosis that results from the teratogenic effects of PAE on the fetus is fetal alcohol spectrum disorder (FASD). Approximately 4.3% of pregnant women report binge drinking within the past month (National Survey on Drug Use and Health, 2016). This is concerning as alcohol is a teratogen that can alter the development of the brain and organ systems of an embryo or fetus. When a woman consumes alcohol while pregnant, it is absorbed into her bloodstream, crosses into the placenta, and travels to the fetus via the placenta-umbilical transport (Burd, Roberts, Olson, & Odendaal, 2007; Paintner, Williams, & Burd, 2012). Therefore, the fetus and placenta have the same concentration of alcohol as the mother's blood (Burd et al., 2007; Paintner et al., 2012). Additionally, amniotic fluid can act as a reservoir for ethanol, increasing the duration of exposure for the fetus (Burd et al., 2007; Paintner et al., 2012). FASD is estimated to affect 2-5% of live births in North America (Cook et al., 2016; May et al., 2018; Popova, 2018), and is often noted as more frequent among special populations including Indigenous and First Nations populations, children in foster care, incarcerated populations, and those residing in residential care facilities for management of mental health concerns (Lange et al., 2017).

Fetal Alcohol Spectrum Disorder (FASD)

According to Canadian guidelines, a diagnosis of FASD requires a minimum of either two or more binge episodes (equates to four or more standard drinks in one sitting) or seven or more standard drinks in one week (one standard drink is 14 grams of ethanol) at some point during pregnancy (Cook et al., 2016). However, there is some evidence that PAE at lower levels (one to seven drinks/week) is also associated with brain alterations in children (Eckstrand et al., 2012; Wozniak et al., 2006). PAE causes damage to the brain such as an overall decrease in brain size, as well as specific damage to particular brain structures including the corpus callosum, ventricles, cerebellum, and more (Jones & Smith, 1973). The brain abnormalities associated with PAE are widespread, heterogeneous, and are maintained across the lifespan (Lebel, Roussotte, & Sowell, 2011). Additionally, FASD is associated with life-long disabilities in various areas such as cognitive functioning, physical impairments, learning disabilities, and behavioural challenges (Cook et al., 2016; Day, Helsel, Sonon, & Goldschmidt, 2013; Glass et al., 2013; Mattson et al., 2010; Riley, Infante, & Warren, 2011; Singal et al., 2017; Streissguth, 2007; Williams & Smith, 2015). Individuals with FASD may present with the three sentinel facial features, which include a smaller palpebral fissure, philtrum smoothness, and upper lip thinness, depending on severity of the alcohol exposure in utero (Cook et al., 2016). Individuals with a diagnosis of FASD based on facial features require: 1) a *palpebral fissure* length of ≥ 2 SDs below the mean (< third percentile); 2) a *philtrum* rated 4 or 5 on a 5-point scale on the University of Washington Lip–Philtrum Guide (Astley & Clarren, 2001); and 3) an *upper lip* rated 4 or 5 on 5-point scale of the University of Washington Lip–Philtrum Guide. Also, specific craniofacial and microcephaly, a thin upper vermilion border, and overall growth deficiencies are often present but not necessarily required for diagnosis (Clarren & Smith, 1978). However, physical abnormalities including

facial features are not present in all children with FASD, as some children do not display these characteristics, making FASD an "invisible disability" (Rasmussen, Andrew, Zwaigenbaum, & Tough, 2008). The brain dysfunction and impairment is commonly not visible to the outside world, resulting in no physical indicators of FASD. This hinders understanding of those with FASD and is a barrier for appropriate treatment. Furthermore, difficulties that are typically secondary to FASD, but are overwhelmingly prevalent, include problems at school, trouble with the law, mental health issues, and substance/alcohol abuse (Baer, Sampson, Barr, Connor, & Streissguth, 2003; Clarke & Gibbard, 2003; Streissguth, 2007).

History of FASD. The first identification of the adverse effects from PAE was based on findings from autopsy reports demonstrating a specific pattern of birth defects occurring in children of mothers who were alcohol-dependent, later denoted as fetal alcohol syndrome (FAS; Jones, Smith, Ulleland, & Streissguth, 1973). Similarly, at this time, children with a history of PAE who presented neurodevelopmental difficulties, but without the physical indicators, were classified as having fetal alcohol effects (FAE). The term partial fetal alcohol syndrome (pFAS) was then applied if some of the facial features were present along with neurodevelopmental difficulties, and PAE was confirmed (Chudley et al., 2005; Clarren and Smith, 1978; Sokol & Clarren, 1989; Stratton, Howe, and Battaglia, 1996). The effects of PAE were then recognized as occurring on a spectrum with fetal alcohol syndrome (FAS) and prenatal death at one end, and alcohol related neurodevelopmental disorders (ARND) with associated cognitive and neuropsychological deficits at the other (Mattson & Riley, 1998). Since the DSM-5 (APA, 2013) the term FASD has been used to include the broad spectrum of symptoms resulting from PAE.

Canadian guidelines for the diagnosis of FASD have been developed and disseminated in order to provide consistency in diagnosis across national centers (Cook et al., 2016). In 1996, the

Institute of Medicine brought together experts in the field to consider "Diagnosis, Epidemiology, Prevention and Treatment of Fetal Alcohol Syndrome" (Stratton, Howe, & Battaglia, 1996). This resulted in delineating and describing the four key features of alcohol exposure which included growth deficiency, facial features, brain dysfunction, and a recognition of the level of alcohol. Subsequently in 1997, Astley and Clarren developed the 4-Digit Code (Astley, 2004; Astley, 2010; Astley & Clarren, 2000), which provided an objective and quantitative approach to the four key features (growth, face, brain function, and alcohol exposure). A 4-point Likert scale was then used to rate the features as either normal or absent (level 1), unknown or mild (level 2), moderate or some risk (level 3), and a severe presentation of the feature or definite evidence of brain damage (level 4) (Astley, 2004; Astley, 2010). Since then, as further information on brain function in FASD has been acquired, the 4-Digit Code has been continually revised. The initial Canadian Guidelines for Diagnosis were published in 2005 following a consultative process with experts in the field of FASD (Chudley et al., 2005). A similar process was completed in the United States, with the corresponding guidelines being published in 2005 by the Centers of Disease Control (CDC; Bertrand et al., 2005).

Diagnosis of FASD. As outlined by the Canadian guidelines for FASD assessment and diagnosis across the lifespan, best practices in the diagnosis of FASD requires an assessment conducted by a multidisciplinary team, including a medical examination and a comprehensive neurodevelopmental assessment (Cook et al, 2016). The medical examination determines the presence of the sentinel facial features and the degree to which there is microcephaly (or smaller than normal head circumference), both integral aspects of the assessment. A neurodevelopmental assessment investigates the degree to which there is evidence of pervasive brain dysfunction, defined by severe impairment (≥ two SDs below the mean) in three or more of the following

neurodevelopmental domains: motor skills; neuroanatomy/neurophysiology; cognition; language; academic achievement; memory; attention; executive function (i.e., impulse control and hyperactivity); affect regulation; adaptive behaviour; and social skills or social communication (Cook et al., 2016). Each domain is affected differently in each individual, resulting in a heterogenous spectrum of abilities and challenges both within and between individuals.

A diagnosis of FASD may be made based on two sets of criteria: 1) FASD with sentinel facial features including the three sentinel facial features, PAE confirmed or unknown, and evidence of impairment in three or more neurodevelopmental domains (e.g., cognition, language, executive function), or, in infants and young children, evidence of microcephaly; or 2) FASD without sentinel facial features if there is evidence of impairment in three or more neurodevelopmental domains and confirmation of PAE, with the estimated dose at a level known to be associated with neurodevelopmental effects. Additionally, a diagnosis of FASD requires documentation confirming that the biological mother consumed alcohol during pregnancy, which must be based on reliable clinical observation, self-report, reports by a dependable source, medical records documenting positive blood alcohol concentrations, alcohol treatment, or other social, legal or medical problems related to drinking during the pregnancy. Importantly, confirmation of PAE is not required when the child displays all three facial features associated with alcohol exposure (Cook et al., 2016).

Further, the label of "at risk for neurodevelopmental disorder and FASD, associated with prenatal alcohol exposure" is a label that can be given when the full criteria for an FASD diagnosis is not met for some reason, often because the patient is too young, or the assessment is incomplete. It is given when the estimated alcohol dose is at a level known to be associated with

neurodevelopmental effects, but the central nervous system criteria (e.g., severe impairment in only present in two domains, such as motor skills and cognition) are not met.

Misdiagnosis of FASD. Many children and adolescents with FASD go unrecognized and subsequently go untreated, due to complexities in the heterogeneity of the disorder and difficulties with accurate diagnosis. An investigation in a sample of foster care children reported a misdiagnosis rate of FASD of 6.4%, and importantly, a missed diagnosis rate of 80.1% (Chasnoff, Wells, & King, 2015). Inaccuracies in diagnosis may be attributed to unknown maternal history of alcohol use during pregnancy (Astley, 2006; Benz, Rasmussen, & Andrew, 2009), lack of consistent facial dysmorphology and growth impairment across FASD (Astley, 2006; Bertrand, Floyd, & Weber, 2005; Sampson, Streissguth, Bookstein, & Barr, 2000), and the high rate of co-occurring mental health disorders (O'Connor & Paley, 2009). The overlap in clinical presentation of FASD with other neurodevelopmental disorders, such as attention-deficit/hyperactivity disorder (ADHD), limits accurate diagnosis of alcohol-affected children (Rasmussen et al., 2010). Misdiagnosis of FASD has a number of consequences, including implications for the pharmacologic and therapeutic approach to treatment, inaccurate incidence and prevalence estimates, and reduced power to detect a clinically meaningful difference between groups in clinical research studies (Astley & Clarren 2000; Chasnoff et al. 2015).

FASD service utilization. Given the complexities of diagnosis and heterogenous presentations of children with FASD, individuals often utilize a large number of services across the lifespan (Thanh & Jonsson, 2009). People with FASD often require various services including medical treatment, special education, justice, correctional, family, and community support services (Cook et al., 2016; Thanh & Jonsson, 2009). The full cost of FASD is difficult to assess; however, it is estimated that the yearly cost for a person with FASD is over $25,000

per year, with a lifetime cost of more than $1.8 million per individual, or over $9.7 billion annually in Canada (range: $7.7 billion to $12.8 billion) (Stade, Ungar, Stevens, Beven, & Koren, 2007; Stade et al., 2009; Thanh & Jonsson, 2009; Thanh & Jonsson, 2015; Thanh, Jonsson, Dennett, & Jacobs, 2010). Of these costs, health care accounts for 21% (range: 16% to 26%), education for 17% (range: 13% to 21%), social services for 13% (range: 10% to 17%), criminal justice for 40% (range: 25% to 55%), and others for 9% (range: 7% to 11%) (Thanh & Jonsson, 2015). Individuals with FASD often have complex presentations that require team members across their life to ensure effective and comprehensive care (Cook et al., 2016).

Clinical Presentation of FASD

Neurocognitive abilities

The presence, chronicity, and severity of symptoms seen in those with FASD differ depending on the amount of alcohol consumed by the mother, nutrition, maternal age, stage of gestation, etc., (May et al., 2013; Sulik, 2005); therefore, not all symptoms are present in every individual with FASD, and they often vary in their degree of severity (Astley, 2013). In a review by Mattson and colleagues (2011), they discussed how the neurobehavioural profile for children with FASD includes a variety of impairments in many areas such as overall intellectual disability, executive functioning (EF), memory, language, motor function, academic, adaptive skills, and social skills. In particular, children with FASD show difficulties on neuropsychological measures that involve more complex processing and demands on EFs including working memory, attention, and inhibitory control (Kodituwakku, 2009; Mattson et al., 2011). Researchers have also highlighted that behavioural and psychiatric issues are considered part of the neurobehavioural phenotype of FASD (Mattson, et al., 2011).

Cognitive ability. PAE can lead to a range impairments in different cognitive abilities, (Kodituwakku, 2009), yet these impairments do not appear to depend upon general intellectual functioning (Kerns, Audrey, Mateer, & Streissguth, 1997; Quattlebaum & O'Connor, 2012; Vaurio, Riley, & Mattson, 2011), as some individuals may show average intellectual abilities, yet significant problems with EF. Researchers have shown varying general intellectual abilities ranging between very low scores within the intellectually disabled range, to above average abilities in children and youth with FASD (Mattson & Riley, 1998; Mattson et al., 2011). For instance, intellectual disabilities are typically believed to be found to occur at rates of approximately one-third of the FASD population (Mattson et al., 1997; Rasmussen et al., 2010; Steinhausen et al., 1998) Given the cognitive range for children with FASD is quite broad, the variance means children with FASD may not meet criteria for special education services despite their challenges (Millar et al., 2017).

Executive functioning (EF). EF is a term used to describe a multitude of higher-order cognitive functions (Best & Miller, 2010; Diamond, 2013; Hosenbocus & Chahal, 2012), and refers to skills needed to prepare for and complete complex behaviours, such as goal-directed and task-oriented behaviours, self-regulation/behavioural inhibition, planning, working memory, mental flexibility, impulse control, and self-awareness (Best & Miller, 2010; Diamond, 2013; Hosenbocus & Chahal, 2012). These processes are implicated in several domains of daily living including academic achievement, adaptive ability, and social competence (Hosenbocus & Chahal, 2012). Executive dysfunction is frequently observed in neurodevelopmental disorders and is considered a hallmark deficit for children with FASD (Mattson et al., 2011). EF depends on processing in the frontal and prefrontal regions of the brain, the area often most severely affected by PAE (Fuglestad et al., 2015).

Despite EF being considered a core deficit in FASD, there is little agreement among researchers regarding which domains are most impaired (Aragon et al., 2008; Kodituwakku, 2009; Rasmussen, 2005). In their recent meta-analysis, Kingdon, Cardoso and McGrath (2016), found that the strongest and most consistent EF deficits were obtained on neuropsychological measures of planning, set shifting, fluency, and working memory. Additionally, school-age children and adolescents with FASD often demonstrate EF impairments across measures of cognitive flexibility, selective inhibition, planning ability, concept formation, and reasoning (Fuglestad et al., 2015; Rasmussen & Bisanz, 2009). Given the differences in dosage, chronicity, and timing of alcohol exposure, EFs are understandably variably affected.

One of the most problematic aspects of individuals with FASD EF dysfunction is arguably their difficulty with self-regulation (e.g., controlling ones behaviours, emotions, and thoughts), and their inability to stay alert and focused, control impulses, and regulate their emotions (Kodituwakku, Handmaker, Cutler, Weathersby, & Handmaker, 1995). Many studies have demonstrated that PAE impacts brain regions that support self-regulation and efficient EF (Fryer et al., 2007; Gautam, Nunez, Narr, Kan, & Sowell, 2014; Kable, Taddeo, Strickland, & Coles, 2016; Roussotte et al., 2012). Understanding the pattern and magnitude of EF deficits may facilitate the development of therapeutic interventions specific to FASD. For instance, given the likelihood of EF and self-regulation difficulties in children with FASD, a therapeutic approach targeting these skills may be beneficial (Soh et al., 2015).

Learning and verbal memory. Children with FASD have both memory and learning difficulties. Learning requires multiple cognitive processes such as controlled attention, EF, and memory. Impairments in working memory processes have been shown to interfere with other abilities in children with FASD (i.e., learning; Rasmussen & Bisanz, 2011), and likely have

implications for the development of other executive control and attention skills (Burden, Jacobson, Sokol, & Jacobson, 2005; Kodituwakku, 2007).

Research on memory and learning in children with FASD has been variable, as there has been disagreement between researchers and clinicians on a consistent neurocognitive and behavioural phenotype. Specifically, it has been hypothesized that memory deficits may be found primarily in the process of encoding or manipulating information in short-term memory, rather than with long-term storage of information (Mattson & Roebuck, 2002; Pei, Rinaldi, Rasmussen, Massey, & Massey, 2008). For example, children with FASD have shown difficulties on the California Verbal Learning Test for Children (CVLT-C), a standardized assessment measure used to determine verbal learning and memory (Mattson et al., 2011). In particular, children with FASD learn fewer words than children not exposed to alcohol, even after repeated exposure to the words (Crocker, Vaurio, Riley, & Mattson, 2011; Mattson et al., 1996).

Mental health disorders in children with FASD

A mental health disorder can be best described as a psychiatric condition (behavioural or psychological) marked by significant distress or impairment in daily functioning (APA, 2013). Childhood mental health disorders are often classified into *externalizing* and *internalizing* disorders or symptoms (Achenbach, 1982). Internalizing behaviours can be defined as a way of adapting to an environment that causes internal stress, and includes anxious, withdrawn, and depressed behavior. Externalizing behaviours can be defined as acting outwardly in a manner that causes conflict with others and may include aggressive and rule-breaking behavior (Achenbach & Edelbrock, 1978). In the general population, prevalence rates for different disorders or symptoms of disorder vary across ages, with externalizing behavior problems more

commonly diagnosed in earlier childhood, and internalizing behavior problems more commonly identified in later childhood (Miller & Votruba-Drzal, 2016).

Beyond the primary cognitive and behavioural deficits commonly seen in individuals with FASD, over 90% of individuals with FASD experience a co-occurring mental health disorder (Kodituwakku, 2007; May et al., 2014; Pei, Denys, Hughes, & Rasmussen, 2011) compared to 20% of the general population (Smetanin, Briante, Stiff, Ahmad, & Khan, 2015). Individuals with FASD are at risk for experiencing a range of different mental health disorders, including both internalizing and externalizing conditions (Pei et al., 2011). With the neurocognitive problems associated with PAE, it is easy to see how psychological dysfunction and mental health disorders are over represented in this population (O'Connor & Paley, 2009; O'Connor, 2014). However, given the heterogeneity of FASD, it is difficult to predict the individual mental health trajectories of individuals with FASD. Factors that can impact the mental health trajectories of individuals with FASD include genetic and epigenetic phenomena, exposure to other teratogens prenatally, environmental stressors, socioeconomic status, and problems in parenting (O'Connor, 2014). Additionally, mental health symptoms tend to persist or worsen with age in individuals with FASD (Spohr, Willms, & Steinhausen, 1993; Steinhausen & Spohr, 1998), highlighting the importance of effective intervention for these individuals.

Internalizing disorders in FASD. Children and adolescents with FASD experience more internalizing disorders than the general population; however, internalizing disorders are often more difficult to recognize than externalizing disorders in both the general and FASD population (Fryer et al., 2007; Pei et al., 2011). In a study of inpatient and outpatient children with histories of heavy PAE, it was found that 87% were diagnosed with a mental health disorder, 61% of which were mood disorders (O'Connor et al., 2002). Depression is quite

common, affecting approximately 45-50% of individuals with FASD, whereas anxiety affects approximately 20-40% of individuals with FASD (Denys, Rasmussen, & Henneveld, 2011; Fagerlund, Autti-Rämö, Hoyme, Mattson, & Korkman, 2011; Famy, Streissguth, & Unis, 1998). PAE has been found to be an independent predictor of anxiety symptoms even after controlling for home placement with a related or non-related caregiver (Walthall, O'Connor, & Paley, 2008). Further, these anxiety problems persisted across the lifespan, and often presented in high levels of phobic anxiety in adults with PAE (Walthall, O'Connor, & Paley, 2008). In their recent meta-analysis, Khoury, Jamieson, and Milligan (2018) found that the strength of the association between PAE and internalizing behaviour problems was greater with increased age.

Externalizing disorders in FASD. Externalizing psychopathology can include ADHD, Conduct Disorder (CD), and Oppositional Defiant Disorder (ODD). Compared to internalizing disorders, externalizing disorders are more often reported as over-represented within the FASD population (Khoury et al., 2018). The relationship between PAE and externalizing disorders or behaviour problems has been well documented (e.g., Franklin, Deitz, Jirikowic, & Astley, 2008; Nash et al., 2006). For instance, Mattson and Riley (2000) found that 91% of children with histories of heavy PAE, compared to 27% of non-exposed controls, had clinically significant externalizing behaviour problems. As for rates of externalizing disorders, Fryer and colleagues (2007) found that 95% of their alcohol-exposed group had ADHD as compared to 30% of their control group. CD has been found to occur in as many as 53% of individuals with FASD, compared to 7% of the typically developing control group (Schonfeld, Mattson, & Riley, 2005). Severity of PAE, socioeconomic status, and family living environment have been found to moderate the relationship between PAE and externalizing behaviour (Khoury et al., 2018).

Associated difficulties with FASD mental health problems. The presence of internalizing and/or externalizing problems often results in an increased likelihood of secondary or associated difficulties, including suicide. In a recent investigation by O'Connor and colleagues (2019), they found that 35.2% of teens with FASD had considered suicide in the last 12 months. Further, teens with FASD were almost five and a half times more likely to make a serious suicide attempt compared to other teens of their chronological age. Alarmingly, males with FASD were at a 19½ times higher risk of serious suicide attempts compared to typically developing teens (O'Connor et al., 2019). Additionally, they found that the higher the psychosocial stressors (i.e., number of home placements), the more likely the adolescents were to experience suicidal ideation. Individual characteristics also compound to increase suicidal ideation/attempts, and include deficits in decision-making and problem-solving, problems in self-regulation, EF deficits, social skills difficulties resulting in isolation, and mood or conduct disorders (Bridge et al., 2012; Kable et al., 2016; O'Connor, 2014). Further, difficulties in understanding cause and effect, decision-making, learning from past experiences, and issues with impulsivity may result in problems at school and/or employment, substance use, and trouble with the law (Flannigan, Pei, Stewart, & Johnson, 2018; Streissguth et al., 2004). Academic failure (Millians, 2015), encounters with the criminal justice system (McLachlan, 2012), drug and alcohol use (Totten, 2010), social skill deficits and social isolation (O'Connor et al., 2006), are associated with mental health problems.

The heterogeneity of symptoms of FASD and any co-occurring mental health disorder make the process of screening, assessing, diagnosing, and treating FASD very complex. This often leads to missed diagnosis, and misdiagnosis of the mental health disorder (Benz, Rasmussen, & Andrew, 2009; Clarren & Lutke, 2008; Morleo et al., 2011), resulting in those

with FASD being less likely to receive the treatment and services that they need.

Cumulative Risk

Developmental risk research initially focused on singular risk factors known or suspected to increase the probability of adverse child outcomes (Felliti et al., 1998; Rutter, 1979, 1981). The widespread use of multiple risk factor metrics in developmental psychology today is related to the robust finding that multiple rather than single risk exposures have worse developmental consequences (Rutter, 1979, 1981; Sameroff, Seifer, & McDonough, 2004; Sameroff, 2006). Research on cumulative risk is rooted in Rutter's (1979) accumulation of risk model that focused on quantity of risk and posited that the number of risk factors compound to lead to maladaptive outcomes. Douglas (1975) found that the number of times a child was separated from their parents due to hospitalization prior to 5 years of age predicted a variety of adolescent outcomes—troubled behavior, reading deficits, delinquency, and frequent job changes. Among the most intensively studied singular risk factors in the child development literature are insecure attachment, divorce, institutionalization, war, racial prejudice, and parental psychopathology (Evans, Li, & Whipple, 2013).

Early adversity is commonly operationalized in research as an adverse childhood experiences (ACEs) score (Felitti et al., 1998). Felliti and colleagues (1998) found that adults who completed a survey about their exposure to childhood abuse and household dysfunction showed a strong graded relationship between multiple categories of exposures and adult risk behaviours and disease. As adverse exposures increased, adult health problems increased (Felliti et al., 1998), leading to a "cumulative" or dose-dependent effect of adverse experiences. While calculation of ACEs scores can vary slightly across studies, all provide a cumulative risk score that accounts for experiences such as abuse, neglect, and other types of household dysfunction

during childhood. Therefore, multiple instances of maltreatment will lead to worse outcomes than a single exposure. In the general population, ACEs are associated with increased risks of internalizing disorders (Chapman et al., 2004).

Most studies investigating the accumulation of risk model focus on the creation of a cumulative risk index, such that risk factors are summed across multiple levels. These indexes have examined the nature of the relationship between the number of risk factors an individual is exposed to and a variety of outcomes across the lifespan. Prior studies have focused primarily on Sameroff, Seifer, Baldwin, and Baldwin's (1993) additive model, in which a linear change in outcome is proposed: the higher one's cumulative risk score, the more likely he or she is to demonstrate maladaptive outcomes. However, contrasting this additive model are models that suggest a threshold effect. The threshold effect proposes that there is little difference in outcomes before a certain cumulative risk score is reached, but after this threshold, there is a significant increase in maladaptive outcomes, indicating a quadratic relationship (Appleyard, Egeland, van Dulman, & Sroufe, 2005; Rutter, 1979); or that there is a threshold beyond which there is a plateau, or levelling off, for the outcome in question (Morales & Guerra, 2006). Various statistical approaches have been utilized to determine the relationship between risk factors and outcomes. For instance, a multiple regression analysis is the most commonly used technique to make predictions or determine if relationships are present, from the individual risk factors to various outcomes (Burchinal, Roberts, Hooper, & Zeisel, 2000). The multiple regression approach determines to what degree each risk factor contributes to the outcome independently and together. Although this approach comes with many benefits, it can be problematic when the risk factors are correlated with each other or if the sample size is small (Burchinal et al., 2000). Further, previous research has tested cumulative risk theories utilizing a total cumulative risk

index, as risk factors are typically scored dichotomously (0 if absent, 1 if present), and then summed, thus yielding an overall index score which is typically out of a total possible score (Evans, 2003; Kim & Brody, 2005; Rutter, 1993; Sameroff, 1989; Werner & Smith, 1982; Wilson, 1987). When factors are created, factor scores can be used in a regression in relation to the outcomes, although information within each risk factor is lost when factor scores are created. Lastly, correlations can be conducted between risk factors and outcomes (Burchinal et al., 2000).

These cumulative risk models have been tested in both cross-sectional and longitudinal research studies. Some cross-sectional studies have identified linear relationships between childhood cumulative risk and concurrent internalizing and externalizing disorders (e.g., Atzaba-Poria, Pike, & Deater-Deckard, 2004; Gerard & Beuhler, 2004), psychiatric disorders (e.g., Raviv et al., 2010; Rutter, 1979), distress symptoms (e.g., psychophysiological stress, delayed gratification, and perceptions of self-worth; Evans & English, 2002; Finkelhor, Shattuck, Turner, & Hamby, 2012), and academic problems (e.g., Forehand, Biggar, & Kotchick, 1998). Some longitudinal studies have identified linear relationships between childhood cumulative risk and adolescent outcomes including internalizing and externalizing symptoms (e.g., Appleyard et al., 2005), academic problems (e.g., Forehand et al., 1998; Sameroff, 2000), and self-competence (Sameroff et al., 1998).

Given that different experiences/exposures at different times may be etiologically linked to functional difficulties in children exposed to prenatal alcohol, it is crucial to investigate which adversities may explain the variance in children (Lebel et al., 2019). In general, cumulative risk models provide a framework to adjudicate and characterize risk factors and assist in diagnostic decision-making. Therefore, a framework such as this can guide expectations for developmental trajectory or prognosis, intervention, and prevention (Evans, Li, & Whipple, 2013). Literature

highlights the importance of utilizing information from prenatal and postnatal periods when looking at an individual's exposure profile (Lebel et al., 2019).

Recently, as part of our larger investigation into mental health and brain abnormalities in children with multiple early risks, we have suggested a preliminary characterization of prenatal and postnatal adverse exposures to study whether other prenatal and postnatal exposures have differential effects beyond PAE (Lebel et al., 2019). Through collaboration with experts in diagnosis, assessment, child welfare, child development and psychopathology, and neuroscience, we created an adverse exposure framework to establish prenatal and postnatal adverse exposures. The framework is a hybrid cumulative risk/dimensional model that builds on the four-digit code for diagnosing FASD (Astley, 2004). Using a Likert-type scale from 1 to 4 similar to the four-digit code, this framework ranks exposures in seven categories (i.e., dimensions of risk): PAE, other prenatal substance exposure, other prenatal toxic stress, early postnatal threat (<age 24 months), early postnatal deprivation (<age 24 months), late postnatal threat (≥age 24 months), and late postnatal deprivation (≥age 24 months). A rank of "1" indicates a confirmed absence, "2" indicates unknown, "3" indicates some/moderate risk, and "4" indicates high risk. Refer to Table 1 to see the complete characterization tool. The result of the characterization tool is a seven digit 'code' corresponding to each of the categories that delineates their level of risk per category.

Table 1

Lebel et al. 2019 Exposure Definitions and Criteria for Scores

Exposure type	Description	Rank 3	Rank 4
Prenatal alcohol exposure	Consumption of any form of alcohol during pregnancy	Exposure to prenatal alcohol not meeting criteria for a score of 4 or confirmed exposure of unknown amount	High exposure of ≥7 drinks/week or ≥ 2 binge episodes (≥4 drinks on one

			occasion) at some point in pregnancy
Other prenatal substance exposure	Exposure to harmful substances including marijuana, nicotine, cocaine, methamphetamines, and opioids during pregnancy.	Exposure to nicotine or marijuana of any amount; low frequency use of other substances, or confirmed use of unknown amount	High frequency use (≥5 times in pregnancy) of an illicit substance (cocaine, methamphetamines, opioids, etc.)
Other prenatal toxic stress	Harm or threat of harm to the mother and fetus during pregnancy; lack of prenatal care, housing, food, or income to meet needs; maternal mental health problems.	Symptoms of a mental health problem (undiagnosed), lack of prenatal care, housing/food/income insecurity <3 months, OR a single instance of domestic violence or sex trade work	DSM 5 diagnosis of mental health disorder, domestic violence or sex trade work at least twice during pregnancy, housing/food/income insecurity ≥3 months, or multiple exposures
Early postnatal deprivation (<24 months)	The basic needs of the child not being met or a risk of needs not being met, including attachment needs.	One care transition (excluding from hospital), housing/food/income insecurity, or loss of caregiver (e.g., death, incarceration)	Multiple care transitions (≥2), neglect, or multiple exposures
Late postnatal deprivation (≥24 months)	Same as above	Same as above	Same as above
Early postnatal threat (<24 months)	Harm or threat of harm, including physical, emotional, sexual abuse; or witnessing violence, substance abuse, or criminal activity in the home.	Witnessing substance use or domestic violence, caregiver with mental illness	Abuse of any kind, or multiple exposures

Late postnatal threat (≥24 months)	Same as above	Same as above	Same as above

Note. Adverse exposures were assessed on a Likert-type scale from 1 to 4. Specific criteria for Ranks 3 and 4 are shown below for each variable. Criteria for Ranks 1 and 2 are not shown, as they were the same for all variables. Scores of 1 represent a confirmed absence of any exposure, whereas 2 represents unknown exposure (generally due to insufficient information).

FASD Etiology

Prenatal Exposures: Exposure to Other Substances

Substance use among pregnant women is estimated to be 6.3% (National Survey on Drug Use and Health, 2016), and is more common among women who also use alcohol. Research on prenatal exposure to drugs has lagged behind research on PAE, although prenatal exposure to drugs may affect the fetus in a similar way. It is estimated that 10.6% of pregnant women aged 15–44 continue to use cigarettes or other tobacco products throughout the pregnancy (National Survey on Drug Use and Health, 2016), which is associated with outcomes including low birth weight, smaller head circumference and stillbirths (Hamułka, Zielińska, & Chądzyńska, 2018; Himes, Stroud, Scheidweiler, Niaura, & Huestis, 2013; Kharkova, Grjibovski, Krettek, Nieboer, & Odland, 2017; Salihu & Wilson, 2007).

One of the most common substances used during pregnancy is marijuana, and it is estimated that approximately 6.3% of pregnant women have used marijuana during the previous month (National Survey on Drug Use and Health, 2016). With the legalization of marijuana, it has led to a decreased perception of associated risks of marijuana use (Stickrath, 2019). Prenatal marijuana exposure may be associated with low birthweight, small for gestational age, APGAR scores, and NICU admission, although research has been mixed (Conner, Carter, Tuuli, MacOnes, & Cahill, 2015; Dotters-Katz, Smid, Manuck, & Metz, 2017; Fergusson, Horwood, & Northstone, 2002; Gunn, Rosales, Nuñez, Gibson, & Christ, 2016; Janisse, Bailey, Ager, &

Sokol, 2014; Leemaqz et al., 2016; Mark, Desai, & Terplan, 2016; Schempf & Strobino, 2008; Warshak et al., 2015).

Less than 1% of pregnant women report using cocaine in the past month (National Survey on Drug Use and Health, 2016). Cocaine increases the risk of preterm birth as well as fetal growth restriction such as decreased birth weight, birth length, and head circumference (Bada et al., 2002; dos Santos et al., 2018; Gouin, Murphy, & Shah, 2011). Mild symptoms such as poor muscle tone and reflexes, increased irritability and jitteriness, as well as poor state regulation have also been reported in infants shortly after birth (Singer, Arendt, Minnes, Farkas, & Salvator, 2000). Approximately 0.3% of pregnant women report using methamphetamines (National Survey on Drug Use and Health, 2016). It is estimated that 1.2% of women use opioids during their pregnancy (National Survey on Drug Use and Health, 2016), which includes both illicit drugs (e.g., morphine, heroin, fentanyl) and opioid pharmacotherapies (e.g., methadone, buprenorphine) prescribed for opioid use disorders. Overall, previous research has found that externalizing behaviours and risk of mental health problems is increased in children with prenatal substance exposure, including cocaine, methamphetamine, marijuana, opioids, and nicotine (Behnke & Smith, 2013; Minnes, Lang, & Singer, 2011).

Prenatal Exposures: Toxic stress

Mental health problems affect many pregnant women and occur even more frequently in women with substance use disorders (Blankley, Galbally, Snellen, Power, & Lewis, 2015). The most common conditions are depression and anxiety, with approximately 18% and 16% of women experiencing clinically significant symptoms of anxiety or depression, respectively, during pregnancy (Bennett, Einarson, Taddio, Koren, & Einarson, 2004; Gavin et al., 2005; Ross & McLean, 2006; Rubertsson, Hellström, Cross, & Sydsjö, 2014). Other mental illnesses,

including, schizophrenia, bipolar disorder, and personality disorders, have not been studied as extensively as maternal depression and anxiety (Lewis, Austin, Knapp, Vaiano, & Galbally, 2015); however, are still known to be associated with pregnancy and birth related complications (De Genna, Feske, Larkby, Angiolieri, & Gold, 2012; Pare-Miron, Czuzoj-Shulman, Oddy, Spence, & Abenhaim, 2016; Rusner, Berg, & Begley, 2016; Zhao, McCauley, & Sheeran, 2017). Especially in combination with substance use, women with a mental health disorder may be more likely to receive insufficient or inconsistent prenatal care which can perpetuate the risk of adverse perinatal outcomes (Friedman, Heneghan, & Rosenthal, 2009).

Women using substances during pregnancy are more likely to be younger, have lower levels of education, be unemployed and/or have a lower household income, be single, have a partner that uses substances, or have legal altercations (Cannon, Dominique, O'Leary, Sniezek, & Floyd, 2012; Derauf et al., 2007; el Marroun et al., 2008; Goel, Beasley, Rajkumar, & Banerjee, 2011; Pare-Miron et al., 2016; Van Gelder et al., 2010). The accumulation of these risk factors can perpetuate adverse mental health symptoms experienced by women or increase levels of stress during pregnancy (Mulder et al., 2002), which impacts child outcomes (Talge, Neal, & Glover, 2007). For example, housing insecurity has been associated with a greater likelihood of preterm births and low birth weight (Cutts et al., 2015).

Postnatal Risks

The majority of individuals with PAE have other negative prenatal or postnatal exposures that may impact their developmental and/or mental health profile (Astley, 2010; Astley, Bailey, Talbot, & Clarren, 2000; Koponena, Kalland, & Autti-Rämöc, 2009). Serious postnatal risks (e.g., abuse, neglect) are present in approximately 43% of children with FASD (Astley, 2010). Childhood experiences have critical implications for childhood mental health, as these

experiences can have both positive and/or negative effects on child development and outcomes. For instance, children living in foster or residential care are at greater risk for behavioural problems and mental health disorders (Bos et al., 2011), poor attachment or attachment disorders (Rutter, Kreppner, & Sonuga-Barke, 2009), and other adverse experiences such as poor academic performance and trouble with the law (Vinnerljung & Sallnas, 2008). Postnatal adversities have variable effects depending on the timing and duration of exposure, but generally are associated with increased behavioral problems, increased risk of substance use, and mental health disorders (Heim, Shugart, Craighead, & Nemeroff, 2010).

Threat and deprivation have been hypothesized as two core dimensions that tend to have unique effects on emotional and cognitive development (McLaughlin et al., 2014; Sheridan & Mclaughlin, 2014), and recent research evidence supports this distinction (Dennison et al., 2019; Sheridan et al., 2017). Threat involves harm or threat of harm, including physical, sexual, and emotional abuse, and exposure to violence (McLaughlin & Sheridan, 2016). Whereas deprivation represents limited quantity and complexity of cognitive inputs and learning opportunities, including poverty, institutionalization, and neglect (McLaughlin & Sheridan, 2016). Threat is suggested to influence emotional processing, whereas deprivation may be more likely to influence cognitive facets (McLaughin & Sheridan, 2016). Further, evidence shows differential effects of maltreatment in the early postnatal period (i.e., < two years) versus later childhood (≥ two years) on outcomes across multiple domains including cognition, academic, neuropsychological, and mental health (Humphreys, Nelson, Fox, & Zeanah, 2017; Kaplow & Widom, 2007; Sheridan, Fox, Zeanah, McLaughlin, & Nelson, 2012; Smyke, Zeanah, Fox, Nelson, & Guthrie, 2010).

Deprivation. Deprivation, or neglect, is characterized by the failure to provide a child's

basic necessities for proper physical, emotional, and cognitive growth. This can include many factors but is typically defined as a lack of proper food, clothing, and housing along with no safety/protection, emotional deprivation, and/or unresponsive caregiving or a lack of stimulation (Infurna et al., 2016; Keeshin & Dubowitz, 2013). Neglect can result in disordered attachment and increased stress reactivity at a young age (Drury et al., 2012; McGoron et al., 2012; O'Connor & Rutter, 2000). Greater severity and duration of neglect often correlates with worse outcomes (Loman et al., 2013; Rutter et al., 2007; Sonuga-Barke et al., 2017). For example, institutionalization represents an extreme form of neglect where children are globally deprived (such as the experience of children who lived in Romanian orphanages), and it has been found that children in globally depriving institutions, as opposed to only psychosocially depriving institutions, had poorer outcomes (Merz & McCall, 2010; Iftene & Roberts, 2004). Similarly, when children enter foster care or get adopted at a younger, it tends to be a protective factor that mitigates some of the impact of early neglect (Sheridan, Fox, Zeanah, McLaughlin, & Nelson, 2012).

Poverty represents a form of human deprivation, which is often linked with low levels of stimulation, poor housing and nutrition, high levels of stress, and inability to meet the needs of a child (Hughes & Tucker, 2018; Laraia, Siega-Riz, Gundersen, & Dole, 2006; Luby et al., 2013). Deprivation may also occur in the form of separation from parents through mental or physical illness, death, incarceration, or placement in a different home (i.e., foster care). While removal of a child from biological parents may be necessary, caregiving transitions are difficult for children and represent their own risk for altered development. Multiple caregiver changes are related to an increase in externalizing behaviors in children who were prenatally exposed to drugs, in a dose-dependent manner (Newton, Litrownik, & Landsverk, 2000; Perry & Price, 2017). Foster

care placement instability has also been shown to be associated with internalizing symptoms (Newton et al., 2000). Younger age at entry into the foster care system has also been deemed protective in the context of children's mental health (Tarren-Sweeney, 2008).

The 2012 National Child Abuse and Neglect Data System indicated that 78% of all maltreatment reports are for neglect allegations, defined as an omission of care due to failure to provide basic needs or lack of adequate supervision (O'Hara et al., 2015). O'Hara and colleagues (2015) investigated a cohort of children in the LONGSCAN study that had been either neglected alone or neglected and physically abused and found that children who were only neglected had poorer cognitive outcomes than children who were neglected and physically abused. Forms of deprivation frequently co-occur with other forms of child maltreatment.

Threat. Abuse or threat may be physical, emotional, or sexual, and many children will experience more than one type (Al Odhayani, Watson, & Watson, 2013; Cecil, Viding, Barker, Guiney, & McCrory, 2014; Felitti et al., 1998; Hornor, 2012). Threat has been associated with impairments in learning, memory, and attention (Beers & De Bellis, 2002; Edalati & Krank, 2016; Schalinski, Teicher, Carolus, & Rockstroh, 2018), along with mental health disorders such as post-traumatic stress disorder (PTSD; Daigre et al., 2015; Humphreys & Zeanah, 2015; Jaffee, 2017) and disrupted fear conditioning and threat-safety discrimination (McLaughlin et al., 2016).

Physical abuse is often associated with internalizing symptoms, such as depression (Skinner et al., 2016), and even more so with externalizing behaviors (Dykman et al., 1997; Moylan et al., 2010; van der Put, Lanctôt, de Ruiter, & van Vugt, 2015). Less cognitive flexibility and some degree of language impairments have also been associated with physical abuse (McFadyen & Kitson, 1996; Spann et al., 2012). Emotional abuse can be defined as persistent disregard of a child's emotional and psychological needs (Maguire et al., 2015). Due

to the nature of emotional abuse, it may be underestimated. However, when confirmed, emotional abuse has been strongly associated with internalizing symptoms such as anxiety, depression, low self-esteem, and suicidality (Cecil et al., 2017; Cui, Ji, & Liu, 2018; Maguire et al., 2015; Shin, Lee, Jeon, & Wills, 2015; Van Harmelen et al., 2010). Sexual abuse is associated with a greater risk of substance use, as well as earlier initiation of and higher-risk sexual behaviors (Skinner et al., 2016; van der Put et al., 2015). Anxiety and depression are also frequently reported in individuals that have been sexually abused (Coles, Lee, Taft, Mazza, & Loxton, 2015; Skinner et al., 2016; van der Put et al., 2015). Childhood sexual abuse has also been associated with memory impairments, with greater duration of abuse correlating with lower scores on memory tasks (Navalta, Polcari, Webster, & Ani Boghossian Martin Teicher, 2006).

Exposure to violence in one's home and community is associated numerous adverse outcomes, including an increased in the risk of post-traumatic stress disorder (Silva et al., 2000). Furthermore, direct abuse and witnessing violent behavior is considered doubly disadvantageous (Cecil et al., 2014; Moylan et al., 2010). An increase in externalizing symptoms including specific challenges such as self-control problems, aggression, and an increase in problem behaviours have been associated with exposure to violence (Barthelemy et al., 2016; Conners-Burrow et al., 2013; Evans, Davies, & DiLillo, 2008; Fleckman, Drury, Taylor, & Theall, 2016; Grasso, Ford, & Briggs-Gowan, 2012; Peltonen, Ellonen, Larsen, & Helweg-Larsen, 2010; Litrownik, Newton, Hunter, English, & Everson, 2003). Internalizing symptoms have also been reported along with mental health problems continuing into adolescence and adulthood (Evans et al., 2008; Franzese, Covey, Tucker, McCoy, & Menard, 2014; Grasso et al., 2012; Peltonen et al., 2010; Logan-Greene, Nurius, Hooven, & Thompson, 2013; Moylan et al., 2010; Nicodimos, Gelaye, Williams, & Berhane, 2009). Some research has demonstrated cognitive deficits

associated with witnessing violence (Koenen, Moffitt, Caspi, Taylor, & Purcell, 2003; Samuelson, Krueger, Burnett, & Wilson, 2010).

Concurrently, approximately 2-9% of women are exposed to domestic violence during pregnancy (Alhusen, Ray, Sharps, & Bullock, 2015; Finnbogadóttir, Dykes, & Wann-Hansson, 2016). This has been associated with an increased likelihood of adverse outcomes related to pregnancy and birth such as preterm delivery, small for gestational age, low birth weight, and greater risk of perinatal death (Alhusen et al., 2015; Rodrigues, Rocha, & Barros, 2008; Taillieu & Brownridge, 2010). Moreover, exposure to domestic violence may increase symptoms of depression, and use of substances in order to cope (Alhusen et al., 2015; Finnbogadóttir et al., 2016; Taillieu & Brownridge, 2010).

Literature investigating the outcomes of children that have experienced early child maltreatment typically lumps all types of maltreatment and compares outcomes to children who have not experiences any type of maltreatment, yet, types of maltreatment (i.e., neglect, physical abuse, and sexual abuse) impose different traumatic experiences, with different effects on the developing brain and resultant differences in cognitive and behavioral development (Egeland, Sroufe, & Erickson, 1983; Pears, Kim, & Fisher, 2008; Trickett and McBride-Chang, 1995). Therefore, evidence is accumulating that highlights the importance of assessing the child's specific maltreatment trajectory (Font & Berger, 2015; Green et al., 2018; Vasileva, & Petermann, 2018).

Cumulative risk, neurocognitive factors, and mental health in children with PAE

Cumulative risk. A history of either PAE or maltreatment has the potential to cause deficits in cognitive, social, and behavioural domains, but the interaction of both exposures has been largely neglected in the literature (Lebel et al., 2019; Price, Cook, Norgate, & Mukherjee,

2017). Adversities frequently co-occur, influencing outcomes both individually and cumulatively by adding up or interacting with one another (Cecil, Viding, Fearon, Glaser, & McCrory, 2017; Dufford & Kim, 2017; Evans et al., 2013; Fratto, 2016; Horan & Widom, 2015; Kerker et al., 2015; McLaughlin & Sheridan, 2016; Oliver, Kretschmer, & Maughan, 2014; Raviv, Taussig, Culhane, & Garrido, 2010). An increase in the number of adversities, their duration and their severity, especially in the absence of protective factors, is associated with mental health issues (e.g., externalizing and internalizing symptoms) and physical health issues across ages (e.g., sleep disturbances, cardiovascular and respiratory illnesses, poor immune, reproductive and endocrine function, shorter lifespans) (Felitti & Anda, 2010; Kerker et al., 2015; Pechtel & Pizzagalli, 2011).

It is possible that a compounding relationship exists where children born following alcohol exposure are more vulnerable to the effects of other exposures, leading to more likely or more severe deficits across domains than expected following a single exposure (Price, Cook, Norgate, & Mukherjee, 2017). In a recent systematic review, Price and colleagues (2017) found that when PAE occurred with traumatic childhood experiences, these two exposures compounded to result in a higher risk of difficulties in speech, language comprehension, intelligence, attention, memory, and a range of emotional and behavioural issues compared to either PAE or trauma alone. Conversely, Mukherjee and colleagues (2019) found that that PAE had a significant impact on neurodevelopmental outcomes (ADHD or autism spectrum disorder), and adaptive and sensory profiles, independent of neglect. The authors concluded that neglect did not appear to have any additional impact on the neurodevelopmental outcomes of children and youth with FASD. Although various studies exist examining cumulative risk in relation to neurocognitive outcomes and physical health outcomes (e.g., Anda et al., 2006; Felitti et al.,

1998; Guinosso, Johnson, & Riley, 2016), research has yet to identify cumulative risk in relation to various mental health outcomes in children.

Mental health in the general population. Various neurocognitive deficits have been implicated in mental health disorders in the general population. For instance, deficits in cognitive functioning, including impairment in memory and executive functioning, are suggested to be core features in internalizing disorders, such as depression (Dannehl, Rief, & Euteneuer, 2019; Lee, Hermens, Porter, & Redoblado-Hodge, 2012), suggesting they are a mechanism for the development and maintenance of mental health disorders. Similarly, cognitive impairment has also been implicated in bipolar disorder (Douglas & Porter, 2009; Douglas et al., 2018; Porter, Bourke, & Gallagher, 2007; Robinson et al., 2006; Porter, Robinson, Malhi, & Gallagher, 2015). Deficits in the encoding, consolidation, and/or retrieval of positive memories play a role in the symptomatology of posttraumatic stress disorder (PTSD) (Brewin & Holmes, 2003; McNally, Lasko, Macklin, & Pitman, 1995; Schönfeld & Ehlers, 2017; Contractor, Banducci, Dolan, Keegan, & Weiss, 2019). Meta-analyses have indicated higher levels of depression among children and adolescents with learning difficulties (Maag & Reid, 2006; Nelson & Harwood, 2011b) and anxiety (Nelson & Harwood, 2011a).

Mental health and FASD. Given the complex presentation and high co-occurrence of mental health disorders in children with FASD, neurocognitive factors predictive of mental health disorders in the general population (such as working memory in relation to depression) may play a similar role in mental health disorders in the FASD population. Affect regulation (i.e., regulating emotional arousal) is one of the neurodevelopmental domains required for FASD diagnosis, as epidemiological studies have found very high levels of comorbidity between PAE and mental health disorders (Temple, Cook, Unsworth, Rajani, Mela, 2019). A recent

investigation by Temple and colleagues (2019) investigated how affect regulation impairment in individuals with FASD was related to various mental health disorders. They found that 41% of those with an FASD diagnosis or an 'at risk' designation had impairments in affect regulation. A previous investigation found that those with affect regulation impairments were found to be older at the time of diagnosis, and have associated attachment disorders, PTSD, conduct disorders, and suicidality (Clarren et al., 2015).

Individuals with FASD are heterogenous in their neurobehavioural profiles, resulting in a heterogenous mental health profile. Investigating neurocognitive factors and their relationship to mental health symptoms and disorders is important in individuals with FASD as they present as a possible target for intervention. Many of the cognitive domains can be recognized early in children with PAE, and effective coping strategies and environmental supports might be aimed at this particularly vulnerable group to decrease their risk (Temple et al., 2019).

Current Study

The present study aims to better explain mental health outcomes in children exposed to multiple early risks, by investigating whether other prenatal and postnatal exposures have effects beyond alcohol exposure. Using Lebel and colleagues (2019) characterization tool which considers multiple time points and types of exposures prenatally and postnatally, this study will examine mental health outcomes as measured by the Kiddie Schedule for Affective Disorders and Schizophrenia for School Age Children – Present and Lifetime Version (K-SADS-PL) semi-structured clinical interview with the caregiver. The study will also incorporate standardized measures of intelligence (IQ), EF, verbal learning, and parent-report behaviour ratings of mental health symptoms. Further, we hope to examine the role of neurocognitive factors in relation to mental health symptoms in this population. Results from this will highlight the importance of

considering multiple risk factors when treating children and youth exposed to alcohol, by clarifying the impact of different risk factors on individual trajectories.

Research Questions and Hypotheses

The proposed study aims to address the following research questions:

1) How does cumulative prenatal risk factors, as assessed using the Lebel et al., 2019 tool, relate to mental health symptoms in children and youth exposed to alcohol prenatally?
   Consistent with previous research (Felitti et al., 1998; Price et al., 2017), it is hypothesized that participants exposed to more prenatal risk factors as identified by our risk categorization tool, will have more mental health symptoms.
2) How does cumulative postnatal risk factors, as assessed using the Lebel et al., 2019 tool, relate to mental health symptoms in children and youth exposed to alcohol prenatally?
   Similarly, it is hypothesized that participants exposed to more postnatal risk factors as identified by our risk categorization tool, will have more mental health symptoms.
3) Do clinical neurocognitive factors further explain the variance associated with mental health outcomes in children and youth who have been exposed to alcohol prenatally?
   It is expected that neurocognitive factors (EF and verbal memory) will further explain the variance in children exposed to multiple early risks and their mental health symptoms and diagnoses.

Chapter 3: Methodology

This study is part of a larger research project investigating the mental health of children and youth exposed to multiple early risks, and the underlying brain structures and functions that impact mental health, funded by the Addictions and Mental Health Strategic Clinical Health Network – Clinical Connections Grant (PI: C. Lebel). As part of the larger project, participants completed a variety of measures including neuropsychological, academic, emotion regulation, and multiple mental health screeners. The present study will only examined a subset of variables, which are described in more detail below.

FASD Diagnosis. Participants were required to have a pre-existing diagnosis of FASD based on the current Canadian guidelines, and/or confirmed and documented information on their exposures both prenatally and postnatally. Consistent with the Canadian Guidelines (Cook et al., 2016) alcohol exposure was confirmed via the biological mother's self-report, reliable observations by close family or friends, clinical observation, and/or medical, legal or child services records. Participants were excluded from the study if: 1) they did not have documented and/or confirmed information regarding prenatal exposures to alcohol; 2) they did not have documented and/or confirmed information regarding postnatal experiences or environments; 3) if they were in crisis or suicidal; 4) if their motivation to participate was to get an assessment to confirm an FASD diagnosis; and/or 5) if they had ADHD and were not currently taken ADHD medication, as per assessment protocol from the Cumulative Risk Diagnostic Clinic (Alberta Health Services). Finally, participants must have been in a stable home placement for at least 6 months prior to the study.

Recruitment occurred through FASD clinics (support from Dr. Gibbard), Child & Family Services (support from Ms. Tortorelli), organizations throughout Alberta (e.g., Calgary Fetal

Alcohol Network, Edmonton Fetal Alcohol Network, Calgary Urban Project Society, First 2000 Days Network), and advertisements in caregiver support groups.

Demographic information. Demographic information was collected through a questionnaire that asked date of birth, diagnoses, current medications, other family members in the home, familial income, and services used. Race/ethnicity of the child was not obtained in the demographic questionnaire, and consequently families were re-contacted over the phone to get the information.

Risk Designation. Characterization of prenatal and postnatal exposure was done using Lebel et al., 2019 cumulative risk framework by consensus in a group consisting of a developmental pediatrician with expertise in FASD diagnosis, a child welfare manager, a child clinical psychologist, and a neuroscientist. Information pertaining to early prenatal and postnatal exposures was obtained from each participant's child welfare file (which contained information from birth families, social workers, police records, and medical files), and semi-structured interviews completed either in person at the time of testing, or over the phone when the K-SADS-PL (described below) was completed with foster/adoptive parents and birth families where possible.

Measures

Cognitive

Wechsler Abbreviated Scale of Intelligence, Second Edition (WASI-II). The WASI-II (Wechsler, 2012) is a brief standardized measure of cognitive functioning comprised of four subtests (Block Design, Vocabulary, Matrix Reasoning, and Similarities) taken from the more comprehensive Wechsler Adult Intelligence Scale, Fourth Edition (WAIS-IV; Wechsler, 2008). Raw scores for the subtests are converted into norm-based standard scores (M = 100; SD = 15)

that are combined to form composites that represent verbal (Verbal Comprehension Index [VCI] comprised of Vocabulary and Similarities) and non-verbal (Perceptual Reasoning Index [PRI] comprised of Block Design and Matrix Reasoning) ability. All four subtests also comprise the Full-Scale Intelligence Quotient (FSIQ-4). Administration was conducted according to the instructions presented in the examiner's manual.

The WASI-II was normed on the sample of 2,300 individual's representative of the general United States population. In regard to consistency and reliability, Wechsler (2012) reports interrater reliability coefficients from .94 to .99 across all four subtests. Additionally, internal consistency was reported with an alpha coefficient ranging from .87 to .97 for the VCI, PRI, and FSIQ-4. Wechsler (2012) has also demonstrated concurrent validity between the WASI-II and both the WAIS-IV and Wechsler Intelligence Scale for Children, Fourth Edition (Wechsler, 2003). Specifically, correlation coefficients for the WAIS-IV ranged from .70 to .86 for subtests, and .86 to .92 for FSIQ-4 scores. The relationship between the WASI-II and the Wechsler Intelligence Scale for Children, Fifth Edition (WISC-5; Wechsler 2017) have been examined by third party researchers, with corrected correlation coefficients ranging from .53 to .80 for subtests and an overall FSIQ-4 corrected correlation coefficient of .87 (Raiford, Zhou, & Drozdick, 2016).

Executive Functioning and Verbal Memory

Behaviour Rating Inventory of Executive Functioning (BRIEF). EF was assessed by the BRIEF (Gioia, Isquith, Guy, & Kenworthy, 2013). The BRIEF measures several behaviours associated with EF and its underlying constructs (Inhibit, Shift, Emotional Control, Initiate, Working Memory, Plan/Organize, Organization of Materials, Monitor) and two validity scales

(Inconsistency and Negativity). The clinical scales form two broader Indexes (Behavioral Regulation and Metacognition) and an overall score, the Global Executive Composite.

The BRIEF requires respondents to answer questions using a six-point Likert-type scale with N ("Never"), R ("Rarely"), S ("Sometimes"), O ("Often"), V ("Very Often), or A ("Always"), reflecting the frequency with which the individual being evaluated performs an indicated behaviour. Respondents are instructed to base their answers of behaviours observed/conducted. Administration typically takes 10 to 15 minutes. A *T*-score of > 60 is indicative of moderately to significantly elevated concerns. The BRI captures the child's ability to shift cognitive set and modulate emotions and behaviour via appropriate inhibitory control. It is comprised of the Inhibit, the Shift, and the Emotional Control scales. The MI clinical scale reflects the rated child's ability to initiate, plan, organize, self-monitor, and sustain working memory. It can be interpreted as a child's ability to cognitively self-manage tasks and to monitor their performance. The MI relates directly to a child's ability to actively problem solve in a variety of contexts. It is composed of the Initiate, Working Memory, Plan/Organize, Organization of Materials, and Monitor scales.

Three forms (Parent, Teacher, and Self-Report) are offered. The Parent and Teacher Forms of the BRIEF each contain 86 items that measure different aspects of EF. Specific normative data are based on age and gender, and separate normative tables for parent and teacher forms provide T scores, percentiles, and 90% confidence intervals for four developmental age groups by gender of the child. Normative data are based on child ratings from 1,419 parents and 720 teachers from rural, suburban, and urban areas. The clinical sample included children with developmental disorders or acquired neurological disorders (e.g., reading disorder, ADHD subtypes, traumatic brain injury, Tourette's disorder, intellectual disability, localized brain

lesions, high functioning autism). High internal consistency (α's = .80-.98) and test-retest reliability (r's = .82 for parents, .88 for teachers) were found. For the purposes of this study, the parent form was the only form administered due to multiple factors including age of participants, and concerns with self-awareness and ability to complete/understand a rating scale.

California Verbal Learning Test – Children's Version (CVLT-C). The CVLT-C (Delis, Kaplan, Kramer, & Ober, 1994) is individually administered to assess the strategies and processes children use in learning and recalling verbal material. The test is administered to children between the ages of 5 and 16 to help diagnose and treat memory impairments that are secondary to mild or severe learning disabilities, attention-deficit disorders, intellectual disability, and other neurological and/or psychiatric problems. The test is designed to assess multiple components of verbal learning and memory. It involves presentation of a 15-word list (List A), containing 5 words from each of three semantic categories, for five trials. This is followed by one-time presentation of a distractor list (List B), followed by free and semantically cued recall of List A. Long delayed free and cued recall trials occur after a 20-min delay during which nonverbal tests are administered. Finally, a recognition trial is presented in which the child must correctly identify the 15 original words from List A from among distraction items. Internal consistency and alpha reliabilities for the test are high (usually >0.80) (Mottram & Donders, 2005).

For each variable, the CVLT–C raw scores are converted to standard scores based on the normative sample (z-scores, which have a mean of 0 and standard deviation of 1). Negative z-scores indicate worse performance. Further, z-scores are provided only in 0.5 increments. List A Total represents the total learning summary score (*T*-score, List A Trials 1–5) which has a mean of 50 and a standard deviation of 10.

Developmental Neuropsychological Assessment - Second Edition (NEPSY-II; selected subtests). The NEPSY-II is a measure of an individual's neuropsychological functioning. The Narrative Memory subtest from the Memory and Learning domain for the NEPSY-II assesses memory for organized verbal material under free recall, cued recall, and recognition conditions was administered. The NEPSY-II normative sample is a national, stratified random sample consisting of 1,200 preschoolers, children, and adolescents between the ages of 3 and 16 years, collected between 2005 and 2006. The Narrative Memory subtest has test-retest reliability ranging from .61 - .83 for children 7 – 16 years of age (Brooks, Sherman, & Strauss, 2009).

Mental Health

Kiddie Schedule for Affective Disorders and Schizophrenia, Present and Lifetime Version (K-SADS-PL). The K-SADS-PL is a semi-structured clinical interview to measure current and past symptoms of mood, anxiety, psychotic, and disruptive behavior disorders in children ages 6-18 years old, based on the Diagnostic and Statistical Manual of Mental Disorders – Fifth Edition (DSM-V; American Psychiatric Association, 2013). It was designed to promote earlier diagnosis of mental disorders in children in a way that incorporates reports by both the child and parent and a clinician's clinical judgment. The K-SADS-PL has been validated in multiple research and treatment settings.

The K-SADS-PL was adapted from the Present Episode version of the K-SADS (K-SADS-P) (Chamber et al., 1985). The K-SADS-PL instrumentation gives flexibility to the interviewer about how to phrase and assess symptom items, while still eliciting the current DSM-5 criteria. If a primary symptom is endorsed, further questions will be asked to determine whether diagnostic criteria are met. If a primary symptom is not endorsed, additional symptoms

for that disorder will not be queried. It has been written and translated into 16 different languages, including Korean, Hebrew, Turkish, Icelandic, and Persian, is also available in several Indian dialects. The screener and supplementals were given to a majority of participants; however, four participants were not given the respective supplementals due to an administration error.

Behavior Assessment System for Children – Second Edition (BASC-2). The BASC-2 is a standardized questionnaire that aims to evaluate the behavior and emotions of individuals between 2 and 25 years of age. For the present study and similar to the BRIEF, only the parent rating scales (PRS) section of the BASC-2 was considered, given the variability in cognitive abilities across participants, and difficulties with self-awareness. As such, parents or legal guardians served as informants on different forms as distinguished by age, for children (ages 6–11), or adolescents (ages 12–21). Using a 4-point Likert scale (1 for never, 2 for sometimes, 3 for often, and 4 for almost always), informants rated occurrence of adaptive skills and problem behaviors. Results are separated into three general composites: Externalizing Behaviours (including hyperactivity, aggression, and conduct problems), Internalizing Behaviours (including anxiety, depression, and somatization), and Adaptive Behaviours (including adaptability, social skills, leadership, activities of daily living, and functional communication). Additionally, the resulting Behavioral Symptoms Index (BSI; including externalizing composite, internalizing composite, atypicality, withdrawal, and attention) provides an overall composite score. For each of the composite and subscale scores, a *T*-score of 70 or above indicates clinical significance (Kamphaus & Campbell, 2008), with a *T*-score of 60-69 being considered clinically elevated. The measure is useful in that it can help identify clinical diagnoses of disorders typically occurring in childhood or adolescence (Tan, 2007).

The PRS of the BASC-2 has been determined to be a reliable and valid measure to assess internalizing problems, externalizing problems, atypicality, withdrawal, attention problems, and adaptive skills in the home or community setting (Mahan & Matson, 2011). Internal consistency ranged from $\alpha = .73$ to $\alpha = .95$ and $\alpha = .76$ to $\alpha = .95$, respectively, for the child and adolescent forms. Additionally, median test–retest reliabilities were $r = .84$ for the child form and $r = .81$ for the adolescent form. Finally, the authors found median interrater reliability to be $r = .69$ for the child form and $r = .77$ for the adolescent form.

Procedure

Data Collection. Data for this study was collected as part of a larger project examining brain alterations and mental health in children exposed to early multiple risks (REB17-0663). As part of the larger investigation, children and their caregiver underwent the informed consent process. Children then completed a comprehensive assessment including cognitive, academic, neuropsychological, and social-emotional functioning measures, as well as an MRI scan at the Alberta Children's Hospital. Parents/caregivers also completed a variety of report measures (e.g., Multidimensional Anxiety Scale for Children – Second Edition [MASC-II], Child Depression Inventory – Second Edition [CDI-2]), and the K-SADS-PL that was completed over the phone with caregiver following the assessment day. Upon completion of participation, families were provided a summary of their child's performance on some of the measures (i.e., cognitive, academic, neuropsychological, the BASC-2 PRS, and a brief summary of findings from the K-SADS-PL). Families also received a $50 gift card for participation.

Chapter 4: Results

Sample Clinical/Demographic Information

The present study sample included 33 children between the ages of 7.58 and 15.92 years (M = 10.57 years, SD = 2.34 years), and majority of the sample was male (N = 18; 54.5%). In total, 40 children were tested, but 7 were excluded due to missing information or incomplete assessments as some children were unable to complete the measures. Over half of the sample was diagnosed with FASD (N = 18; 54.5%), with the remainder of participants on a wait list for a diagnosis (N = 15; 45.5%). PAE was confirmed in all participants using the aforementioned method, and only one child was confirmed to only have alcohol exposure without exposure to other substances (described in more detail below). In our sample, 21.2% (N = 7) identified as White, Anglo, or European-Canadian, 66.7% (N = 22) identified as First Nations/North American Aboriginal, and 12.1% (N = 4) identified Black or African-Canadian. Of those that identified as First Nations/North American Aboriginal, 33.3% (N = 11) were multiracial, although it was confirmed that the biological mother was of First Nations/North American Aboriginal descent, and therefore they identified as such.

The Full-Scale IQ was measured by the four subscales on the WASI (FSIQ-4), or an IQ score from a psychological assessment completed within the last two years, such as cognitive scores from their FASD assessment or a school-based psychoeducational report provided by caregivers. The average FSIQ-4 is presented in the table below. The perceptual reasoning index (PRI) ranged from a standard score of 59 to 112, with a mean of 91.72 (SD = 12.57). The verbal comprehension index (VCI) ranged from a standard score of 64 to 106, with a mean of 83.82 (SD = 11.90).

Table 2

Demographic Information

	Mean (SD)	Minimum	Maximum
Sex (% male)	54.5%		
Age (years)	10.457 (2.34)	7.58	15.92
FSIQ-4	86.06 (11.43)	59.00	107.00

Note: age is presented in decimal form (i.e., 15 years, 6 months = 15.5). FSIQ-4 is presented in standard score format (M = 100, SD = 15).

Previous diagnoses. In the demographic questionnaire, caregivers indicated mental health and development disorders that their child had been previously diagnosed. In our sample, 93.9% (N = 31) had at least one previous mental health disorder. Of those, 51.5% (N = 17) had only one diagnosis, 27.3% (N = 9) had two diagnoses, and 15.2% (N = 5) had three previous diagnoses. Not surprising, a large majority of our sample (N = 25; 75.8%) had a previous diagnosis of ADHD. An anxiety disorder was diagnosed in 12.1% (N = 4), 21.2% were diagnosed with a specific learning disorder (N = 7), 15.2% were diagnosed with oppositional defiant disorder (N = 5), 15.2% were diagnosed with reactive attachment disorder (N = 5), 9.1% (N = 3) were diagnosed with post-traumatic stress disorder (PTSD), and 6.1% were diagnosed with Tourette's. Only one child was previously diagnosed with depression, and similarly only one child was diagnosed with Obsessive-Compulsive Disorder (OCD).

Home and family composition. Caregivers reported that 66.67% (N = 22) lived with a biologically related family member with a neurodevelopmental or medical disorder (e.g., FASD, autism spectrum disorder), as most participants currently lived with a sibling that was adopted from the same biological mother. Further, 39.40% (N = 13) of the children and youth lived in a

home with an unrelated sibling that had a neurodevelopmental or medical disorder. Caregivers reported that participants lived with an average of 1.67 (*SD* = 0.85) siblings.

Of our sample, 39.39% (*N* = 13) of children were in a home that had an average annual income of $100,000 to $124,99, and 21.21% (*N* = 7) had an annual income of $75,000 to $99,999. Only 12.12% (*N* = 4) were from homes with incomes less than $50,000, and 24.24% (*N* = 8) had incomes over $125,000. Only one child was in a single parent home, as all others were dual parents, and subsequently dual incomes.

Medication and services. In our sample, 66.67% (*N* = 22) were currently taking a psychotropic or non-psychotropic medication. Of those taking medication, the number of medications ranged from 1 to 5 medications, with an average of 1.86 medications (*SD* = 1.25) per child. Of the medications, 57.58% (*N* = 19) were on stimulants, 12.12% (*N* = 4) were on antidepressants, 9.09% (*N* = 3) were on atypical antipsychotics, 9.09% (*N* = 3) were on corticosteroids, 6.06% (*N* = 2) were on bronchodilators, 3.03% (*N* = 1) was on an anxiolytic, 3.03% (*N* = 1) was on an alpha agonist hypotensive medication, 18.18% (*N* = 6) were on over the counter medications (e.g., melatonin, restoralax, allergy medications), and one child was on sulfonylureas, a diabetic medication.

In regard to services, 27.27% (*N* = 9) were reported to be receiving supports from Family Support for Children with Disabilities (FSCD) including respite, behavioural, or community aide supports. 9.09% (*N* = 3) were receiving specific support from occupational therapists, and one child was currently receiving support from a speech-language therapist. 15.15% (*N* = 5) were receiving psychological services, and 12.12% (*N* = 4) indicated consistent support from a psychiatrist. Furthermore, 12.12% (*N* = 4) were receiving Supports for Permanency (government program that provides financial support to families who adopt or obtain private guardianship of

children under the age of 18 years in permanent government care), and 18.18% ($N = 6$) were in community funded organizations (e.g., Big Brothers Big Sisters).

Risk Categorization. As outlined previously, participants were categorized through a rigorous process whereby a child clinical psychologist, pediatrician, radiologist, expert in child welfare, and graduate students of these experts discussed the specific experiences of each child and adjudicated their risks based on our cumulative risk tool (Lebel et al., 2019; Table 1). All children were exposed to some amount of alcohol. The majority of the sample (54.5%) were in the high-risk group or had high exposure to alcohol of ≥7 drinks/week or ≥ 2 binge episodes (≥4 drinks on one occasion) at some point in pregnancy. Approximately half of the sample (48.5%) were exposed to a high frequency of substances including methamphetamines, cocaine, and/or opioids, and 33.3% of the participants had some exposure to nicotine or marijuana of any amount, and/or low frequency use of other substances including cocaine or opioids. While only one child was not exposed to any other substances during pregnancy, five children were suspected, but not confirmed, to have exposure to other substances. This included instances of mothers with substance use issues prior to pregnancy alongside alcohol, or mothers who were transient during the majority of their pregnancy.

Nine biological mothers were reported to have a diagnosed mental health disorder (including diagnosed depression, anxiety, bipolar disorder, borderline personality disorder, PTSD, and schizophrenia). Two biological mothers were reported to have been diagnosed with FASD themselves, and two more were believed to have had FASD. However, information on the biological mothers was typically sparse, as such, this may be an underestimate. The average time the biological mother was pregnant was 5.06 times ($SD = 2.05$), ranging between 1 to 10 times.

Regarding prenatal risks, 21.2% were exposed to prenatal toxic stress including a biological mother with symptoms of a mental health disorder, lack of prenatal care, housing/food/income insecurity that lasted less than three months, or a single instance of domestic violence or sex trade work. When the information was corroborated through our risk categorization tool, 33.3% of the sample had a mother with a DSM-5 diagnosis of a mental health disorder, domestic violence or sex trade work at least twice during pregnancy, housing, food, or income insecurity lasting over three months, or exposure to multiple prenatal toxic stress events.

The mean number of placements was 3.18 (SD = 3.22), with a range from one stable placement (i.e., adopted from hospital) to over 10 placements. Importantly, for the purposes of this study, placement numbers were capped at 10 due to insufficient records and uncertainty of placements for four of the children. Just under half of the sample (N = 16; 48.5%) were adopted from hospital or placed in foster care and later adopted by the same family. Postnatal deprivation included instances of care transitions, food and housing insecurity, and in extreme cases physical and emotional neglect. Postnatal threat included witnessing domestic violence, living with a caregiver with a mental illness, and physical or sexual abuse. Of the sample, 27.3% experienced high-risk deprivation and threat in both the early and late postnatal period, including instances of neglect, physical abuse (i.e., hit, kicked, choked), warzone violence, and sexual abuse. Approximately half of the sample (48.5%) were adopted from the hospital, and therefore not exposed to early postnatal deprivation or threat in most cases.

Table 3

Characterization Tool of Sample

Exposure type	**1** (absence of risk)	**2** (unknown)	**3** (some/ moderate risk)	**4** (high risk)
Prenatal alcohol exposure	0 (0%)	4 (12.1%)	11 (33.3%)	18 (54.5%)
Other prenatal substance exposure	1 (3%)	5 (15.2%)	11 (33.3%)	16 (48.5%)
Other prenatal toxic stress	2 (6.1%)	13 (39.4%)	7 (21.2%)	11 (33.3%)
Early postnatal deprivation (<24 months)	16 (48.5%)	5 (15.2%)	3 (9.1%)	9 (27.3%)
Late postnatal deprivation (≥24 months)	18 (54.5%)	3 (9.1%)	3 (9.1%)	9 (27.3%)
Early postnatal threat (<24 months)	16 (48.5%)	5 (15.2%)	3 (9.1%)	9 (27.3%)
Late postnatal threat (≥24 months)	18 (54.5%)	4 (12.1%)	2 (6.1%)	9 (27.3%)

Analysis of Mental Health Symptoms and Diagnoses: K-SADS-PL

K-SADS-PL Symptom Counts. For the purposes of this study, the K-SADS-PL was used as the primary mental health outcome measure. Across the 33 participants in our sample, participants varied significantly in their mental health symptom presentations. In previous studies, information obtained in the K-SADS-PL has been used as a dichotomous outcome (i.e., presence or absence of a disorder); however given the heterogeneity of our sample, a more in depth look into the complex mental health symptoms were captured by counting up the symptoms they presented with (herein referred to as symptom count). If a child presented with either subthreshold or threshold levels of concern for a particular symptom on the screener

portion of the K-SADS-PL, their symptoms were counted. The symptom counts were delineated into categories based on the DSM-5 diagnostic sections. Therefore, “Depressive Disorders,” “Anxiety Disorders,” “Bipolar and Related Disorders,” “Schizophrenia Spectrum and Other Psychotic Disorders,” “Feeding and Eating Disorders,” “Obsessive-Compulsive and Related Disorders,” “Elimination Disorders,” “Trauma- and Stressor-Related Disorders,” “Disruptive, Impulse-Control, and Conduct Disorders,” and “Neurodevelopmental Disorders” were the sections. A total symptom count was created, which was the summation of all symptoms across diagnostic areas and was out of a possible 71 total symptoms. As outlined in Figure 1, participants were highly symptomatic across the DSM-5 diagnostic categories on the K-SADS-PL.

To determine if there were differences between past and present levels of symptoms on the K-SADS-PL, a paired samples T-test was conducted to determine if there was a significant difference in total mean symptom count between past symptoms and the current (present) symptoms. Participants were more symptomatic in the past (M = 23.39, SD = 13.20) compared to the present (M = 22.88, SD = 13.59), a statistically significant mean increase in 0.51 symptoms from past to present, 95% CI [0.118, 0.913], $t(32) = 2.639$, $p = .013$. Cohen’s d effect size was calculated to be .459, corresponding to a medium effect size. For the purposes of this study, only the total present symptom count was utilized in subsequent analyses.

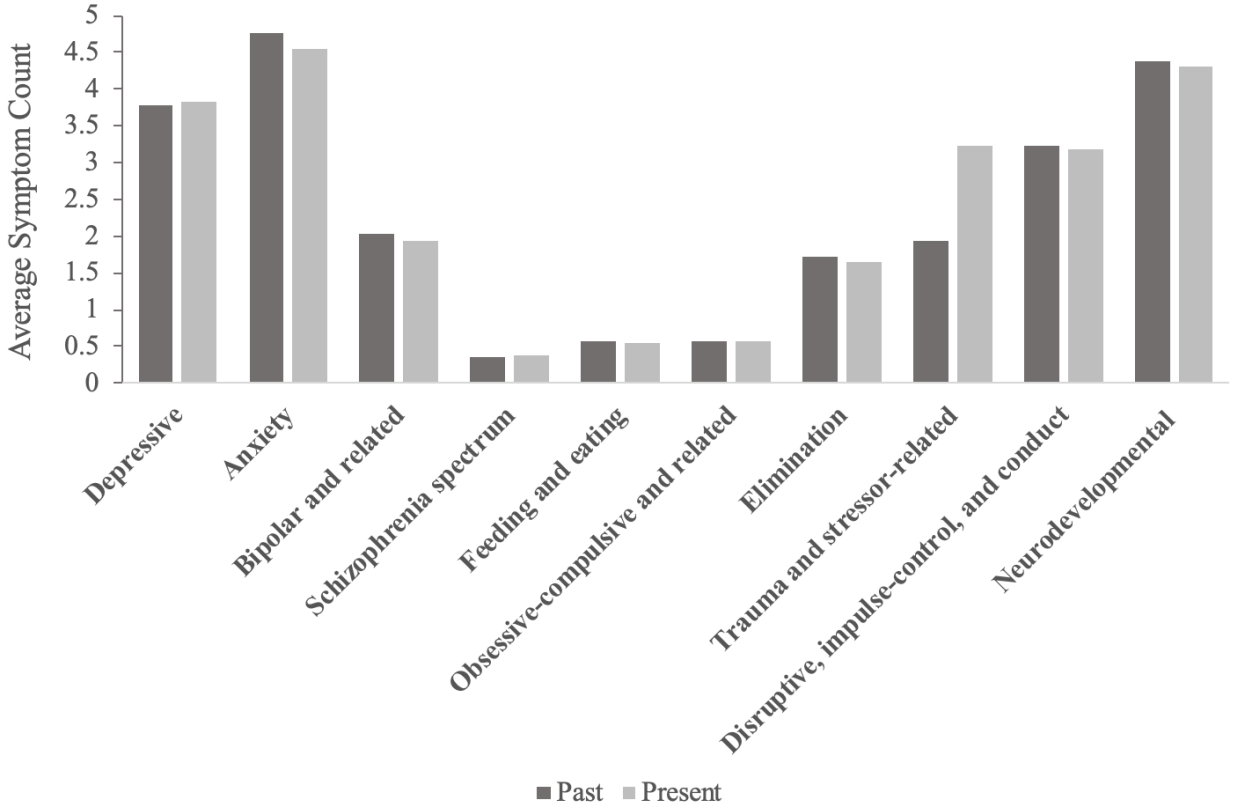

Figure 1. Average symptom counts based on the DSM-5 diagnostic sections. Each category is variable based on total symptom counts. Maximum symptom counts per category: Depressive disorders = 8; Anxiety disorders = 14; Bipolar and related disorders = 5; Schizophrenia spectrum and other psychotic disorders = 2; Feeding and eating disorders = 3; Obsessive-compulsive and related disorders = 2; Elimination disorders = 6; Trauma- and stressor-related disorders = 5; Disruptive, impulse-control, and conduct disorders = 10; and Neurodevelopmental disorders = 6.

Correlation between BASC-2 and symptom counts. Given the novelty of utilizing symptom count on the K-SADS-PL as an outcome measure, bivariate correlations were conducted between the clinical scales on the BASC-2 PRS and the total present symptom count for the screener on the K-SADS to determine if there was convergence of reporting based on the BASC-II and the K-SADS-PL. On the clinical scales of the BASC, 75% ($N = 27$) had a score on the externalizing scale that was either elevated or in the clinical range (T-score above 60),

whereas 41.67% (N = 15) had a score on the Internalizing scale over 60, and 80.56% (N = 29) had a Behavioural Symptoms Index over 60. As Adaptive Skills are measured on a reverse *T*-Score scale, a *T*-Score of 40 or below is in the elevated range. As such, 83.33% (N = 30) had adaptive skills in the elevated range. See Table 4 for complete BASC-PRS scales. Symptom counts on the K-SADS-PL was deemed an appropriate method for use in the present study's analysis.

Table 4

BASC-2 PRS T-Scores

BASC Scales	Mean (SD)	Minimum	Maximum
Externalizing	67.70 (13.73)	44	103
Hyperactivity	68.79 (11.68)	45	98
Aggression	63.27 (14.97)	40	101
Conduct	65.67 (15.05)	40	105
Internalizing	59.18 (17.51)	34	96
Anxiety	54.06 (15.14)	30	82
Depression	61.64 (17.22)	37	105
Somatization	56.58 (17.92)	36	102
Behavioural Symptoms Index	67.94 (12.24)	47	94
Atypicality	67.06 (16.64)	44	112
Withdrawal	58.59 (11.56)	40	81
Attention Problems	65.78 (6.95)	50	80
Adaptive Skills	35.39 (8.03)	22	56
Adaptability	38.28 (11.16)	21	62
Social Skills	39.13 (8.53)	27	60
Leadership	40.56 (6.14)	29	57
Acts of Daily Living	33.38 (8.20)	22	52
Functional Communication	33.09 (9.02)	19	50

Table 5

Correlations Between BASC-2 PRS and Total Present Symptom Counts

Variables	1	2	3	4	5	6
1. Externalizing	-					
2. Internalizing	.368*	-				
3. Behavioural Symptoms	.789**	.689**	-			
4. Adaptive Skills	-.508**	-.424*	-.778**	-		
5. K-SADS-PL Total Symptom Count Past	.358*	.598**	.542**	-.437*	-	
6. K-SADS-PL Total Symptom Count Present	.360*	.601**	.550**	-.448**	.997**	-

* $p < .05$
** $p < .01$

Present Symptom count and cumulative risk correlations. To determine associations between aspects of our cumulative risk tool and symptom counts for specific diagnostic categories on the K-SADS-PL, bivariate correlations were run between risk scores on cumulative risk tool (including placements, age at stable placement, child ACEs, prenatal maternal mental health, and prenatal maternal neurodevelopmental disorder), and specific symptom counts (see Table 6).

In terms of prenatal exposures, PAE had moderate negative correlations (-.426 to -.460) with depressive disorders, anxiety disorders, and total symptom counts, suggesting that the higher level of PAE resulted in lower symptom counts of such disorders. Prenatal exposure to other substances had moderate negative correlations (-.346 to -.445) with depressive disorders, bipolar and related disorders, obsessive compulsive and related disorders, neurodevelopmental disorders, and total symptom count. Prenatal toxic stress had no significant correlations with any of the symptom counts (p's > .05). Early postnatal deprivation was significantly correlated with early postnatal threat (.650), late postnatal deprivation (.785), and late postnatal threat (.467).

Late postnatal threat was significantly correlated with early postnatal threat (.612), and late postnatal deprivation (.494). For correlation coefficients and *p*-values, refer to Table 6.

For postnatal risks, moderate positive correlations (.463 to .577) were found between number of placements and symptom counts of depressive disorders, feeding and eating disorders, trauma- and stressor-related disorders, neurodevelopmental disorders, and total symptom counts. Similarly, moderate positive correlations were found between age of stable placement (i.e., age of adoption into stable home; .357 to .548), and depressive disorders and trauma- and stressor-related disorders, such that those children placed into a stable home at older ages had higher symptom counts of those disorders. Early postnatal threat was moderately positively correlated (.387 to .544) with depressive disorders, feeding and eating disorders, and trauma- and stressor-related disorders. Early postnatal deprivation was moderately positively correlated (.455 to .544) with depressive disorders, feeding and eating disorders, trauma- and stressor-related disorders, and total symptom count. Late postnatal threat or deprivation were moderately positively correlated with depressive disorders, feeding and eating disorders, trauma- and stressor-related disorders, and total symptom count (.395 to .516). When child ACEs were calculated, there was a moderate positive correlation (.400 to .632) with feeding and eating disorders, trauma- and stressor-related disorders, and total symptom count. Prenatal maternal mental health was moderately positively correlated with depressive disorders (.437), whereas prenatal maternal neurodevelopmental disorders were moderately negatively correlated (-.353 to -.476) with depressive disorders, anxiety disorders, and trauma- and stressor-related disorders. Symptom counts of different disorders tended to co-occur. For p-values of correlations, refer to Table 6.

Table 6

Correlation Between Risks and Specific Symptom Counts

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1. Placements	-																						
2. Age at stable placement	.645**	-																					
3. PAE	-.364*	-.145	-																				
4. Prenatal other substance	-.204	.056	.272	-																			
5. Prenatal toxic stress	.139	.011	-.155	.024	-																		
6. Early postnatal threat	.404*	.540**	-.072	-.239	-.246	-																	
7. Early postnatal deprivation	.658**	.795**	-.309	.018	-.002	.650**	-																
8. Late postnatal threat	.404*	.583**	-.095	-.297	-.232	.612**	.467**	-															
9. Late postnatal deprivation	.483**	.818**	-.208	-.051	-.059	.334	.785**	.494**	-														
10. Child ACEs	.693**	.694**	-.223	-.251	-.035	.847**	.815**	.615**	.596**	-													
11. Prenatal mental health	.231	.113	-.232	-.280	.072	.366*	.253	.010	-.013	.307	-												
12. Prenatal maternal NDD	-.425*	-.581**	.304	.137	.102	-.394*	-.331	-.644**	-.513**	-.475**	.070	-											
13. Depressive disorders	**.577****	**.405***	**-.455****	**-.358***	-.087	**.544****	**.544****	**.516****	.330	**.632****	**.437***	**-.353***	-										
14. Anxiety disorders	.440*	.271	**-.460****	-.304	.128	.288	.360*	.348*	.326	**.475****	.020	**-.376***	.594**	-									
15. Bipolar and related disorders	.138	.068	-.261	**-.445****	.216	.088	.172	.154	.126	.255	.294	.043	.551**	.393*	-								
16.Schizophrenia spectrum related	.172	.083	-.101	-.313	-.031	.038	.110	.403*	.207	.171	-.148	-.299	.514**	.531**	.465**	-							
17. Feeding and eating disorders	**.547****	.337	-.313	-.277	-.309	**.431***	**.462****	**.504****	**.395***	**.513****	.338	-.327	.762**	.572**	.324	.473**	-						
18. OCD and related disorders	.289	.084	-.171	**-.385***	-.263	.246	.125	.593**	.156	.213	.021	-.272	.485**	.449**	.234	.450**	.479**	-					
19. Elimination disorders	.341	.192	-.298	-.284	.121	-.119	.161	.089	.354*	.109	.122	.018	.401*	.399*	.605**	.270	.393*	.247	-				
20. Trauma disorders	**.579****	**.548****	-.295	-.173	.151	**.387***	**.492****	**.496****	**.441***	**.563****	.114	**-.476****	.630**	.707**	.390*	.490**	.543**	.372*	.186	-			
21. Disruptive and related	.289	.156	-.254	-.200	-.012	.123	.297	.238	.284	.216	.049	-.130	.558**	.474**	.414*	.558**	.431*	.513**	.414*	.375*	-		
22. NDD	**.463****	.176	.131	**-.346***	-.181	.294	.218	.288	.243	**.400***	.141	-.003	.381*	.223	.312	.265	.329	.455**	.320	.281	.170	-	
23. Total	**.560****	**.357***	**-.426***	**-.416***	033	.344	**.455****	**.472****	**.417***	**.536****	.207	-.323	.843**	.847**	.663**	.662**	.730**	.609**	.610**	.735**	.708**	.458**	-

* $p < .05$
** $p < .01$
Note. NDD = neurodevelopmental disorder; OCD = obsessive-compulsive disorder

Neurocognitive outcomes

Results from the BRIEF-PRS are reported in Table 7. Consistent with previous research, 75.8% ($N = 25$) had a Behavioural Regulation Index (BRI) with a *T*-Score over 60, which is in the elevated risk range. 84.85% ($N = 28$) had a Metacognitive Index (MI) with a *T*-Score over 60. When using the Global Executive Composite (GEC) overarching clinical scale, 75.76% ($N = 25$) were reported to have an overall EF score with a *T*-Score over 60.

Table 7

BRIEF-PRS T-Scores

BRIEF Scales	Mean (SD)	Minimum	Maximum
Inhibit	70.67 (11.04)	45	88
Shift	68.03 (14.32)	43	99
Emotional Control	63.76 (13.08)	37	85
Behavioural Regulation Index	69.24 (12.31)	49	95
Initiate	66.52 (11.53)	47	99
Working Memory	71.30 (11.18)	49	88
Plan/Organize	67.88 (10.01)	51	98
Organization of Materials	56.94 (10.29)	36	74
Monitor	64.36 (10.99)	46	91
Metacognitive Index	68.70 (10.68)	47	98
Global Executive Composite	70.30 (11.53)	47	100

Verbal learning and memory was assessed using the CVLT-C. Scores are presented in Table 8. While the mean number of total words remembered fell in the average range (compared to peers of the same age), children in our sample were variable in their performance, ranging from the Extremely Low to Extremely High range. Over the five trials of List A, participant's mean performance across the different lists fell in the average range; however, performance decreased over the five trials, likely representing difficulties with sustained attention evident in many children with FASD.

Children also completed the Narrative Memory subtest on the NEPSY-II to assess verbal learning and memory. Scaled score means and standard deviations are presented in Table 8. Children performed from the Extremely Low to Extremely High range across both the free and total recall task, representing significant variability in performance on this task.

Table 8

Neurocognitive Scores

CVLT-C *Z*-scores	Mean (SD)	Minimum	Maximum
List A total	43.45 (12.93)	21.00	67.00
List A trial 1	-.13 (1.19)	-3.00	3.00
List A trial 5	-.68 (1.47)	-3.50	1.50
List B free recall	-.50 (1.30)	-2.50	2.50
List A short-delay free recall	-.55 (1.19)	-3.00	2.00
List A short-delay cued recall	-.40 (1.06)	-3.00	2.00
List A long-delay free recall	-.65 (1.45)	-3.00	2.00
List A long-delay cued recall	-.48 (1.33)	-4.00	2.00
NEPSY-II scaled scores			
Narrative memory total	7.43 (3.48)	2.00	16.00
Narrative memory free recall	7.86 (3.22)	3.00	17.00

Prenatal and postnatal exposures and neurocognitive outcomes. Various multiple linear regressions were run to understand if prenatal and postnatal cumulative risk predicted neurocognitive abilities (EF, verbal memory) in children with PAE. To assess linearity, scatterplots of neurocognitive factors (EF, verbal memory) against risk were plotted with a superimposed regression line. Visual inspection of these plots indicated a linear relationship between the variables. There was homoscedasticity and normality of the residuals.

When investigating prenatal factors (level of PAE, exposure to other substances, or prenatal toxic stress), level of PAE did not predict EF (as measured by the GEC on the BRIEF),

or verbal memory on the CVLT-C or the NEPSY-II (p's > .05). Level of exposure to other substances significantly predicted EF, $F(1, 31) = 7.780$, $p = .009$, but no other relationships were significant.

When investigating if postnatal threat impacted neurocognitive abilities, early postnatal threat occurring prior to 24 months of age did not predict EF or verbal memory abilities. However, late postnatal threat (occurring after 24 months of age) significantly predicted EF as measured on the BRIEF, $F(1, 32) = 4.428$, $p = .044$; no other relationships were significant. Similarly, early postnatal deprivation did not significantly predict any neurocognitive factors, but late postnatal deprivation significantly predicted EF, $F(1, 32) = 6.857$, $p = .014$.

Neurocognitive outcomes and total symptom count. To determine relationship between verbal learning (CVLT-C, NEPSY-II narrative memory subtest), EF (as measured by the BRIEF) and total present symptom count, a bivariate correlation was conducted. Only the GEC on the BRIEF was significantly correlated with total present symptom count (.457, $p < .01$). As such, the NEPSY-II or CVLT-C were not included in further analysis.

Table 9

Correlations of Neurocognitive Outcomes and Total Symptom Count

Variables	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1. List A total	-											
2. List A trial 1	.696**	-										
3. List A trial 5	.636**	.282	-									
4. List B free recall	.719**	.545**	.682**	-								
5. List A short-delay free recall	.703**	.277	.599**	.447**	-							
6. List A short-delay cued recall	.667**	.545**	.300	.376*	.584**	-						
7. List A long delay free recall	.631**	.340	.560**	.436*	.682**	.526**	-					

8. List A long delay cued recall	.701**	.477**	.511**	.451*	.743**	.526**	.627**	-				
9. NEPSY-II narrative memory total	.522**	.481**	.226	.411*	.279	.764**	.335	.399*	-			
10. NEPSY-II narrative memory free recall	.402	.332	.327	.427	.235	.352	.353	.378	.944**	-		
11. GEC BRIEF	.073	.151	.078	.124	.182	.101	.192	.193	-.216	-.112	-	
12. Total present symptom count	-.061	-.258	.292	-.052	.321	.371	.213	.230	-.106	.315	**.457****	-

* $p < .05$
** $p < .01$

Research Question #1: What is the association between prenatal cumulative risk factors (PAE, exposure to other substances, and prenatal toxic stress) and mental health issues in a sample of children and youth with PAE?

First, multiple independent linear regressions were conducted to determine if sex, age, and IQ predicted total present symptom count. No relationships were significant (p's > .05). However, an independent-samples t-test was run to determine if there were differences in total present symptom count between males and females. Females had a higher symptom count (M = 27.07, SD = 17.50) than males (M = 19.39, SD = 8.20), $t(31) = 9.490$, $p = .004$.

A multiple linear regression was conducted to determine the relationship between prenatal exposures, including PAE, level of exposure to other prenatal substances, and prenatal toxic stress, and symptom count. There was linearity as assessed by partial regression plots and a plot of studentized residuals against the predicted values. There was independence of residuals, as assessed by a Durbin-Watson statistic of 1.482. There was homoscedasticity, as assessed by visual inspection of a plot of studentized residuals versus unstandardized predicted values. There was no evidence of multicollinearity, as assessed by tolerance values greater than 0.1. There were no studentized deleted residuals greater than ±3 standard deviations, no leverage values greater than 0.2, and values for Cook's distance above 1. The assumption of normality was met,

as assessed by a Q-Q Plot. The multiple regression model statistically significantly predicted total symptom count, $F(3, 29) = 3.740$, $p < .022$, adj. $R^2 = .279$. PAE was the only significant predictor in the equation ($p \leq .05$). Regression coefficients and standard errors can be found in Table 10. Results suggest that of the prenatal exposures, PAE is the most significant predictor of total mental health symptom count as measured by the K-SADS-PL.

Table 10

Summary of Multiple Regression Analysis for Prenatal Factors

Variable	*B*	SE_B	β
Intercept	62.788	14.162	
PAE	-6.521	3.189	-.340*
Prenatal Other Substances	-5.235	2.660	-.323
Prenatal Toxic Stress	-.159	2.213	-.012

Note. *$p < .05$; *B* = Unstandardized regression coefficient; SE_B = Standard error of the coefficient; β = Standardized coefficient

Research Question #2: What is the association between postnatal cumulative risk factors (early deprivation, late deprivation, early threat, late threat) and mental health issues in a sample of children and youth with PAE?

A multiple linear regression was run to determine if postnatal risk factors, such as postnatal threat and deprivation, predicted total symptom count on the K-SADS-PL. There was linearity as assessed by partial regression plots and a plot of studentized residuals against the predicted values. There was independence of residuals, as assessed by a Durbin-Watson statistic of 1.214. There was homoscedasticity, as assessed by visual inspection of a plot of studentized residuals versus unstandardized predicted values. There was no evidence of multicollinearity, as assessed by tolerance values greater than 0.1. There were no studentized deleted residuals greater

than ±3 standard deviations, no leverage values greater than 0.2, and values for Cook's distance above 1. The assumption of normality was met, as assessed by a Q-Q Plot.

The multiple regression model statistically significantly predicted total symptom count, $F(4, 28) = 3.000$, $p = .035$, adj. R2 = .200. Regression coefficients and standard errors are presented in Table 11. Taken together, in children with PAE, postnatal risk factors (instances of threat and deprivation) significantly predicted total mental health symptom count.

Table 11

Summary of multiple regression analysis for postnatal factors

Variable	*B*	SE_B	β
Intercept	9.686	4.785	
Early postnatal threat	-1.446	2.941	-.138
Early postnatal deprivation	4.090	3.791	.392
Late postnatal threat	4.041	2.376	.393
Late postnatal deprivation	-.393	3.223	-.039

Note. All p's < .05; B = Unstandardized regression coefficient; SE_B = Standard error of the coefficient; β = Standardized coefficient

Research Question #3: What clinical neurocognitive factors predict mental health outcomes in children exposed to multiple early risks, above other prenatal and postnatal exposures?

Neurocognitive factors in relationship to symptom count. A hierarchical multiple regression was then run to determine if the addition of postnatal experiences and EF improved the prediction of total symptom count over and above PAE level. See Table 12 for full details on each regression model. A variable of "overall postnatal experience" was created based on the cumulative risk tool. Participants were given a score of 1 if they experienced no postnatal risks, 2 if it was unknown, 3 if there was some/moderate risk, and 4 if it was high risk, and then these

scores were summed to create an overall postnatal experience score for each participant. There was linearity as assessed by partial regression plots and a plot of studentized residuals against the predicted values. There was independence of residuals, as assessed by a Durbin-Watson statistic of 1.572. There was homoscedasticity, as assessed by visual inspection of a plot of studentized residuals versus unstandardized predicted values. There was no evidence of multicollinearity, as assessed by tolerance values greater than 0.1. There were no studentized deleted residuals greater than ±3 standard deviations, no leverage values greater than 0.2, and values for Cook's distance above 1. There assumption of normality was met, as assessed by Q-Q Plot.

The full model of PAE, postnatal experiences, and EF to predict total symptom count was statistically significant, $R^2 = .454$, $F(3, 32) = 8.024$, $p = .000$; adjusted $R^2 = .397$. The addition of postnatal experiences to the prediction of symptom count led to an increase in R^2 of .362, $F(2, 32) = 8.527$, $p = .001$; adjusted $R^2 = .320$. PAE alone statistically significantly predicts total symptom count, $R^2 = .182$, $F(1, 32) = 6.878$, $p = .013$; adjusted $R^2 = .155$.

Table 12

Hierarchical Multiple Regression Predicting Symptom Count from PAE and Postnatal Experiences

	Symptom Count					
	Model 1		Model 2		Model 3	
Variable	B	*β*	B	*β*	B	*β*
Constant	50.87		35.42**		9.56**	
PAE	-8.18*	-.426	-3.31**	-.17	-3.58**	-.19
Postnatal risk			11.59**	.49	9.12**	.39
EF					.37**	.31
R^2	.18		.36		.45	
ΔR^2	.18		.18		.09	

F	6.88*	8.48*	8.02*
ΔF	6.88*	8.43*	4.51*

Note. ** $p < .001$; * $p < .05$

Above the impact of PAE, postnatal risk statistically significantly increased variance explained, from 18.2% to 36.1%. When EF was added to the model, there was a statistically significant change in variance explained to 44.7%. The hierarchical regression model is accounting for more variance as variables are entered.

Given that the correlation between PAE and total symptom count was previously found the be -.426 (see Table 6), suggesting a moderate negative correlation (lower PAE associated with higher total mental health symptom count), the negative unstandardized beta's (B) are consistent as the first factor of the hierarchical regression as they indicate a negative relationship. However, as factors are entered in the model, the relationship becomes positive. The standardized beta's (β) indicate the number of standard deviations that the outcome will change as a result of one standard deviation change in the predictor. As such, they provide insight into the importance of the predictor. In our model, the β for PAE is -0.187, for postnatal risk is 0.388, and for EF is 0.310, suggesting that postnatal risk has the most impact in this model.

Chapter 5: Discussion

The present study aimed to better explain mental health outcomes in children exposed to multiple early risks, by investigating whether exposure to cumulative prenatal and postnatal risks have effects on mental health beyond PAE. A comprehensive characterization of each child's prenatal and postnatal exposures was completed using Lebel and colleagues (2019) characterization tool, which considers multiple time points and types of exposures prenatally and postnatally. Given the high prevalence of mental health issues in children and youth exposed to alcohol prenatally, this study highlights the importance of considering multiple risk factors when trying to understand the individual mental health trajectories in children and youth with FASD. This is critical to early identification and appropriate strategies to mitigate poor outcomes.

The first research question aimed to investigate how cumulative prenatal factors relate to mental health symptoms in children and youth exposed to alcohol prenatally. Of the prenatal factors in our characterization tool (PAE, prenatal exposure to other substances, prenatal toxic stress; Lebel et al., 2019), PAE was the only significant predictor of total mental health symptom count as they were inversely related, with unknown or moderate levels of PAE resulting in higher mental health symptom counts. Although research on the adverse effects of PAE on child development has been well documented, evidence is unclear when investigating level of PAE in relation to a variety of outcomes (Kelly et al., 2009; Kelly et al., 2012). Some research suggests that PAE functions in a dose-response manner, with more PAE equating to poorer outcomes in child behaviour, typically in externalizing problems and aggressive behaviour (e.g., Sood et al., 2001), learning and behaviour problems (Olson et al., 1997), working memory and attention (Brown et al., 1991; Burden et al., 2005), and mental health outcomes (Sayal, Heron, Golding, & Emond 2007). Other researchers have found that it is not the amount of overall alcohol exposure

during the pregnancy, but presence of binge drinking that results in lower verbal IQ scores and higher levels of externalizing behaviours, specifically delinquency (Bailey et al., 2004), and this could be the case for all mental health outcomes; however, has yet to be examined directly. Further, in a meta-analysis conducted by Flak and colleagues (2014), they found that some children with the lowest levels of PAE demonstrated behaviours of concern, including attention-seeking behaviours, behaviour regulation difficulties, and poorer interactive play skills. Other studies have found no such dose-response association, with some suggesting a "U" or "J" shape between abstinent drinkers, light drinkers, and heavy drinkers, with better outcomes in children of mothers who were light drinkers during pregnancy compared to abstinent or heavy drinkers (Kelly et al., 2009; Robinson et al., 2010). These conflicting findings regarding level or 'dose' of PAE is likely due to the intrinsic difficulties within this type of research including potential under-reporting of alcohol intake due to issues with retrospective recall or due to stigma, reliance on self-report measures or questionnaires of mental health, and potentially confounding variables that can affect child development (e.g., exposure to other risk factors, family socioeconomic status).

The second research question investigated the relationship between postnatal risk factors and mental health. Overall, we found that threat and deprivation occurring in the early or late postnatal period (before or after two years of age, respectively) were found to significantly predict mental health symptoms in children and youth with PAE. Within our sample, a compounding effect existed where regardless of experience or timing of risk, children who experienced adverse events in the postnatal period had higher mental health symptom counts. In a meta-analysis conducted by Price and colleagues (2017), they suggested that when PAE and traumatic childhood experiences both occur, they compound to result in a higher risk of

difficulties in speech, language comprehension, intelligence, attention, memory, social, and emotional issues compared to PAE or trauma alone. Conversely, Mukherjee, Cook, Norgate, and Price (2019), found that when neglect occurred with PAE, it did not seem to compound and result in worse adaptive or sensory developmental outcomes.

The third and final research question investigated what clinical neurocognitive factors further explained the variance associated with mental health outcomes in children and youth with PAE. Results demonstrate that above and beyond PAE, postnatal risk accounted for more variance in mental health symptoms. A cumulative postnatal score was created for this analysis, given that all postnatal factors significantly predicted mental health outcomes as determined in research question two. Further, EF abilities explained additional variance above PAE and postnatal risk. To our knowledge, this is the first study that has investigated the cumulative effect of PAE, postnatal risks, and neurocognitive abilities in relation to mental health symptoms in children with confirmed PAE.

Although no research exists looking at EF and mental health outcomes in children and youth with PAE, a handful of studies have examined EF in relation to other outcomes in children with PAE. For instance, Schonfeld, Paley, Frankel, and O'Connor (2006) previously found that EF explained a significant amount of variance in children with PAE and their parent- and teacher-reported social skills. They then investigated the effectiveness of Children's Friendship Training (social skills intervention) in children with FASD and found that EF abilities, specifically behaviour regulation, significantly predictive of improvement in social skills and reduction in problem behaviors (Schonfeld et al., 2009). EF has also been shown to predict adaptive abilities in children with PAE (Ware et al., 2012). EF in relation to other aspects of functioning is promising, as there may be a potential 'spill-over' effect of EF training into other

domains of functioning. This is promising given EF interventions adapted for children with FASD (Nash, 2012; Nash et al., 2015; Soh et al., 2015).

Within our sample, age and sex was unrelated to total mental health symptoms. There is no previous research, to our knowledge, that has examined age and sex differences in children with PAE and other risks in relation to mental health symptoms. However, a handful of studies have investigated age and sex differences in other developmental outcomes in individuals with PAE, more broadly. For instance, it has been suggested that males with PAE may be more negatively affected by alcohol exposure in the prenatal and/or early postpartum periods, and less likely to survive, whereas females may be more negatively affected PAE than males, especially in cognitive performance and total dysmorphology (May et al., 2017), resulting in a higher probability of diagnosis for females. Further, sex differences following PAE have been observed in secondary difficulties, with males at an increased risk for problems including school disruptions and/or dropout, delinquency behaviours, inappropriate sexual behaviour, substance abuse problems (Streissguth, 2012), and higher suicide attempts (O'Connor et al., 2019). However, research is mixed as some studies have found no differences in age or sex on neurobehavioural outcomes including language, memory, and adaptive behaviour (Green et al., 2009; Panczakiewicz et al., 2016). However, within our sample, there was a significant difference between mental health symptoms in males and females, with females showing more overall symptoms than males, potentially suggesting females being more affected by their FASD, and therefore displaying more mental health symptoms (May et al., 2017). Some studies have found that adaptive functioning worsens with age in individuals with PAE, compared to control subjects (Crocker, Vaurio, Riley, & Mattson, 2009; Thomas, Kelly, Mattson, & Riley, 1998; Whaley, O'Connor, & Gunderson, 2001). Further, deficits in verbal inhibition and switching,

verbal fluency, and verbal abstract reasoning were greater in older children than younger children (Rasmussen & Bisanz, 2009).

Heterogeneity of the sample

It is well established that children with PAE are often heterogenous in their exposure to risk (i.e., timing, dosage, and chronicity of PAE; Comasco, Rangmar, Eriksson, & Oreland, 2018), and consequently, their behavioural and mental health profiles are also heterogenous. Our sample of 33 children and youth were extremely diverse in both prenatal and postnatal exposures, and outcomes, as expected. Levels of PAE were extremely variable, for instance, one adoptive mother reported that the biological mother discontinued drinking when she discovered she was pregnant, and other mothers drank until the day their child was born. One of the most alarming stories of alcohol consumption was a biological mother who drank 40 ounces of vodka on more than one occasion to try and abort her pregnancy. Similarly, prenatal exposure to other substances varied significantly in types of substances, and different frequencies and durations during pregnancy. Prenatal toxic stress was often difficult to measure or gain information about. Although many mothers were identified as "transient," not much was known about their life prenatally resulting in approximately 40% of the sample in the unknown category. Further, there were some instances of mothers who became incarcerated over the period of their pregnancy. Although the incarceration may have been a toxic stress event, it is possible it served as a protective factor because the mothers were then not transient or using substances. Within our sample, PAE, prenatal exposure to other substances, and prenatal toxic stress were not significantly correlated with each other, which is inconsistent with previous research that highlights that PAE often co-occurs with other substances and co-occurring mental health disorders (Benningfield et al., 2010; Forray, 2016; Tuten et al., 2009), inadequate prenatal care,

poor nutrition, poverty, medical problems, and exposure to domestic violence (Havens, Simmons, Shannon, & Hansen, 2009; Hutchins, & Dipietro, 1997).

Postnatally, our sample was extremely heterogenous in events experienced. About half of the sample was adopted from the hospital, resulting in confirmed absence of threat or deprivation in the postnatal period in most cases. However, adverse experiences still occurred in a couple of children (e.g., sexual abuse) despite a stable home environment since birth. This is consistent with previous literature, given how individuals with FASD are often vulnerable to many forms of victimization due to the variety of cognitive and behavioural impairments including deficits memory, poor insight and judgment, difficulty with abstract thinking, and the inability to generalize learning from one setting to another (Thiel et al., 2011). These difficulties may lead to problems in assessing what is safe versus dangerous, and difficulties understanding cause-and-effect relationships, increasing vulnerability to victimization (Streissguth, Barr, Kogan, & Bookstein, 1996). Postnatal experiences included physical abuse (e.g., instances of physical assault including being kicked, punched, choked), sexual abuse, and emotional abuse. Additionally, three of the children were adopted from outside of Canada where they experienced chronic war and terrorism related trauma alongside poverty and malnutrition. The most frequently experienced postnatal risk factor in our sample was witnessing domestic violence in their home, consistent with data from child welfare agencies in Canada that found 34% of children were exposed to domestic/family violence (Public Health Agency of Canada, 2010).

Approximately 94% of the sample had a pre-existing diagnosed mental health disorder upon entry to the study, consistent with previous suggested rates of mental health disorders in individuals with FASD (Pei et al., 2011). Of those, approximately 75% were diagnosed with ADHD, again consistent with previous studies that have found rates of ADHD in FASD

populations ranging from 65% (Clark et al., 2004) to 95% (Fryer et al., 2007). Given that some of the most common behavioural difficulties demonstrated by children with FASD are externalizing problems and attentional difficulties, FASD can mimic signs of an ADHD often resulting in dual diagnoses for many children with PAE. In most cases, ADHD is often present and diagnosed prior to FASD (Young et al., 2016); however, there are differences between those diagnosed with FASD and ADHD versus those with FASD. Specifically, individuals with both ADHD and FASD perform worse on tests of attentional problems (Rasmussen et al., 2010) and have higher rates of disruptive and conduct disorder, compared with individuals with FASD alone (Coles et al., 1997; Young et al., 2016).

Within our sample, postnatal experiences predicted mental health above and beyond PAE, demonstrating a compounding effect of multiple exposures, consistent with some previous research (Price et al., 2017). Further, EF predicted total mental health symptom over PAE and postnatal experiences. EF is critical for attention, planning, organization, and problem-solving, and EF skills are utilized daily. Deficits in these areas may impair academic performance, adaptive skills, social relationships (Nikulina & Widom, 2013), and as demonstrated through our results, mental health outcomes. A major component of EF is regulatory behaviours, and our results suggest that children with both PAE and postnatal risks may not be effectively using EF skills, resulting in poorer mental health outcomes. With better EF skills such as the ability to focus attention, cognition, and affect to control emotions in times of stress (such as postnatal risk factors; Raikes, Robinson, Bradley, Raikes, & Ayoub, 2007; Quoidbach, Mikolajczak, & Gross, 2015), EF may be a significant contributor in predicting future mental health outcomes. Previous literature has found that individuals with suicidal ideation and/or depression performed significantly worse on tasks of EF (Marzuk, Hartwell, Leon, & Portera, 2005). As children with

PAE are frequently exposed to adverse experiences in the postnatal period, this finding significant as it suggests a potentially malleable aspect of cognition that may be used as an avenue for intervention. These results suggest the need for targeted efforts dedicated to EF interventions for children and youth exposed to PAE and postnatal risks (e.g., the ALERT program as described by Nash et al., 2012; the Go Far program as described by Coles, Kable, Taddeo, & Strickland, 2015).

Implications

Results of this study suggest several important implications for children with exposure to multiple risks including PAE. Previously, FASD clinicians and researchers have typically focused on understanding learning, adaptive, behavioural, and mental health outcomes as a result of PAE, largely overlooking exposures that may have co-occurred, and therefore may have contributed to each child's unique profile of weaknesses and abilities. The framework created and presented as a research team in part of our larger project (Lebel et al., 2019) is the first to our knowledge that considers the role of multiple early exposures in both the prenatal and postnatal period. Through consideration of other prenatal and postnatal risk factors and their frequency and severity alongside PAE, clinicians and caregivers may gain a more comprehensive understanding of a child to lead to more accurate diagnosis and treatment.

This study indicates that PAE was the most significant predictor to mental health outcomes in this sample, although the relationship was negative, indicating lower levels of PAE associated with more mental health symptoms. Further, other studies have demonstrated that lower PAE mainly effects behavioural and adaptive functioning, whereas higher levels of PAE. are associated with more serious developmental impacts and problems, including physical and medical issues (e.g., Williams & Ross, 2007). It may be the case that in our research selected

sample, the significance of the postnatal exposures experienced by some of the sample (i.e., warzone trauma) altered the effect of PAE on outcomes. Further, other studies typically utilize questionnaires to investigate mental health issues, which may not be sensitive enough to identify mental health problems in this population. Postnatal risk factors of threat and deprivation significantly predicted mental health outcomes in this sample, regardless of type of risk and timing of risk. Other studies have identified that cognitive impairment and mental health symptoms are significantly affected by timing of adversity, such as better outcomes associated with earlier exposure to the risk (Sonuga-Barke et al., 2017), although alcohol exposure in this population is unknown. Mukherjee and colleauges (2019) found that PAE seemed to function independently of neglect, suggesting that the postnatal neglect did not make outcomes any worse. Although it may be the case that PAE has more significant relationships to other outcomes, postnatal experiences were deemed the most important predictor for mental health outcomes within this sample. As such, it is critical to have better assessment tools (such as diagnostic interviewing) to understand and delineate what is organic to the PAE, trauma exposure, or a mental health disorder, as it impacts the implementation appropriate intervention and treatment strategies.

Currently, there is overwhelming evidence indicating high rates of mental health issues associated with FASD/PAE; however, evidence-based practice for treating mental health problems within this population is scarce. Despite the limited evidence for effective treatments, mental health providers are essential for diagnosis of FASD, treatment and organization of care for individuals with FASD, and in prevention of secondary disabilities that are often associated with delayed diagnosis and inappropriate care (Streissguth et al., 1996). However, despite the high prevalence of FASD and co-occurring mental health disorders, a survey of pediatricians

found that only 34% felt prepared to manage children with FASD (Gahagan et al., 2006), and a survey of psychiatry trainees found that only 10% felt confident in their knowledge and ability to treat FASD (Eyal & O'Connor, 2011). Ultimately, results of this study indicate that when children are exposed to PAE, secure and stable placements will reduce the likelihood of experiencing threat and/or deprivation. However, if threat and/or deprivation are inevitable, EF has important implications for the development (and potential maintenance) of mental health symptoms. This suggests that potential interventions to remediate EF deficits may in turn improve mental health functioning. If we can intervene on EF skills in children with PAE and postnatal experiences, we can potentially prevent or mitigate the development of MH in this population. Two such interventions developed and adapted for children and adolescents with FASD are the Alert Program (Nash et al., 2012) and the Go Far program (Coles, Kable, Taddeo, & Strickland, 2015). Both the Alert and Go Far programs target self-regulation leading to improvements in executive functioning, adaptive, and disruptive behaviour difficulties (Coles et al., 2015; Nash et al., 2012).

Further, caregivers and/or clinicians may not understand that their child with FASD/PAE often displays behaviours as a result of the interaction between prenatal and postnatal risk factors. For instance, behaviours may be believed to be caused by their PAE, when in actuality it is due to trauma they experienced in their early life. Translating this and future findings from Lebel and colleagues (2019) characterization tool may be helpful for caregivers/clinicians in advocating and better treating children affected by PAE and other risks.

Limitations

Despite the important implications of this study there are several limitations that must be considered in tandem with its findings. First, this study utilized a relatively small sample (N =

33) that was composed of a heterogeneous sample of children exposed to prenatal alcohol, with a rather large age range. Because of this, generalization of the findings beyond the immediate population in our study should be made with caution. Second, caregivers acted as evaluators of EF which results in several sub-limitations. For example, caregivers may not be the most accurate respondents for neurocognitive functioning in this population. Caregivers were also the primary respondent for the semi-structured clinical interview, which may be prone to over- or under-reporting of symptoms depending on the state of the family and the individual. Further, despite rigid exclusion criteria, participants were self-selected based on those that expressed interest in being involved, and consequently the experiences and outcomes of these participants may not be representative of all children and youth with FASD.

Future Directions

Considering both the implications and limitations of this study, several areas for future research are discussed. First, future studies examining the mental health symptoms in relation to cumulative risk factors should expand the sample size, given our relatively small sample with significant variability. Second, in light of our results from the third research question, studies investigating the impact of EF interventions in relation to mental health outcomes should be conducted. Although previous research has demonstrated potential improvements in EF as a result of these interventions, they have not been investigated in regard to mental health outcomes.

Conclusion

FASD is a common disorder, affecting 2-5% of Canadians and with a societal cost of $1.8 million per individual, or over $9.7 billion annually. The vast majority of individuals with FASD experience risks both prenatally and postnatally alongside PAE. Drug and alcohol use in

the prenatal period is an important, yet complex problem. This problem is further convoluted by postnatal risks including instances of threat or deprivation. It is necessary to accurately identify in utero drug exposure in order to provide the appropriate health, social, and educational interventions to the child and family.

Children and adolescents with PAE can often be missed, misdiagnosed, or untreated, often due to co-occurring behavioral, physical/medical, and mental health issues. Findings from this study suggest that with the significant complexity that children with PAE can present with, it is critical to examine mental health through an FASD/PAE lens by taking into account all information relating to their FASD diagnosis, such as outlined by Lebel and colleagues (2019) characterization tool. Ultimately, these findings highlight the importance of considering risks that occur in both the prenatal and postnatal period when looking at mental health trajectories of children with PAE.

References

Achenbach, T. M. (1982). *Developmental psychopathology* (2d ed.). New York: Wiley.

Achenbach, T. M., & Edelbrock, C. S. (1978). The classification of child psychopathology: a review and analysis of empirical efforts. *Psychological bulletin, 85*(6), 1275.

Al Odhayani, A., Watson, W. J., & Watson, L. (2013). Behavioural consequences of child abuse. *Canadian family physician*, *59*(8), 831-836.

Alhusen, J. L., Ray, E., Sharps, P., & Bullock, L. (2015). Intimate partner violence during pregnancy: maternal and neonatal outcomes. *Journal of women's health*, *24*(1), 100-106.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.

Anda, R. F., Felitti, V. J., Bremner, J. D., Walker, J. D., Whitfield, C. H., Perry, B. D., ... & Giles, W. H. (2006). The enduring effects of abuse and related adverse experiences in childhood. *European archives of psychiatry and clinical neuroscience*, *256*(3), 174-186.

Appleyard, K., Egeland, B., van Dulmen, M. H. M., & Sroufe, L. A. (2005). When more is not better: The role of cumulative risk in child behavior outcomes. *Journal of Child Psychology and Psychiatry, 46,* 235–245.

Aragon, A.S., Kalberg, W.O., Buckley, D., Barela-Scott, L.M., Tabachnick, B.G., & May, P.A. (2008). Neuropsychological study of FASD in a sample of American Indian children: Processing simple versus complex information. *Alcoholism: Clinical and Experimental Research, 32,* 2136–2148.

Astley, S. J. (2004). Diagnostic guide for fetal alcohol Spectrum disorders: The 4-digit diagnostic code. Fetal alcohol syndrome diagnostic and prevention network. Seattle: University of Washington.

Astley, S. J. (2006). Comparison of the 4-digit diagnostic code and the Hoyme diagnostic guidelines for fetal alcohol spectrum disorders. Pediatrics, 118(4), 1532-1545.

Astley, S. J. (2010). Profile of the first 1,400 patients receiving diagnostic evaluations for fetal alcohol spectrum disorder at the Washington State Fetal Alcohol Syndrome Diagnostic & Prevention Network. *Journal of Population Therapeutics and Clinical Pharmacology*, *17*(1).

Astley, S. J. (2013). Validation of the fetal alcohol spectrum disorder (FASD) 4-Digit Diagnostic Code. *Journal of Population Therapeutics and Clinical Pharmacology*, *20*(3).

Astley, S. J., & Clarren, S. K. (2000). Diagnosing the full spectrum of fetal alcohol-exposed individuals: introducing the 4-digit diagnostic code. *Alcohol and alcoholism*, *35*(4), 400-410.

Astley, S. J., & Clarren, S. K. (2001). Measuring the facial phenotype of individuals with prenatal alcohol exposure: correlations with brain dysfunction. *Alcohol and Alcoholism*, *36*(2), 147-159.

Atzaba-Poria, N., Pike, A., & Deater-Deckard, K. (2004). Do risk factors for problem behaviour act in a cumulative manner? An examination of ethnic minority and majority children through an ecological perspective. *Journal of child psychology and psychiatry, 45*(4), 707-718.

Bada, H. S., Das, A., Bauer, C. R., Shankaran, S., Lester, B., Wright, L. L., ... & Maza, P. L. (2002). Gestational cocaine exposure and intrauterine growth: maternal lifestyle study. *Obstetrics & Gynecology*, *100*(5), 916-924.

Baer, J. S., Sampson, P. D., Barr, H. M., Connor, P. D., & Streissguth, A. P. (2003). A 21-year longitudinal analysis of the effects of prenatal alcohol exposure on young adult drinking. *Archives of general psychiatry*, *60*(4), 377-385.

Bailey, B. N., Delaney-Black, V., Covington, C. Y., Ager, J., Janisse, J., Hannigan, J. H., & Sokol, R. J. (2004). Prenatal exposure to binge drinking and cognitive and behavioral outcomes at age 7 years. *American journal of obstetrics and gynecology, 191*(3), 1037-1043.

Barthelemy, O. J., Richardson, M. A., Cabral, H. J., & Frank, D. A. (2016). Prenatal, perinatal, and adolescent exposure to marijuana: Relationships with aggressive behavior. *Neurotoxicology and teratology*, *58*, 60-77.

Beers, S. R., & De Bellis, M. D. (2002). Neuropsychological function in children with maltreatment-related posttraumatic stress disorder. *American Journal of Psychiatry*, *159*(3), 483-486.

Behnke, M., Smith, V. C., & Committee on Substance Abuse. (2013). Prenatal substance abuse: short-and long-term effects on the exposed fetus. *Pediatrics*, *131*(3), e1009-e1024.

Bennett, H. A., Einarson, A., Taddio, A., Koren, G., & Einarson, T. R. (2004). Prevalence of depression during pregnancy: systematic review. *Obstetrics & Gynecology*, *103*(4), 698-709.

Benningfield, M. M., Arria, A. M., Kaltenbach, K., Heil, S. H., Stine, S. M., Coyle, M. G., ... & Martin, P. R. (2010). Co-occurring psychiatric symptoms are associated with increased psychological, social, and medical impairment in opioid dependent pregnant women. *The American journal on addictions, 19*(5), 416-421.

Benz, J., Rasmussen, C., & Andrew, G. (2009). Diagnosing fetal alcohol spectrum disorder: History, challenges and future directions. *Paediatrics & child health*, *14*(4), 231-237.

Bertrand, J., Floyd, R. L., & Weber, M. K. (2005). Guidelines for identifying and referring persons with fetal alcohol syndrome. *Morbidity and Mortality Weekly Report: Recommendations and Reports*, *54*(11), 1-CE.

Best, J. R., & Miller, P. H. (2010). A Developmental Perspective on Executive Function. *Child Development*, *81*(6), 1641–1660. doi: 10.1111/j.1467-8624.2010.01499.x

Blankley, G., Galbally, M., Snellen, M., Power, J., & Lewis, A. J. (2015). Borderline Personality Disorder in the perinatal period: early infant and maternal outcomes. *Australasian Psychiatry*, *23*(6), 688-692.

Bos, K., Zeanah, C. H., Fox, N. A., Drury, S. S., McLaughlin, K. A., & Nelson, C. A. (2011). Psychiatric Outcomes in Young Children with history of Institutionalization. *Harvard Review in Psychiatry*, *19*, 15-24.

Brewin, C. R., & Holmes, E. A. (2003). Psychological theories of posttraumatic stress disorder. *Clinical Psychology Review*, *23*, 339–376. doi: 10.1016/S0272-7358(03)00033-3

Bridge, J. A., McBee-Strayer, S. M., Cannon, E. A., Sheftall, A. H., Reynolds, B., & Campo, J. V. (2012). Impaired decision making in adolescent suicide attempters. *Journal of the American Academy of Child & Adolescent Psychiatry, 51*(4), 394–403

Brooks, B. L., Sherman, E. M., & Strauss, E. (2009). NEPSY-II: A developmental neuropsychological assessment. *Child Neuropsychology*, *16*(1), 80-101.

Brown, R. T., Coles, C. D., Smith, I. E., Platzman, K. A., Silverstein, J., Erickson, S., & Falek, A. (1991). Effects of prenatal alcohol exposure at school age. II. Attention and behavior. *Neurotoxicology and teratology, 13*(4), 369-376.

Burchinal, M. R., Roberts, J. E., Hooper, S., & Zeisel, S. A. (2000). Cumulative risk and early cognitive development: A comparison of statistical risk models. Developmental Psychology, 36(6), 793-807. doi: 10.1037/0012-1649.36.6.793

Burd, L., Roberts, D., Olson, M., & Odendaal, H. (2007). Ethanol and the placenta: a review. *The Journal of Maternal-Fetal & Neonatal Medicine*, *20*(5), 361-375.

Burden, M. J., Jacobson, S. W., Sokol, R. J., & Jacobson, J. L. (2005). Effects of prenatal alcohol exposure on attention and working memory at 7.5 years of age. *Alcoholism: Clinical and Experimental Research*, *29*(3), 443–452

Cannon, M. J., Dominique, Y., O'Leary, L. A., Sniezek, J. E., & Floyd, R. L. (2012). Characteristics and behaviors of mothers who have a child with fetal alcohol syndrome. *Neurotoxicology and teratology*, *34*(1), 90-95.

Cecil, C. A., Viding, E., Barker, E. D., Guiney, J., & McCrory, E. J. (2014). Double disadvantage: The influence of childhood maltreatment and community violence exposure on adolescent mental health. *Journal of Child Psychology and Psychiatry*, *55*(7), 839-848.

Cecil, C. A., Viding, E., Barker, E. D., Guiney, J., & McCrory, E. J. (2014). Double disadvantage: The influence of childhood maltreatment and community violence exposure on adolescent mental health. *Journal of Child Psychology and Psychiatry*, *55*(7), 839-848.

Cecil, C. A., Viding, E., Fearon, P., Glaser, D., & McCrory, E. J. (2017). Disentangling the mental health impact of childhood abuse and neglect. *Child abuse & neglect*, *63*, 106-119

Chambers, W. J., Puig-Antich, J., Hirsch, M., Paez, P., Ambrosini, P. J., Tabrizi, M. A., & Davies, M. (1985). The assessment of affective disorders in children and adolescents by semistructured interview: test-retest reliability of the Schedule for Affective Disorders and Schizophrenia for School-Age Children, Present Episode Version. *Archives of general psychiatry*, *42*(7), 696-702.

Chapman, D. P., Whitfield, C. L., Felitti, V. J., Dube, S. R., Edwards, V. J., & Anda, R. F. (2004). Adverse childhood experiences and the risk of depressive disorders in adulthood. *Journal of affective disorders*, *82*(2), 217-225.

Chasnoff, I. J., Wells, A. M., & King, L. (2015). Misdiagnosis and missed diagnoses in foster and adopted children with prenatal alcohol exposure. *Pediatrics*, *135*(2), 264-270.

Chudley, A. E., Conry, J., Cook, J. L., Loock, C., Rosales, T., & LeBlanc, N. (2005). Fetal alcohol spectrum disorder: Canadian guidelines for diagnosis. *Cmaj*, *172*(5 suppl), S1-S21.

Clark, E., Lutke, J., Minnes, P., & Ouellette-Kuntz, H. (2004). Secondary disabilities among adults with fetal alcohol spectrum disorder in British Columbia. *Journal of FAS International, 2*(13), 1-12.

Clarren, S. K., & Lutke, J. (2008). Building clinical capacity for fetal alcohol spectrum disorder diagnoses in western and northern Canada. *Journal of Population Therapeutics and Clinical Pharmacology*, *15*(2).

Clarren, S. K., & Smith, D. W. (1978). The fetal alcohol syndrome. *New England Journal of Medicine*, *298*(19), 1063-1067.

Clarren, S., Halliwell, C. I., Werk, C. M., Sebaldt, R. J., Petrie, A., Lilley, C., & Cook, J. (2015). Using a common form for consistent collection and reporting of FASD data from across Canada: a feasibility study. *Journal of Population Therapeutics and Clinical Pharmacology, 22*(3).

Coles, C. D., Platzman, K. A., Raskind-Hood, C. L., Brown, R. T., Falek, A., & Smith, I. E. (1997). A comparison of children affected by prenatal alcohol exposure and attention deficit, hyperactivity disorder. *Alcoholism: Clinical and Experimental Research, 21*(1), 150-161.

Coles, J., Lee, A., Taft, A., Mazza, D., & Loxton, D. (2015). Childhood sexual abuse and its association with adult physical and mental health: Results from a national cohort of young Australian women. *Journal of interpersonal violence*, *30*(11), 1929-1944.

Comasco, E., Rangmar, J., Eriksson, U. J., & Oreland, L. (2018). Neurological and neuropsychological effects of low and moderate prenatal alcohol exposure. *Acta Physiologica, 222*(1), e12892. doi: 10.1111/apha.12892

Conner, S. N., Carter, E. B., Tuuli, M. G., Macones, G. A., & Cahill, A. G. (2015). Maternal marijuana use and neonatal morbidity. *American journal of obstetrics and gynecology*, *213*(3), 422-e1.

Conners-Burrow, N. A., McKelvey, L., Pemberton, J. R., Lagory, J., Mesman, G. R., & Whiteside-Mansell, L. (2013). Moderators of the relationship between maternal substance abuse symptoms and preschool children's behavioral outcomes. *Journal of child and family studies*, *22*(8), 1120-1129.

Contractor, A. A., Banducci, A. N., Dolan, M., Keegan, F., & Weiss, N. H. (2019). Relation of positive memory recall count and accessibility with post-trauma mental health. Memory,

1-14.

Cook, J. L., Green, C. R., Lilley, C. M., Anderson, S. M., Baldwin, M. E., Chudley, A. E., ... & Mallon, B. F. (2016). Fetal alcohol spectrum disorder: a guideline for diagnosis across the lifespan. *Cmaj, 188*(3), 191-197.

Crocker, N., Vaurio, L., Riley, E. P., & Mattson, S. N. (2009). Comparison of adaptive behavior in children with heavy prenatal alcohol exposure or attention-deficit/hyperactivity disorder. *Alcoholism: Clinical and Experimental Research, 33*(11), 2015-2023.

Crocker, N., Vaurio, L., Riley, E. P., & Mattson, S. N. (2011). Comparison of verbal learning and memory in children with heavy prenatal alcohol exposure or attention-deficit/hyperactivity disorder. Alcoholism: Clinical and Experimental Research, 35(6), 1114-1121.

Cui, N., Ji, X., & Liu, J. (2018). Child physical abuse, non-anemic iron deficiency and behavior problems. *Journal of pediatric nursing*, *39*, 74-79.

Cutts, D. B., Coleman, S., Black, M. M., Chilton, M. M., Cook, J. T., de Cuba, S. E., ... & Frank, D. A. (2015). Homelessness during pregnancy: a unique, time-dependent risk factor of birth outcomes. *Maternal and child health journal*, *19*(6), 1276-1283.

Daigre, C., Rodríguez-Cintas, L., Tarifa, N., Rodríguez-Martos, L., Grau-López, L., Berenguer, M., ... & Roncero, C. (2015). History of sexual, emotional or physical abuse and psychiatric comorbidity in substance-dependent patients. *Psychiatry research*, *229*(3), 743-749.

Dannehl, K., Rief, W., & Euteneuer, F. (2019). Effects of cognitive behavioural therapy on verbal learning and memory in major depression: Results of a randomized controlled trial. *Clinical psychology & psychotherapy*.

Day, N. L., Helsel, A., Sonon, K., & Goldschmidt, L. (2013). The Association Between Prenatal Alcohol Exposure and Behavior at 22 Years of Age. *Alcoholism: Clinical and Experimental Research*, *37*(7), 1171-1178.

De Genna, N. M., Feske, U., Larkby, C., Angiolieri, T., & Gold, M. A. (2012). Pregnancies, abortions, and births among women with and without borderline personality disorder. *Women's Health Issues*, *22*(4), e371-e377.

Delis, D. C., Kramer, J. H., Kaplan, E., & Ober, B. A. (1994). California verbal learning test-children's version (CVLT-C). San Antonio, TX: The Psychological Corporation.

Dennison, M. J., Rosen, M. L., Sambrook, K. A., Jenness, J. L., Sheridan, M. A., & McLaughlin, K. A. (2019). Differential associations of distinct forms of childhood adversity with neurobehavioral measures of reward processing: A developmental pathway to depression. *Child development*, *90*(1), e96-e113.

Denys, K., Rasmussen, C., & Henneveld, D. (2011). The effectiveness of a community-based intervention for parents with FASD. *Community mental health journal*, *47*(2), 209-219.

Derauf, C., LaGasse, L. L., Smith, L. M., Grant, P., Shah, R., Arria, A., ... & Liu, J. (2007). Demographic and psychosocial characteristics of mothers using methamphetamine during pregnancy: preliminary results of the infant development, environment, and lifestyle study (IDEAL). *The American journal of drug and alcohol abuse*, *33*(2), 281-289.

Derauf, C., Lester, B. M., Neyzi, N., Kekatpure, M., Gracia, L., Davis, J., ... & Kosofsky, B. (2012). Subcortical and cortical structural central nervous system changes and attention processing deficits in preschool-aged children with prenatal methamphetamine and tobacco exposure. *Developmental neuroscience, 34*(4), 327-341.

Diamond, A. (2013). Executive functions. Annual review of psychology, 64, 135-168. doi: 10.1146/annurev-psych-113011-143750

Dos Santos, M., Cahill, E. N., Dal Bo, G., Vanhoutte, P., Caboche, J., Giros, B., & Heck, N. (2018). Cocaine increases dopaminergic connectivity in the nucleus accumbens. *Brain Structure and Function*, *223*(2), 913-923.

Dotters-Katz, S. K., Smid, M. C., Manuck, T. A., & Metz, T. D. (2017). Risk of neonatal and childhood morbidity among preterm infants exposed to marijuana. *The Journal of Maternal-Fetal & Neonatal Medicine*, *30*(24), 2933-2939.

Douglas, J. W. (1975). Early hospital admissions and later disturbances in behavior and learning. Developmental Medicine & Child Neurology, 17, 456–480. doi:10.1111/j.1469-8749.1975.tb03497.x

Douglas, K. M., & Porter, R. J. (2009). Longitudinal assessment of neuropsychological function in major depression. *Australian and New Zealand Journal of Psychiatry*, *43*(12), 1105-1117.

Douglas, K. M., Gallagher, P., Robinson, L. J., Carter, J. D., McIntosh, V. V., Frampton, C. M., ... & Porter, R. J. (2018). Prevalence of cognitive impairment in major depression and bipolar disorder. *Bipolar disorders*, *20*(3), 260-274.

Drury, S. S., Theall, K., Gleason, M. M., Smyke, A. T., De Vivo, I., Wong, J. Y. Y., ... & Nelson, C. A. (2012). Telomere length and early severe social deprivation: linking early adversity and cellular aging. *Molecular psychiatry*, *17*(7), 719.

Dufford, A. J., & Kim, P. (2017). Family income, cumulative risk exposure, and white matter structure in middle childhood. *Frontiers in human neuroscience*, *11*, 547.

Dykman, R. A., McPherson, B., Ackerman, P. T., Newton, J. E., Mooney, D. M., Wherry, J., & Chaffin, M. (1997). Internalizing and externalizing characteristics of sexually and/or physically abused children. *Integrative Physiological and Behavioral Science*, *32*(1), 62-83.

Eckstrand, K. L., Ding, Z., Dodge, N. C., Cowan, R. L., Jacobson, J. L., Jacobson, S. W., & Avison, M. J. (2012). Persistent dose-dependent changes in brain structure in young adults with low-to-moderate alcohol exposure in utero. *Alcoholism: Clinical and Experimental Research*, *36*(11), 1892-1902.

Edalati, H., & Krank, M. D. (2016). Childhood maltreatment and development of substance use disorders: A review and a model of cognitive pathways. *Trauma, Violence, & Abuse*, *17*(5), 454-467.

Egeland, B., Sroufe, L. A., & Erickson, M. (1983). The developmental consequence of different patterns of maltreatment. *Child abuse & neglect, 7*(4), 459-469.

el Marroun, H., Tiemeier, H., Jaddoe, V. W., Hofman, A., Mackenbach, J. P., Steegers, E. A., ... & Huizink, A. C. (2008). Demographic, emotional and social determinants of cannabis use in early pregnancy: the Generation R study. *Drug and alcohol dependence*, *98*(3), 218-226.

Evans, G. W. (2003). A multimethodological analysis of cumulative risk and allostatic load among rural children. Developmental Psychology, 39, 924-933. doi:10.1037/0012-1649.39.5.924

Evans, G. W., & English, K. (2002). The environment of poverty: Multiple stressor exposure, psychophysiological stress, and socioemotional adjustment. Child Development, 73, 1238–1248.

Evans, G. W., Li, D., & Whipple, S. S. (2013). Cumulative risk and child development. *Psychological bulletin*, *139*(6), 1342.

Evans, S. E., Davies, C., & DiLillo, D. (2008). Exposure to domestic violence: A meta-analysis of child and adolescent outcomes. *Aggression and violent behavior*, *13*(2), 131-140.

Eyal, R., & O'Connor, M. J. (2011). Psychiatry trainees' training and experience in fetal alcohol spectrum disorders. *Academic Psychiatry, 35*(4), 238-240.

Fagerlund, Å., Autti-Rämö, I., Hoyme, H. E., Mattson, S. N., & Korkman, M. (2011). Risk factors for behavioural problems in foetal alcohol spectrum disorders. *Acta Paediatrica*, *100*(11), 1481-1488.

Famy, C., Streissguth, A. P., & Unis, A. S. (1998). Mental illness in adults with fetal alcohol syndrome or fetal alcohol effects. *American Journal of Psychiatry*, *155*(4), 552-554.

Felitti, V. J., & Anda, R. F. (2010). The relationship of adverse childhood experiences to adult medical disease, psychiatric disorders, and sexual behavior: Implications for healthcare. *The impact of early life trauma on health and disease: The hidden epidemic*, 77-87.

Felitti, V. J., Anda, R. F., Nordenberg, D., Williamson, D. F., Spitz, A. M., Edwards, V., & Marks, J. S. (1998). Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults: The Adverse Childhood Experiences (ACE) Study. *American journal of preventive medicine*, *14*(4), 245-258.

Fergusson, D. M., Horwood, L. J., & Lynskey, M. T. (1996). Childhood sexual abuse and psychiatric disorder in young adulthood: II. Psychiatric outcomes of childhood sexual abuse. Journal of the American Academy of Child & Adolescent Psychiatry, 35(10), 1365-1374.

Fergusson, D. M., Horwood, L. J., & Lynskey, M. T. (1996). Childhood sexual abuse and psychiatric disorder in young adulthood: II. Psychiatric outcomes of childhood sexual abuse. *Journal of the American Academy of Child & Adolescent Psychiatry, 35*(10), 1365-1374.

Fergusson, D. M., Horwood, L. J., & Northstone, K. (2002). Avon longitudinal study of pregnancy and childhood. *BJOG*, *109*, 21-27.

Finkelhor, D., Shattuck, A., Turner, H., & Hamby, S. (2012). Improving the Adverse Childhood Experiences study scale. Archives of Pediatrics and Adolescent Medicine..

Finnbogadóttir, H., Dykes, A. K., & Wann-Hansson, C. (2016). Prevalence and incidence of domestic violence during pregnancy and associated risk factors: a longitudinal cohort study in the south of Sweden. *BMC pregnancy and childbirth*, *16*(1), 228.

Flak, A. L., Su, S., Bertrand, J., Denny, C. H., Kesmodel, U. S., & Cogswell, M. E. (2014). The association of mild, moderate, and binge prenatal alcohol exposure and child neuropsychological outcomes: a meta-analysis. *Alcoholism: Clinical and Experimental Research, 38*(1), 214-226.

Flannigan, K., Pei, J., Stewart, M., & Johnson, A. (2018). Fetal alcohol spectrum disorder and the criminal justice system: a systematic literature review. *Int J Law Psychiatry*, *57*, 42-52.

Fleckman, J. M., Drury, S. S., Taylor, C. A., & Theall, K. P. (2016). Role of direct and indirect violence exposure on externalizing behavior in children. *Journal of urban health*, *93*(3), 479-492.

Font, S. A., & Berger, L. M. (2015). Child maltreatment and children's developmental trajectories in early to middle childhood. *Child development, 86*(2), 536-556.

Forehand, R., Biggar, H., & Kotchick, B. A. (1998). Cumulative risk across family stressors: Short- and long-term effects for adolescents. Journal of Abnormal Child Psychology, 26, 119–128.

Forray, A. (2016). Substance use during pregnancy. *F1000Research,* 5.

Franklin, L., Deitz, J., Jirikowic, T., & Astley, S. (2008). Children with fetal alcohol spectrum disorders: problem behaviors and sensory processing. *The American Journal of Occupational Therapy*, *62*(3), 265.

Franzese, R. J., Covey, H. C., Tucker, A. S., McCoy, L., & Menard, S. (2014). Adolescent exposure to violence and adult physical and mental health problems. *Child abuse & neglect*, *38*(12), 1955-1965.

Fratto, C. M. (2016). Trauma-informed care for youth in foster care. *Archives of psychiatric nursing*, *30*(3), 439-446.

Friedman, S. H., Heneghan, A., & Rosenthal, M. (2009). Characteristics of women who do not seek prenatal care and implications for prevention. *Journal of Obstetric, Gynecologic & Neonatal Nursing*, *38*(2), 174-181.

Fryer, S. L., McGee, C. L., Matt, G. E., Riley, E. P., & Mattson, S. N. (2007a). Evaluation of psychopathological conditions in children with heavy prenatal alcohol exposure. Pediatrics, 119(3), e733-e741.

Fryer, S. L., Tapert, S. F., Mattson, S. N., Paulus, M. P., Spadoni, A. D., & Riley, E. P. (2007b). Prenatal alcohol exposure affects frontal-striatal bold response during inhibitory control. *Alcoholism: Clinical and Experimental Research*, *31*(8), 1415–1424. doi:10.1111/j.1530-0277.2007.00443.x

Fuglestad, A. J., Whitley, M. L., Carlson, S. M., Boys, C. J., Eckerle, J. K., Fink, B. A., & Wozniak, J. R. (2015). Executive functioning deficits in preschool children with Fetal Alcohol Spectrum Disorders. *Child Neuropsychology*, *21*(6), 716-731.

Gahagan, S., Sharpe, T. T., Brimacombe, M., Fry-Johnson, Y., Levine, R., Mengel, M., ... & Brenneman, G. (2006). Pediatricians' knowledge, training, and experience in the care of children with fetal alcohol syndrome. *Pediatrics, 118*(3), e657-e668.

Gautam, P., Nunez, S. C., Narr, K. L., Kan, E. C., & Sowell, E. R. (2014). Effects of prenatal alcohol exposure on the development of white matter volume and change in executive function. *Neuro-Image Clinical*, *5*, 19–27. doi:10.1016/j.nicl.2014.05.010

Gavin, N. I., Gaynes, B. N., Lohr, K. N., Meltzer-Brody, S., Gartlehner, G., & Swinson, T. (2005). Perinatal depression: a systematic review of prevalence and incidence. *Obstetrics & Gynecology*, *106*(5), 1071-1083.

Gerard, J. M., & Buehler, C. (2004). Cumulative environmental risk and youth problem behavior. Journal of Marriage and Family, 66, 702–720.

Gioia, G.A., Isquith, P.K., Guy, S.C., & Kenworthy, L. (2013). The Behaviour Rating Inventory of Executive Functioning, Parent Form – Second Edition. PAR.

Glass, L., Ware, A. L., Crocker, N., Deweese, B. N., Coles, C. D., Kable, J. A., ... & Riley, E. P. (2013). Neuropsychological deficits associated with heavy prenatal alcohol exposure are not exacerbated by ADHD. *Neuropsychology*, *27*(6), 713.

Goel, N., Beasley, D., Rajkumar, V., & Banerjee, S. (2011). Perinatal outcome of illicit substance use in pregnancy—comparative and contemporary socio-clinical profile in the UK. *European journal of pediatrics*, *170*(2), 199-205.

Gouin, K., Murphy, K., & Shah, P. S. (2011). Effects of cocaine use during pregnancy on low birthweight and preterm birth: systematic review and metaanalyses. *American journal of obstetrics and gynecology*, *204*(4), 340-e1.

Grasso, D. J., Ford, J. D., & Briggs-Gowan, M. J. (2012). Early life trauma exposure and stress sensitivity in young children. *Journal of pediatric psychology*, *38*(1), 94-103.

Green, C. R., Mihic, A. M., Nikkel, S. M., Stade, B. C., Rasmussen, C., Munoz, D. P., & Reynolds, J. N. (2009). Executive function deficits in children with fetal alcohol spectrum disorders (FASD) measured using the Cambridge Neuropsychological Tests Automated Battery (CANTAB). *Journal of Child Psychology and Psychiatry, 50*(6), 688-697.

Green, M. J., Tzoumakis, S., McIntyre, B., Kariuki, M., Laurens, K. R., Dean, K., ... & Carr, V. J. (2018). Childhood maltreatment and early developmental vulnerabilities at age 5 years. *Child development, 89*(5), 1599-1612.

Guinosso, S. A., Johnson, S. B., & Riley, A. W. (2016). Multiple adverse experiences and child cognitive development. *Pediatric Research*, *79*(1-2), 220.

Gunn, J. K. L., Rosales, C. B., Center, K. E., Nuñez, A., Gibson, S. J., Christ, C., & Ehiri, J. E. (2016). Prenatal exposure to cannabis and maternal and child health outcomes: a systematic review and meta-analysis. *BMJ open*, *6*(4), e009986.

Hackman, D. A., & Farah, M. J. (2009). Socioeconomic status and the developing brain. *Trends in cognitive sciences*, *13*(2), 65-73.

Hamułka, J., Zielińska, M. A., & Chądzyńska, K. (2018). The combined effects of alcohol and tobacco use during pregnancy on birth outcomes. *Rocz Panstw Zakl Hig, 69*(1), 45-54.

Harding, K., Flannigan, K, & McFarlane, A. (2019). Policy Action Paper: Toward a Standard Definition of Fetal Alcohol Spectrum Disorder in Canada. *Canada Fetal Alcohol Spectrum Disorder Research Network, Canada.*

Havens, J. R., Simmons, L. A., Shannon, L. M., & Hansen, W. F. (2009). Factors associated with substance use during pregnancy: results from a national sample. *Drug and alcohol dependence, 99*(1-3), 89-95.

Heim, C., Shugart, M., Craighead, W. E., & Nemeroff, C. B. (2010). Neurobiological and psychiatric consequences of child abuse and neglect. *Developmental psychobiology*, *52*(7), 671-690.

Himes, S. K., Stroud, L. R., Scheidweiler, K. B., Niaura, R. S., & Huestis, M. A. (2013). Prenatal tobacco exposure, biomarkers for tobacco in meconium, and neonatal growth outcomes. *The Journal of pediatrics*, *162*(5), 970-975.

Horan, J. M., & Widom, C. S. (2015). Cumulative childhood risk and adult functioning in abused and neglected children grown up. *Development and psychopathology*, *27*(3), 927-941

Hornor, G. (2012). Emotional maltreatment. *Journal of Pediatric Health Care*, *26*(6), 436-442.

Hosenbocus, S., & Chahal, R. (2012). A Review of Executive Function Deficits and Pharmacological Management in Children and Adolescents. *Journal of the Canadian Academy of Child and Adolescent Psychiatry*, *21*(3), 223–229.

Hughes, M., & Tucker, W. (2018). Poverty as an adverse childhood experience. *North Carolina medical journal*, *79*(2), 124-126.

Humphreys, K. L., & Zeanah, C. H. (2015). Deviations from the expectable environment in early childhood and emerging psychopathology. *Neuropsychopharmacology*, *40*(1), 154.

Humphreys, K. L., Nelson, C. A., Fox, N. A., & Zeanah, C. H. (2017). Signs of reactive attachment disorder and disinhibited social engagement disorder at age 12 years: Effects of institutional care history and high-quality foster care. *Development and psychopathology*, *29*(2), 675-684.

Hutchins, E., & Dipietro, J. (1997). Psychosocial risk factors associated with cocaine use during pregnancy: A case-control study. *Obstetrics & Gynecology, 90*(1), 142-147.

Iftene, F., & Roberts, N. (2004). Romanian adolescents: Literature review and psychiatric presentation of romanian adolescents adopted in romania and in canada. *The Canadian child and adolescent psychiatry review*, *13*(4), 110.

Infurna, M. R., Reichl, C., Parzer, P., Schimmenti, A., Bifulco, A., & Kaess, M. (2016). Associations between depression and specific childhood experiences of abuse and neglect: a meta-analysis. *Journal of affective disorders*, *190*, 47-55.

Janisse, J. J., Bailey, B. A., Ager, J., & Sokol, R. J. (2014). Alcohol, tobacco, cocaine, and marijuana use: relative contributions to preterm delivery and fetal growth restriction. *Substance Abuse*, *35*(1), 60-67.

Jones, K., & Smith, D. (1973). Recognition of the fetal alcohol syndrome in early infancy. *The Lancet, 302*(7836), 999-1001.

Jones, K., Smith, D., Ulleland, C., & Streissguth, A. (1973). Pattern of malformation in offspring of chronic alcoholic mothers. *The Lancet, 301*(7815), 1267-1271.

Kable, J. A., O'Connor, M. J., Carmichael Olson, H., Paley, B., Mattson, S. N.,Anderson, S. M., & Riley, E. P. (2016). Neurobehavioral disorder associatedwith prenatal alcohol exposure (ND-PAE); proposed DSM-5 diagnosis. *Child Psychiatry and Human Development,47*(2), 335–346. doi: 10:1007/s10578-015-0566-7

Kable, J. A., Taddeo, E., Strickland, D., & Coles, C. D. (2016). Improving FASD children's self-regulation: Piloting phase 1 of the GoFAR intervention. *Child & family behavior therapy*, *38*(2), 124-141.

Kamphaus, R. W., & Campbell, J. M. (Eds.). (2008). Psychodiagnostic assessment of children: Dimensional and categorical approaches. John Wiley & Sons.

Kaplow, J. B., & Widom, C. S. (2007). Age of onset of child maltreatment predicts long-term mental health outcomes. *Journal of abnormal Psychology*, *116*(1), 176.

Keeshin, B. R., & Dubowitz, H. (2013). Childhood neglect: the role of the paediatrician. *Paediatrics & child health*, *18*(8), e39-e43.

Kelly, Y. J., Sacker, A., Gray, R., Kelly, J., Wolke, D., Head, J., & Quigley, M. A. (2012). Light drinking during pregnancy: still no increased risk for socioemotional difficulties or cognitive deficits at 5 years of age?. *J Epidemiol Community Health, 66*(1), 41-48.

Kelly, Y., Sacker, A., Gray, R., Kelly, J., Wolke, D., & Quigley, M. A. (2009). Light drinking in pregnancy, a risk for behavioural problems and cognitive deficits at 3 years of age?. *International journal of epidemiology, 38*(1), 129-140.

Kerker, B. D., Zhang, J., Nadeem, E., Stein, R. E., Hurlburt, M. S., Heneghan, A., ... & Horwitz, S. M. (2015). Adverse childhood experiences and mental health, chronic medical conditions, and development in young children. *Academic pediatrics*, *15*(5), 510-517.

Kerns, K. A., Audrey, D., Mateer, C. A., & Streissguth, A. P. (1997). Cognitive deficits in nonretarded adults with Fetal Alcohol Syndrome. *Journal of Learning Disabilities, 30*(6), 685-693

Kharkova, O., Grjibovski, A., Krettek, A., Nieboer, E., & Odland, J. (2017). Effect of smoking behavior before and during pregnancy on selected birth outcomes among singleton full-

term pregnancy: a murmansk county birth registry study. *International journal of environmental research and public health*, *14*(8), 867

Khoury, J. E., Jamieson, B., & Milligan, K. (2018). Risk for Childhood Internalizing and Externalizing Behavior Problems in the Context of Prenatal Alcohol Exposure: A Meta-Analysis and Comprehensive Examination of Moderators. *Alcoholism: Clinical and Experimental Research*, *42*(8), 1358-1377.

Kim, S., & Brody, G. H. (2005). Longitudinal pathways to psychological adjustment among Black youth living in single-parent households. *Journal of Family Psychology, 19,* 305-313. doi:10.1037/0893-3200.19.2.305

Kingdon, D., Cardoso, C., & McGrath, J. J. (2016). Research Review: Executive function deficits in fetal alcohol spectrum disorders and attention-deficit/hyperactivity disorder–a meta-analysis. Journal of Child Psychology and Psychiatry, 57(2), 116-131.

Kodituwakku, P. W. (2007). Defining the behavioral phenotype in children with fetal alcohol spectrum disorders: A review. *Neuroscience and Biobehavioral Reviews, 31*, 192–201.

Kodituwakku, P. W., Handmaker, N. S., Cutler, S. K., Weathersby, E. K., & Handmaker, S. D. (1995). Specific impairments in self-regulation in children exposed to alcohol prenatally. *Alcoholism: Clinical and Experimental Research*, *19*, 1558–1564.

Kodituwakku, P.W. (2009). Neurocognitive profile in children with fetal alcohol spectrum disorders. *Developmental Disabilities Research Reviews, 15*, 218–224.

Koenen, K. C., Moffitt, T. E., Caspi, A., Taylor, A., & Purcell, S. (2003). Domestic violence is associated with environmental suppression of IQ in young children. *Development and psychopathology*, *15*(2), 297-311.

Koponen, A. M., Kalland, M., & Autti-Rämö, I. (2009). Caregiving environment and socio-emotional development of foster-placed FASD-children. *Children and Youth Services Review*, *31*(9), 1049-1056

Lange, S., Probst, C., Gmel, G., Rehm, J., Burd, L., & Popova, S. (2017). Global prevalence of fetal alcohol spectrum disorder among children and youth: a systematic review and meta-analysis. *JAMA pediatrics*, *171*(10), 948-956.

Laraia, B. A., Siega-Riz, A. M., Gundersen, C., & Dole, N. (2006). Psychosocial factors and socioeconomic indicators are associated with household food insecurity among pregnant women. *The Journal of nutrition*, *136*(1), 177-182.

Lebel, C. A., McMorris, C. A., Kar, P., Ritter, C., Andre, Q., Tortorelli, C., & Gibbard, W. B. (2019). Characterizing adverse prenatal and postnatal experiences in children. Birth defects research, 1-11. doi: 10.1002/bdr2.1464

Lebel, C., Roussotte, F., & Sowell, E. R. (2011). Imaging the impact of prenatal alcohol exposure on the structure of the developing human brain. *Neuropsychology review*, *21*(2), 102-118.

Lee, R. S. C., Hermens, D. F., Porter, M. a., & Redoblado-Hodge, M. A. (2012). A meta-analysis of cognitive deficits in first-episode major depressive disorder. *Journal of Affective Disorders, 140*(2), 113– 124.

Leemaqz, S. Y., Dekker, G. A., McCowan, L. M., Kenny, L. C., Myers, J. E., Simpson, N. A., ... & SCOPE Consortium. (2016). Maternal marijuana use has independent effects on risk for spontaneous preterm birth but not other common late pregnancy complications. *Reproductive Toxicology*, *62*, 77-86.

Lewis, A., Austin, E., Knapp, R., Vaiano, T., & Galbally, M. (2015, December). Perinatal maternal mental health, fetal programming and child development. In *Healthcare* (Vol. 3, No. 4, pp. 1212-1227). Multidisciplinary Digital Publishing Institute.

Litrownik, A. J., Newton, R., Hunter, W. M., English, D., & Everson, M. D. (2003). Exposure to family violence in young at-risk children: A longitudinal look at the effects of victimization and witnessed physical and psychological aggression. *Journal of Family Violence*, *18*(1), 59-73.

Logan-Greene, P., Nurius, P. S., Hooven, C., & Thompson, E. A. (2013). The sustained impact of adolescent violence histories on early adulthood outcomes. *Victims & offenders*, *8*(2), 231-252.

Loman, M. M., Johnson, A. E., Westerlund, A., Pollak, S. D., Nelson, C. A., & Gunnar, M. R. (2013). The effect of early deprivation on executive attention in middle childhood. *Journal of Child Psychology and Psychiatry*, *54*(1), 37-45.

Luby, J., Belden, A., Botteron, K., Marrus, N., Harms, M. P., Babb, C., ... & Barch, D. (2013). The effects of poverty on childhood brain development: the mediating effect of caregiving and stressful life events. *JAMA pediatrics*, *167*(12), 1135-1142.

Maag, J., & Reid, R. (2006). Depression among students with learning disabilities: Assessing the risk. *Journal of Learning Disabilities*, *39*, 3–10.

Maguire, S. A., Williams, B., Naughton, A. M., Cowley, L. E., Tempest, V., Mann, M. K., ... & Kemp, A. M. (2015). A systematic review of the emotional, behavioural and cognitive features exhibited by school-aged children experiencing neglect or emotional abuse. *Child: care, health and development*, *41*(5), 641-653.

Maguire, S. A., Williams, B., Naughton, A. M., Cowley, L. E., Tempest, V., Mann, M. K., ... & Kemp, A. M. (2015). A systematic review of the emotional, behavioural and cognitive features exhibited by school-aged children experiencing neglect or emotional abuse. *Child: care, health and development, 41*(5), 641-653.

Mahan, S., & Matson, J. L. (2011). Children and adolescents with autism spectrum disorders compared to typically developing controls on the Behavioral Assessment System for Children, (BASC-2). Research in Autism Spectrum Disorders, 5(1), 119-125.

Mark, K., Desai, A., & Terplan, M. (2016). Marijuana use and pregnancy: prevalence, associated characteristics, and birth outcomes. *Archives of women's mental health*, *19*(1), 105-111.

Marzuk, P. M., Hartwell, N., Leon, A. C., & Portera, L. (2005). Executive functioning in depressed patients with suicidal ideation. *Acta Psychiatrica Scandinavica, 112*(4), 294-301.

Mattson, S. N., & Riley, E. P. (1998). A Review of the Neurobehavioral Deficits in Children with Fetal Alcohol Syndrome or Prenatal Exposure to Alcohol. *Alcoholism: Clinical and experimental research, 22*(2), 279-294.

Mattson, S. N., & Riley, E. P. (2000). Parent ratings of behavior in children with heavy prenatal alcohol exposure and IQ-matched controls. *Alcoholism: Clinical and Experimental Research, 24*(2), 226-231.

Mattson, S. N., & Roebuck, T. M. (2002). Acquisition and retention of verbal and nonverbal information in children with heavy prenatal alcohol exposure. *Alcoholism: Clinical and Experimental Research*, *26*(6), 875-882.

Mattson, S. N., Foroud, T., Sowell, E. R., Jones, K. L., Coles, C. D., Fagerlund, Å., ... & Wetherill, L. (2010). Collaborative initiative on fetal alcohol spectrum disorders: methodology of clinical projects. *Alcohol*, *44*(7-8), 635-641.

Mattson, S. N., Riley, E. P., Delis, D. C., Stern, C., & Jones, K. L. (1996). Verbal learning and memory in children with fetal alcohol syndrome. *Alcoholism: Clinical and Experimental Research, 20*(5), 810-816.

Mattson, S. N., Riley, E. P., Gramling, L., Delis, D. C., Jones, K. L., & of Dysmorphology, T. D. (1997). Heavy prenatal alcohol exposure with or without physical features of fetal alcohol syndrome leads to IQ deficits. The Journal of pediatrics, 131(5), 718-721.

Mattson, S. N., Roesch, S. C., Glass, L., Deweese, B. N., Claire, D., Coles, J., May, W. O., Kalberg, E. R., Sowell, C. M., Kenneth, A., Lyons, J., Riley, E. P., & the CIFASD. (2011). Further Development of a Neurobehavioral Profile of Fetal Alcohol Spectrum Disorders. *Alcoholism: Clinical and Experimental Research*, 1- 12.

May, P. A., Baete, A., Russo, J., Elliott, A. J., Blankenship, J., Kalberg, W. O., ... & Adam, M. P. (2014). Prevalence and characteristics of fetal alcohol spectrum disorders. Pediatrics, 134(5), 855.

May, P. A., Blankenship, J., Marais, A. S., Gossage, J. P., Kalberg, W. O., Joubert, B., ... & Robinson, L. K. (2013). Maternal alcohol consumption producing fetal alcohol spectrum disorders (FASD): quantity, frequency, and timing of drinking. *Drug and alcohol dependence*, *133*(2), 502-512.

May, P. A., Chambers, C. D., Kalberg, W. O., Zellner, J., Feldman, H., Buckley, D., ... & Taras, H. (2018). Prevalence of fetal alcohol spectrum disorders in 4 US communities. *Jama*, *319*(5), 474-482.

May, P. A., Tabachnick, B., Hasken, J. M., Marais, A. S., de Vries, M. M., Barnard, R., ... & Buckley, D. (2017). Who is most affected by prenatal alcohol exposure: Boys or girls?. *Drug and alcohol dependence, 177,* 258-267.

McFadyen, R. G., & Kitson, W. J. (1996). Language comprehension and expression among adolescents who have experienced childhood physical abuse. *Journal of Child Psychology and Psychiatry*, *37*(5), 551-562.

McGoron, L., Gleason, M. M., Smyke, A. T., Drury, S. S., Nelson III, C. A., Gregas, M. C., ... & Zeanah, C. H. (2012). Recovering from early deprivation: attachment mediates effects of caregiving on psychopathology. *Journal of the American Academy of Child & Adolescent Psychiatry*, *51*(7), 683-693.

McLachlan, K. E. (2012). *An examination of the abilities, risks, and needs of adolescents and young adults with Fetal Alcohol Spectrum Disorder (FASD) in the criminal justice system* (Doctoral dissertation, Arts & Social Sciences: Department of Psychology).

McLaughlin, K. A., Sheridan, M. A., & Lambert, H. K. (2014). Childhood adversity and neural development: deprivation and threat as distinct dimensions of early experience. *Neuroscience & Biobehavioral Reviews*, *47*, 578-591.

McLaughlin, K. A., Sheridan, M. A., Gold, A. L., Duys, A., Lambert, H. K., Peverill, M., ... & Pine, D. S. (2016). Maltreatment exposure, brain structure, and fear conditioning in children and adolescents. *Neuropsychopharmacology*, *41*(8), 1956.

McNally, R. J., Lasko, N. B., Macklin, M. L., & Pitman, R. K. (1995). Autobiographical memory disturbance in combat-related posttraumatic stress disorder. *Behavior Research and Therapy*, *33*, 619–630. doi: 10.1016/0005-7967(95)00007-K

Merz, E. C., & McCall, R. B. (2010). Behavior problems in children adopted from psychosocially depriving institutions. *Journal of abnormal child psychology*, *38*(4), 459-470.

Millar, J. A., Thompson, J., Schwab, D., Hanlon-Dearman, A., Goodman, D., Koren, G., & Masotti, P. (2017). Educating students with FASD: linking policy, research and practice. Journal of Research in Special Educational Needs, 17(1), 3-17.

Miller, P., & Votruba-Drzal, E. (2017). The role of family income dynamics in predicting trajectories of internalizing and externalizing problems. *Journal of abnormal child psychology*, *45*(3), 543-556.

Millians, M. N. (2015). Educational needs and care of children with FASD. *Current Developmental Disorders Reports*, *2*(3), 210-218.

Minnes, S., Lang, A., & Singer, L. (2011). Prenatal tobacco, marijuana, stimulant, and opiate exposure: outcomes and practice implications. *Addiction science & clinical practice*, *6*(1), 57.

Morales, J. R., & Guerra, N. G. (2006). Effects of multiple context and cumulative stress on urban children's adjustment in elementary school. Child Development, 77, 907–923.

Morleo, M., Woolfall, K., Dedman, D., Mukherjee, R., Bellis, M. A., & Cook, P. A. (2011). Under-reporting of foetal alcohol spectrum disorders: an analysis of hospital episode statistics. *BMC pediatrics*, *11*(1), 14.

Mottram, L., & Donders, J. (2005). Construct validity of the California Verbal Learning Test--Children's Version (CVLT-C) after pediatric traumatic brain injury. *Psychological assessment, 17*(2), 212.

Moylan, C. A., Herrenkohl, T. I., Sousa, C., Tajima, E. A., Herrenkohl, R. C., & Russo, M. J. (2010). The effects of child abuse and exposure to domestic violence on adolescent internalizing and externalizing behavior problems. *Journal of family Violence*, *25*(1), 53-63.

Mukherjee, R. A., Cook, P. A., Norgate, S. H., & Price, A. D. (2019). Neurodevelopmental outcomes in individuals with fetal alcohol spectrum disorder (FASD) with and without exposure to neglect: Clinical cohort data from a national FASD diagnostic clinic. *Alcohol, 76,* 23-28.

Mulder, E. J., De Medina, P. R., Huizink, A. C., Van den Bergh, B. R., Buitelaar, J. K., & Visser, G. H. (2002). Prenatal maternal stress: effects on pregnancy and the (unborn) child. *Early human development*, *70*(1-2), 3-14.

Nash, K. J. (2012). Improving Executive Functioning in Children with Fetal Alcohol Spectrum Disorders Using the Alert Program for Self Regulation®. *University of Toronto* (Canada).

Nash, K., Rovet, J., Greenbaum, R., Fantus, E., Nulman, I., & Koren, G. (2006). Identifying the behavioural phenotype in fetal alcohol spectrum disorder: sensitivity, specificity and screening potential. *Archives of women's mental health*, *9*(4), 181-186.

Nash, K., Stevens, S., Greenbaum, R., Weiner, J., Koren, G., & Rovet, J. (2015). Improving executive functioning in children with fetal alcohol spectrum disorders. *Child Neuropsychology, 21*(2), 191-209.

National Survey on Drug Use and Health (2016). Substance Abuse and Mental Health Services, Center for Behavioural Health Statistics and Quality. Rockville, Maryland

Navalta, C. P., Polcari, A., Webster, D. M., Boghossian, A., & Teicher, M. H. (2006). Effects of childhood sexual abuse on neuropsychological and cognitive function in college women. *The Journal of neuropsychiatry and clinical neurosciences*, *18*(1), 45-53.

Nelson, C. A., Zeanah, C. H., Fox, N.a., Marshall, P. J., Smyke, A. T., & Guthrie, D. (2007). Cognitive recovery in socially deprived Young children: The Bucharest early intervention project. Science, 318, 1937–1940.

Nelson, J., & Harwood, H. (2011a). Learning disabilities and anxiety: A meta-analysis. *Journal of Learning Disabilities*, *44*, 3–17.

Nelson, J., & Harwood, H. (2011b). A meta-analysis of parent and teacher reports of depression among students with learning disabilities: Evidence for the importance of multi-informant assessment. *Psychology in the Schools*, *48*, 371–384.

Newton, R. R., Litrownik, A. J., & Landsverk, J. A. (2000). Children and youth in foster care: Disentangling the relationship between problem behaviors and number of placements. *Child abuse & neglect*, *24*(10), 1363-1374.

Nicodimos, S., Gelaye, B., Williams, M. A., & Berhane, Y. (2009). Associations between witnessing parental violence and experiencing symptoms of depression among college students. *East African journal of public health*, *6*(2), 184.

Nikulina, V., & Widom, C. S. (2013). Child maltreatment and executive functioning in middle adulthood: a prospective examination. *Neuropsychology, 27*(4), 417.

O'Connor, M. J. (2014). Mental health outcomes associated with prenatal alcohol exposure: Genetic and environmental factors. *Current Developmental Disorders Reports,1,* 181–188. doi: 10.1007/s40474-014-0021-7

O'Connor, M. J., & Paley, B. (2009). Psychiatric conditions associated with prenatal alcohol exposure. *Developmental disabilities research reviews*, *15*(3), 225-234.

O'Connor, M. J., Frankel, F., Paley, B., Schonfeld, A. M., Carpenter, E., Laugeson, E. A., & Marquardt, R. (2006). A controlled social skills training for children with fetal alcohol spectrum disorders. *Journal of consulting and clinical psychology*, *74*(4), 639.

O'Connor, M. J., Portnoff, L. C., Lebsack-Coleman, M., & Dipple, K. M. (2019). Suicide risk in adolescents with fetal alcohol spectrum disorders. *Birth defects research*.

O'Connor, M. J., Shah, B., Whaley, S., Cronin, P., Gunderson, B., & Graham, J. (2002). Psychiatric illness in a clinical sample of children with prenatal alcohol exposure. *The American journal of drug and alcohol abuse, 28(*4), 743-754.

O'Connor, T. G., Rutter, M., & English and Romanian Adoptees Study Team. (2000). Attachment disorder behavior following early severe deprivation: Extension and longitudinal follow-up. *Journal of the American Academy of Child & Adolescent Psychiatry*, *39*(6), 703-712.

O'Hara, M., Legano, L., Homel, P., Walker-Descartes, I., Rojas, M., & Laraque, D. (2015). Children neglected: Where cumulative risk theory fails. *Child abuse & neglect, 45,* 1-8.

Oliver, B. R., Kretschmer, T., & Maughan, B. (2014). Configurations of early risk and their association with academic, cognitive, emotional and behavioural outcomes in middle childhood. *Social psychiatry and psychiatric epidemiology*, *49*(5), 723-732.

Olson, H. C., Streissguth, A. P., Sampson, P. D., Barr, H. M., Bookstein, F. L., & Thiede, K. (1997). Association of prenatal alcohol exposure with behavioral and learning problems in early adolescence. *Journal of the American Academy of Child & Adolescent Psychiatry, 36*(9), 1187-1194.

Paintner, A., Williams, A. D., & Burd, L. (2012). Fetal alcohol spectrum disorders—Implications for child neurology, Part 2: Diagnosis and management. *Journal of Child Neurology*, *27*(3), 355-362.

Panczakiewicz, A. L., Glass, L., Coles, C. D., Kable, J. A., Sowell, E. R., Wozniak, J. R., ... & CIFASD. (2016). Neurobehavioral deficits consistent across age and sex in youth with prenatal alcohol exposure. *Alcoholism: Clinical and Experimental Research*, *40*(9), 1971-1981.

Pare-Miron, V., Czuzoj-Shulman, N., Oddy, L., Spence, A. R., & Abenhaim, H. A. (2016). Effect of borderline personality disorder on obstetrical and neonatal outcomes. *Women's Health Issues*, *26*(2), 190-195.

Pears, K. C., Kim, H. K., & Fisher, P. A. (2008). Psychosocial and cognitive functioning of children with specific profiles of maltreatment. *Child abuse & neglect, 32*(10), 958-971.

Pechtel, P., & Pizzagalli, D. A. (2011). Effects of early life stress on cognitive and affective function: an integrated review of human literature. *Psychopharmacology*, *214*(1), 55-70.

Pei, J. R., Rinaldi, C. M., Rasmussen, C., Massey, V., & Massey, D. (2008). Memory patterns of acquisition and retention of verbal and nonverbal information in children with fetal alcohol spectrum disorders. *Journal of Population Therapeutics and Clinical Pharmacology*, *15*(1).

Pei, J., Denys, K., Hughes, J., & Rasmussen, C. (2011). Mental health issues in fetal alcohol spectrum disorder. *Journal of Mental Health, 20*(5), 438-448. doi: 10.3109/09638237.2011.577113

Peltonen, K., Ellonen, N., Larsen, H. B., & Helweg-Larsen, K. (2010). Parental violence and adolescent mental health. *European Child & Adolescent Psychiatry*, *19*(11), 813-822.

Perry, K. J., & Price, J. M. (2017). The role of placement history and current family environment in children's aggression in foster care. *Journal of child and family studies*, *26*(4), 1135-1150.

Popova, S. (2018). *World Health Organization international study on the prevalence of fetal alcohol spectrum disorder (FASD): Canadian component*. Institute for Mental Health Policy Research, Centre for Addiction and Mental Health.

Popova, S., Lange, S., Probst, C., Parunashvili, N., & Rehm, J. (2017). Prevalence of alcohol consumption during pregnancy and Fetal Alcohol Spectrum Disorders among the general and Aboriginal populations in Canada and the United States. *European Journal of Medical Genetics, special issue on updates in "Teratology and The Fetal Alcohol Spectrum Disorders", 60*(1), 32-48. doi: 10.1016/j.ejmg.2016.09.010

Porter, R. J., Bourke, C., & Gallagher, P. (2007). Neuropsychological impairment in major depression: its nature, origin and clinical significance. *Australian and New Zealand Journal of Psychiatry*, *41*(2), 115-128.

Porter, R. J., Robinson, L. J., Malhi, G. S., & Gallagher, P. (2015). The neurocognitive profile of mood disorders–a review of the evidence and methodological issues. *Bipolar disorders*, *17*, 21-40.

Price, A., Cook, P. A., Norgate, S., & Mukherjee, R. (2017). Prenatal alcohol exposure and traumatic childhood experiences: A systematic review. *Neuroscience & Biobehavioral Reviews, 80,* 89-98.

Public Health Agency of Canada (2010). Canadian Incidence Study of Reported Child Abuse and Neglect - 2008: Major Findings. Ottawa, ON.

Quattlebaum, J. L., & O'Connor, M. J. (2012). Higher functioning children with prenatal alcohol exposure: Is there a specific neurocognitive profile? *Child Neuropsychology: A Journal on Normal and Abnormal Development in Childhood and Adolescence,* doi: 10.1080/09297049.2012.713466

Quoidbach, J., Mikolajczak, M., & Gross, J. J. (2015). Positive interventions: An emotion regulation perspective. *Psychological Bulletin, 141*(3), 655-693. doi: 10.1037/a0038648

Raiford, S., Zhou, X., & Drozdick, L. (2016). *Using the WASI-II with the WISC-V*. Wechsler Intelligence Scale for Children - Fifth Edition Technical Manual #3. Retrieved from https://www.researchgate.net/publication/296902556_Using_the_WASI-II_with_the_WISC-V

Raikes, H. A., Robinson, J. L., Bradley, R. H., Raikes, H. H., & Ayoub, C. C. (2007). Developmental trends in self-regulation among low-income toddlers. *Social Development, 1,* 128-149.

Rasmussen, C. (2005). Executive functioning and working memory in fetal alcohol spectrum disorder. Alcoholism: Clinical and Experimental Research, 29, 1359–1367.

Rasmussen, C. & Bisanz, J. (2009). Executive functioning in children with Fetal Alcohol Spectrum Disorder: Profiles and age-related differences. *Child Neuropsychology*. *15 (3),* 201-215.

Rasmussen, C., & Bisanz, J. (2011). The relation between mathematics and working memory in young children with fetal alcohol spectrum disorders. The Journal of Special Education, 45(3), 184-191.

Rasmussen, C., Andrew, G., Zwaigenbaum, L., & Tough, S. (2008). Neurobehavioural outcomes of children with fetal alcohol spectrum disorders: A Canadian perspective. *Paediatrics & child health, 13*(3), 185-191.

Rasmussen, C., Benz, J., Pei, J., Andrew, G., Schuller, G., Abele-Webster, L., ... & Lord, L. (2010). The impact of an ADHD co-morbidity on the diagnosis of FASD. *Journal of Population Therapeutics and Clinical Pharmacology*, *17*(1).

Rasmussen, C., Tamana, S., Baugh, L., Andrew, G., Tough, S., & Zwaigenbaum, L. (2013). Neuropsychological impairments on the NEPSY-II among children with FASD. *Child Neuropsychology*, *19*(4), 337-349.

Raviv, T., Taussig, H. N., Culhane, S. E., & Garrido, E. F. (2010). Cumulative risk exposure and mental health symptoms among maltreated youth placed in out-of-home care. *Child abuse & neglect*, *34*(10), 742-751.

Riley, E. P., Infante, M. A., & Warren, K. R. (2011). Fetal alcohol spectrum disorders: an overview. *Neuropsychology review*, *21*(2), 73.

Robinson, L. J., Thompson, J. M., Gallagher, P., Goswami, U., Young, A. H., Ferrier, I. N., & Moore, P. B. (2006). A meta-analysis of cognitive deficits in euthymic patients with bipolar disorder. *Journal of affective disorders*, *93*(1-3), 105-115.

Robinson, M., Oddy, W. H., McLean, N. J., Jacoby, P., Pennell, C. E., De Klerk, N. H., ... & Newnham, J. P. (2010). Low–moderate prenatal alcohol exposure and risk to child behavioural development: a prospective cohort study. *BJOG: An International Journal of Obstetrics & Gynaecology, 117*(9), 1139-1152.

Rodrigues, T., Rocha, L., & Barros, H. (2008). Physical abuse during pregnancy and preterm delivery. *American Journal of Obstetrics and Gynecology*, *198*(2), 171-e1.

Ross, L. E., & McLean, L. M. (2006). Anxiety disorders during pregnancy and the postpartum period: A systematic review. *The Journal of clinical psychiatry*.

Roussotte, F. F., Rudie, J. D., Smith, L., O'Connor, M. J., Bookheimer, S. Y., Narr, K. L., & Sowell, E. R. (2012). Frontostriatal connectivity in children during working memory and the effects of prenatal methamphetamine, alcohol, and polydrug exposure. *Developmental Neuroscience*, *34*(1), 43–57. doi:10.1159/000336242

Rubertsson, C., Hellström, J., Cross, M., & Sydsjö, G. (2014). Anxiety in early pregnancy: prevalence and contributing factors. *Archives of women's mental health*, *17*(3), 221-228.

Rusner, M., Berg, M., & Begley, C. (2016). Bipolar disorder in pregnancy and childbirth: a systematic review of outcomes. *BMC pregnancy and childbirth*, *16*(1), 331.

Rutter, M. (1979). Protective factors in children's responses to stress and disadvantage. In M.W. Kent & J. E. Rolf (Eds.), Primary prevention of psychopathology: Vol. 3. Social competence in children (pp. 49–74). Hanover, NH: University Press of New England.

Rutter, M. (1981). Stress, coping, and development: Some issues and some questions. Journal of Child Psychology and Psychiatry, 22, 323–356. doi:10.1111/j.1469-7610.1981.tb00560.x

Rutter, M. L. (1993). Resilience: Some conceptual considerations. Journal of Adolescent Health, 14, 626-631. doi:10.1016/1054-139X(93)90196-V

Rutter, M., Colvert, E., Kreppner, J., Beckett, C., Castle, J., Groothues, C., ... & Sonuga-Barke, E. J. (2007). Early adolescent outcomes for institutionally-deprived and non-deprived adoptees. I: Disinhibited attachment. *Journal of Child Psychology and Psychiatry*, *48*(1), 17-30.

Rutter, M., Kreppner, A., & Sonuga-Barke, E. (2009). Emanuel Miller Lecture: Attachment insecurity, disinhibited attachment, and attachment disorders: where do research findings leave the concepts? *Journal of Child Psychology and Psychiatry*, *50*(5), 529-543.

Salihu, H. M., & Wilson, R. E. (2007). Epidemiology of prenatal smoking and perinatal outcomes. *Early human development*, *83*(11), 713-720.

Sameroff, A. J. (1989). Models of developmental regulation: The environtype. In D. Cicchetti (), The emergence of a discipline: Rochester Symposium on Developmental Psychopathology (Vol. 1, pp. 41-68). Hillsdale, NJ: Erlbaum.

Sameroff, A. J. (2000). Developmental systems and psychopathology. Development and Psychopathology, 12, 297–312.

Sameroff, A. J. (2006). Identifying risk and protective factors for healthy child development. In A. Clarke-Stewart & J. Dunn (Eds.), Families count (pp. 53–76). doi:10.1017/CBO9780511616259.004

Sameroff, A. J., Bartko,W. T., Baldwin, A., Baldwin, C.,&Seifer, R. (1998). Family and social influences on the development of child competence. In M. Lewis & C. Feiring (Eds.), Families, risk, and competence (pp. 161– 186). New York: Wiley.

Sameroff, A. J., Seifer, R., & McDonough, S. C. (2004). Contextual contributors to the assessment of infant mental health. In R. DelCarmen-Wiggins & A. Carter (Eds.), Handbook of infant, toddler, and preschool mental health assessment (pp. 61–76). New York, NY: Oxford University Press.

Sameroff, A. J., Seifer, R., Baldwin, A., & Baldwin, C. (1993). Stability of intelligence from preschool to adolescence: The influence of social and family risk factors. *Child development, 64*(1), 80-97.

Sampson, P. D., Streissguth, A. P., Bookstein, F. L., & Barr, H. M. (2000). On categorizations in analyses of alcohol teratogenesis. Environmental Health Perspectives, 108(suppl 3), 421-428.

Samuelson, K. W., Krueger, C. E., Burnett, C., & Wilson, C. K. (2010). Neuropsychological functioning in children with posttraumatic stress disorder. *Child Neuropsychology*, *16*(2), 119-133.

Sayal, K., Heron, J., Golding, J., & Emond, A. (2007). Prenatal alcohol exposure and gender differences in childhood mental health problems: a longitudinal population-based study. *Pediatrics, 119(*2), e426-e434.

Schalinski, I., Teicher, M. H., Carolus, A. M., & Rockstroh, B. (2018). Defining the impact of childhood adversities on cognitive deficits in psychosis: an exploratory analysis. *Schizophrenia research*, *192*, 351-356.

Schempf, A. H., & Strobino, D. M. (2008). Illicit drug use and adverse birth outcomes: is it drugs or context?. *Journal of Urban Health*, *85*(6), 858.

Schonfeld, A. M., Mattson, S. N., & Riley, E. P. (2005). Moral maturity and delinquency after prenatal alcohol exposure. Journal of studies on alcohol, 66(4), 545-554.

Schonfeld, A. M., Paley, B., Frankel, F., & O'Connor, M. J. (2006). Executive functioning predicts social skills following prenatal alcohol exposure. *Child Neuropsychology, 12*(6), 439-452.

Schonfeld, A. M., Paley, B., Frankel, F., & O'Connor, M. J. (2009). Behavioral regulation as a predictor of response to Children's Friendship Training in children with fetal alcohol spectrum disorders. *The Clinical Neuropsychologist, 23*(3), 428-445.

Sheridan, M. A., & McLaughlin, K. A. (2014). Dimensions of early experience and neural development: deprivation and threat. *Trends in cognitive sciences*, *18*(11), 580-585.

Sheridan, M. A., Fox, N. A., Zeanah, C. H., McLaughlin, K. A., & Nelson, C. A. (2012). Variation in neural development as a result of exposure to institutionalization early in childhood. *Proceedings of the National Academy of Sciences*, *109*(32), 12927-12932.

Sheridan, M. A., Peverill, M., Finn, A. S., & McLaughlin, K. A. (2017). Dimensions of childhood adversity have distinct associations with neural systems underlying executive functioning. Development and Psychopathology, 29, 1777–1794.

Shin, S. H., Lee, S., Jeon, S. M., & Wills, T. A. (2015). Childhood emotional abuse, negative emotion-driven impulsivity, and alcohol use in young adulthood. *Child abuse & neglect*, *50*, 94-103.

Silva, R. R., Alpert, M., Munoz, D. M., Singh, S., Matzner, F., & Dummit, S. (2000). Stress and vulnerability to posttraumatic stress disorder in children and adolescents. *American Journal of Psychiatry*, *157*(8), 1229-1235.

Singal, D., Brownell, M., Chateau, D., Hanlon-Dearman, A., Longstaffe, S., & Roos, L. L. (2017). The psychiatric morbidity of women who give birth to children with fetal alcohol spectrum disorder (FASD): results of the Manitoba Mothers and FASD Study. The Canadian Journal of Psychiatry, 62(8), 531-542.

Singer, L. T., Arendt, R., Minnes, S., Farkas, K., & Salvator, A. (2000). Neurobehavioral outcomes of cocaine-exposed infants. *Neurotoxicology and Teratology*, *22*(5), 653-666.

Skinner, M. L., Hong, S., Herrenkohl, T. I., Brown, E. C., Lee, J. O., & Jung, H. (2016). Longitudinal effects of early childhood maltreatment on co-occurring substance misuse

and mental health problems in adulthood: the role of adolescent alcohol use and depression. *Journal of studies on alcohol and drugs*, *77*(3), 464-472.

Smetanin, P., Briante, C., Stiff, D., Ahmad, S., & Khan, M. (2015). *The life and economic impact of major mental illnesses in Canada*. Mental Health Commission of Canada.

Smyke, A. T., Zeanah, C. H., Fox, N. A., Nelson, C. A., & Guthrie, D. (2010). Placement in foster care enhances quality of attachment among young institutionalized children. *Child development*, *81*(1), 212-223.

Soh, D. W., Skocic, J., Nash, K., Stevens, S., Turner, G. R., & Rovet, J. (2015). Self-regulation therapy increases frontal gray matter in children with fetal alcohol spectrum disorder: evaluation by voxel-based morphometry. Frontiers in human neuroscience, 9, 108.

Sokol, R. J., & Clarren, S. K. (1989). Guidelines for use of terminology describing the impact of prenatal alcohol on the offspring. *Alcoholism: Clinical and Experimental Research*, *13*(4), 597-598.

Sonuga-Barke, E. J., Kennedy, M., Kumsta, R., Knights, N., Golm, D., Rutter, M., ... & Kreppner, J. (2017). Child-to-adult neurodevelopmental and mental health trajectories after early life deprivation: the young adult follow-up of the longitudinal English and Romanian Adoptees study. *The Lancet*, *389*(10078), 1539-1548.

Sood, B., Delaney-Black, V., Covington, C., Nordstrom-Klee, B., Ager, J., Templin, T., ... & Sokol, R. J. (2001). Prenatal alcohol exposure and childhood behavior at age 6 to 7 years: I. dose-response effect. *Pediatrics*, *108*(2), e34-e34.

Spann, M. N., Mayes, L. C., Kalmar, J. H., Guiney, J., Womer, F. Y., Pittman, B., ... & Blumberg, H. P. (2012). Childhood abuse and neglect and cognitive flexibility in adolescents. *Child Neuropsychology*, *18*(2), 182-189.

Spohr, H. L., Willms, J., & Steinhausen, H. C. (1993). Prenatal alcohol exposure and long-term developmental consequences. *The Lancet, 341*(8850), 907-910.

Stade, B., Ali, A., Bennett, D., Campbell, D., Johnston, M., Lens, C., ... & Koren, G. (2009). The burden of prenatal exposure to alcohol: revised measurement of cost. *Journal of Population Therapeutics and Clinical Pharmacology*, *16*(1).

Stade, B., Ungar, W. J., Stevens, B., Beyen, J., & Koren, G. (2007). Cost of fetal alcohol spectrum disorder in Canada. *Canadian Family Physician*, *53*(8), 1303-1304.

Steinhausen, H. C., & Spohr, H. L. (1998). Long-term outcome of children with fetal alcohol syndrome: Psychopathology, behavior, and intelligence. *Alcoholism: Clinical and Experimental Research*, *22*(2), 334-338.

Stickrath, E. (2019). Marijuana Use in Pregnancy: An Updated Look at Marijuana Use and Its Impact on Pregnancy. *Clinical obstetrics and gynecology, 62*(1), 185-190.

Stratton, K., Howe, C., & Battaglia, F. C. (Eds.). (1996). *Fetal alcohol syndrome: Diagnosis, epidemiology, prevention, and treatment*. National Academies Press.

Streissguth, A. (2007). Offspring effects of prenatal alcohol exposure from birth to 25 years: The Seattle prospective longitudinal study. *Journal of clinical psychology in medical settings, 14*(2), 81-101.

Streissguth, A. P. (2012). Sex differences in prenatal alcohol abuse in humans, in Gender Differences in Prenatal Substance Exposure (Lewis M, Kestler L eds), pp 139–154. American Psychological Association, Washington, DC.

Streissguth, A. P., Barr, H. M., Kogan, J., & Bookstein, F. L. (1996). Understanding the occurrence of secondary disabilities in clients with fetal alcohol syndrome (FAS) and

fetal alcohol effects (FAE). *Final report to the Centers for Disease Control and Prevention (CDC)*, 96-06.

Streissguth, A. P., Bookstein, F. L., Barr, H. M., Sampson, P. D., O'Malley, K., & Young, J. K. (2004). Risk factors for adverse life outcomes in fetal alcohol syndrome and fetal alcohol effects. Journal of Developmental & Behavioral Pediatrics, 25(4), 228-238.

Sulik, K. K. (2005). Genesis of alcohol-induced craniofacial dysmorphism. *Experimental biology and Medicine*, *230*(6), 366-375.

Taillieu, T. L., & Brownridge, D. A. (2010). Violence against pregnant women: Prevalence, patterns, risk factors, theories, and directions for future research. *Aggression and Violent Behavior*, *15*(1), 14-35.

Talge, N. M., Neal, C., Glover, V., & Early Stress, Translational Research and Prevention Science Network: Fetal and Neonatal Experience on Child and Adolescent Mental Health. (2007). Antenatal maternal stress and long-term effects on child neurodevelopment: how and why? *Journal of Child Psychology and Psychiatry*, *48*(3-4), 245-261.

Tan, C. S. (2007). Test Review Behavior assessment system for children .[Review of the software Behavior assessment system for children. CR Reynolds & RW Kamphaus]. Assessment for Effective Intervention, 32(2), 121-124.

Tarren-Sweeney, M. (2008). The mental health of children in out-of-home care. *Current opinion in psychiatry*, *21*(4), 345-349.

Temple, V. K., Cook, J. L., Unsworth, K., Rajani, H., & Mela, M. (2019). Mental Health and Affect Regulation Impairment in Fetal Alcohol Spectrum Disorder (FASD): Results from the Canadian National FASD Database. *Alcohol and Alcoholism*.

Thanh, N. X., & Jonsson, E. (2009). Costs of fetal alcohol spectrum disorder in Alberta, Canada. Journal of Population Therapeutics and Clinical Pharmacology, 16(1).

Thanh, N. X., & Jonsson, E. (2015). Costs of Fetal Alcohol Spectrum Disorder in the Canadian Justice System. Journal of population therapeutics and clinical pharmacology, 22(1).

Thanh, N.X., Jonsson, E., Dennett, L., & Jacobs, P. (2010). Costs of FASD, In: Edward PR, Clarren S, Weinberg J and Jonsson E (Eds.). Fetal Alcohol Spectrum Disorder: Management and Policy Perspectives of FASD. Wiley-Blackwell 2010.

Thiel, K. S., Baladerian, N. J., Boyce, K. R., Cantos, O. D., Davis, L. A., Kelly, K., ... & Stream, J. (2011). Fetal alcohol spectrum disorders and victimization: Implications for families, educators, social services, law enforcement, and the judicial system. *The Journal of Psychiatry & Law, 39*(1), 121-157.

Thomas, S. E., Kelly, S. J., Mattson, S. N., & Riley, E. P. (1998). Comparison of social abilities of children with fetal alcohol syndrome to those of children with similar IQ scores and normal controls. *Alcoholism: Clinical and Experimental Research, 22*(2), 528-533.

Totten, M. (2010). Investigating the linkages between FASD, gangs, sexual exploitation and woman abuse in the Canadian Aboriginal population: A preliminary study. *First Peoples Child & Family Review*, *5*(2), 9-22.

Trickett, P. K., & McBride-Chang, C. (1995). The developmental impact of different forms of child abuse and neglect. *Developmental review, 15*(3), 311-337.

Tuten, M., Fitzsimons, H., Chisolm, M. S., Jones, H. E., Heil, S. H., & O'Grady, K. E. (2009). The impact of mood disorders on the delivery and neonatal outcomes of methadone-maintained pregnant patients. *The American journal of drug and alcohol abuse, 35*(5), 358-363.

Ungerer, M., Knezovich, J., & Ramsay, M. (2013). In utero alcohol exposure, epigenetic changes, and their consequences. *Alcohol research: current reviews*, 35(1), 37.

Van der Put, C. E., Lanctôt, N., De Ruiter, C., & Van Vugt, E. (2015). Child maltreatment among boy and girl probationers: Does type of maltreatment make a difference in offending behavior and psychosocial problems?. *Child abuse & neglect*, *46*, 142-151.

Van Gelder, M. M., Van Rooij, I. A., Miller, R. K., Zielhuis, G. A., de Jong-van den Berg, L. T., & Roeleveld, N. (2010). Teratogenic mechanisms of medical drugs. *Human reproduction update*, *16*(4), 378-394

Van Harmelen, A. L., van Tol, M. J., van der Wee, N. J., Veltman, D. J., Aleman, A., Spinhoven, P., ... & Elzinga, B. M. (2010). Reduced medial prefrontal cortex volume in adults reporting childhood emotional maltreatment. *Biological psychiatry*, *68*(9), 832-838

Vasileva, M., & Petermann, F. (2018). Attachment, development, and mental health in abused and neglected preschool children in foster care: A meta-analysis. *Trauma, Violence, & Abuse, 19(*4), 443-458.

Vaurio, L., Riley, E. P., & Mattson, S. N. (2011). Comparison of neuropsychological performance in children with heavy prenatal alcohol exposure and an IQ-matched comparison group. *Journal of* the *International Neuropsychological Society*. *17*, 463-473.

Vinnerljung, B., & Sallna, M. (2008). Into adulthood: a follow-up study of 718 young people who were placed in out-of-home care during their teens. Child and Family Social Work, 13,144–55.

Ware, A. L., Crocker, N., O'Brien, J. W., Deweese, B. N., Roesch, S. C., Coles, C. D., ... & Jones, K. L. (2012). Executive function predicts adaptive behavior in children with

histories of heavy prenatal alcohol exposure and attention-deficit/hyperactivity disorder. *Alcoholism: Clinical and Experimental Research, 36*(8), 1431-1441.

Warshak, C. R., Regan, J., Moore, B., Magner, K., Kritzer, S., & Van Hook, J. (2015). Association between marijuana use and adverse obstetrical and neonatal outcomes. *Journal of Perinatology*, *35*(12), 991.Weber, S., Jud, A., & Landolt, M. A. (2016). Quality of life in maltreated children and adult survivors of child maltreatment: a systematic review. *Quality of life research*, *25*(2), 237-255.

Wechsler, D. (2003). Wechsler Intelligence Scale for Children - Fourth Edition. San Antonio, TX: The Psychological Corporation.

Wechsler, D. (2008). Wechsler Adult Intelligence Scale - Fourth Edition. San Antonio, TX: The Psychological Corporation.

Wechsler, D. (2012). Wechsler Abbreviated Scale of Intelligence - Second Edition. San Antonio, TX: The Psychological Corporation.

Wechsler, D. (2017). Wechsler Intelligence Scale for Children - Fifth Edition. San Antonio, TX: The Psychological Corporation.

Werner, E. E., & Smith, R. S. (1982). Vulnerable but invincible: A study of resilient children. New York, NY: McGraw-Hill.

Whaley, S. E., O'Connor, M. J., & Gunderson, B. (2001). Comparison of the adaptive functioning of children prenatally exposed to alcohol to a nonexposed clinical sample. *Alcoholism: Clinical and Experimental Research, 25*(7), 1018-1024.

Williams, J. F., Smith, V. C., & Committee on Substance Abuse. (2015). Fetal alcohol spectrum disorders. Pediatrics, 136(5), e1395-e1406.

Williams, J. H., & Ross, L. (2007). Consequences of prenatal toxin exposure for mental health in children and adolescents. *European child & adolescent psychiatry*, *16*(4), 243-253.

Wilson, W. J. (1987). The truly disadvantaged: The inner city, the underclass, and public policy. Chicago, IL: University of Chicago Press

Wozniak, J. R., Mueller, B. A., Chang, P. N., Muetzel, R. L., Caros, L., & Lim, K. O. (2006). Diffusion tensor imaging in children with fetal alcohol spectrum disorders. *Alcoholism: Clinical and Experimental Research*, *30*(10), 1799-180.

Young, S., Absoud, M., Blackburn, C., Branney, P., Colley, B., Farrag, E., ... & O'Malley, K. D. (2016). Guidelines for identification and treatment of individuals with attention deficit/hyperactivity disorder and associated fetal alcohol spectrum disorders based upon expert consensus. *BMC psychiatry, 16*(1), 324.

Zhao, L., McCauley, K., & Sheeran, L. (2017). The interaction of pregnancy, substance use and mental illness on birthing outcomes in Australia. *Midwifery*, *54*, 81-88.