

Neurobehavioural outcomes of children with fetal alcohol spectrum disorders: A Canadian perspective

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Fetal alcohol spectrum disorder (FASD) is one of the most common preventable causes of developmental disability and is currently one of the most pressing public health concerns in Canada. FASD refers to the range of physical, mental, behavioural and learning disabilities that an individual may acquire as a result of maternal alcohol consumption. Prenatal exposure to alcohol leads to numerous primary and secondary disabilities in affected children, which can result in poor long-term outcomes. The present paper reviews previous research on the neurobehavioural outcomes of children with FASD, particularly in terms of behavioural, mental health and adaptive outcomes. The role of risk and protective factors on these outcomes and the impact of FASD on the family are also examined. Finally, future directions and implications regarding outcomes research among children with FASD, particularly within a Canadian context, are discussed.

Key Words: Children; Fetal alcohol spectrum disorder; Neurobehavioural; Outcome

Fetal alcohol spectrum disorder (FASD) is a significant Canadian health concern. Prenatal alcohol exposure (PAE) can cause irreversible brain damage and behavioural, mental and physical deficits requiring extensive support and services in the areas of health, social services, education and training, justice, addictions and family supports (1). Health Canada estimates the rate of FASD to be nine per 1000 births (2), which is consistent with the United States (US) data indicating that this condition is one of the most common preventable causes of mental retardation (3) with substantial costs to society. A recent Canadian study (4) estimated the annual costs of FASD at \$344,208,000 for care of those younger than 21 years of age. As researchers are beginning to understand the full spectrum of physical manifestations and impairments associated with FASD, it has become increasingly apparent that follow-up studies are essential to track the outcomes of children with FASD, particularly in terms of behavioural, mental health, and adaptive and executive functioning. Children and youth with FASD have difficulties understanding the consequences of

L'évolution neurocomportementale des enfants atteints de troubles de l'alcoolisation fœtale : Une perspective canadienne

L'ensemble des troubles de l'alcoolisation fœtale (ETAF) est l'une des causes évitables d'invalidité les plus courantes, et c'est l'un des problèmes de santé publique les plus urgents au Canada. L'ETAF désigne l'ensemble des invalidités physiques, mentales, comportementales et d'apprentissage dont une personne peut être atteinte à cause de la consommation d'alcool de sa mère pendant la grossesse. L'exposition prénatale à l'alcool provoque de nombreuses invalidités primaires et secondaires chez les enfants atteints, ce qui peut s'associer à une évolution négative à long terme. Le présent article analyse les recherches passées sur l'évolution neurodéveloppementale des enfants atteints de l'ETAF, notamment du point de vue comportemental, intellectuel et adaptatif. Les auteurs s'intéressent également au rôle des facteurs de risque et des facteurs protecteurs sur cette évolution et aux répercussions de l'ETAF sur la famille. Enfin, ils abordent les orientations futures et leurs effets sur les recherches en matière d'issues chez les enfants atteints de l'ETAF, surtout dans le contexte canadien.

their actions and learning from past mistakes, making them vulnerable to high-risk behaviours (1) and to poor adaptation to societal expectations. However, most of what is known about the outcomes of children with FASD comes from the US and Europe, with a paucity of Canadian research examining outcomes in this population. In the present paper, previous research on the behavioural, mental health, and adaptive and executive functioning outcomes of children with FASD is reviewed. The role of risk and protective factors on these outcomes, as well as how FASD affects the family is also examined. Finally, future directions and implications regarding outcomes of children with FASD within a Canadian context are discussed.

BACKGROUND

Fetal alcohol syndrome (FAS) was first identified in 1973 by Jones and Smith (5), based on case observations in which a similar pattern of malformations among infants born to alcoholic mothers were noted (6). FAS is a consequence of PAE and is characterized by growth deficiency in

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TABLE 1
Summary of outcomes associated with prenatal alcohol exposure

Behavioural	Mental health	Adaptive and executive functioning
Antisocial behaviour	Alcohol problems	Socialization
Delinquent behaviour	Mood disorder	Employment difficulties
Classroom/school behaviours	Bipolar disorder	Independent living difficulties
Learning behaviours	Depression	Inhibitory control
Externalizing behaviour	Panic disorder	Cause and effect reasoning
Aggressive behaviour	Hyperkinetic disorders	Planning and organizing
Criminal activity	Emotional disorders	Learning from mistakes
Maladaptive behaviour	Conduct disorders	
Impulsivity	Sleep disorders	
Teasing/bullying	Abnormal habits	
Dishonesty	Stereotypical behaviour	
Avoiding work/school	Other psychiatric disorders	
Sexual inappropriateness	(post-traumatic stress disorder,	
Self-injury	obsessive-compulsive disorder and	
Alcohol/drug use	oppositional defiant disorder)	

weight and/or height; facial features that may include short palpebral fissures, smooth philtrum, thin upper lip, flat mid-face and short nose; and evidence of central nervous system (CNS) dysfunction (7,8), as evidenced by microcephaly, cognitive deficits, learning problems, attentional difficulties, hyperactivity and/or motor problems (9). The term fetal alcohol effect (FAE) has been used to describe individuals who do not have all the characteristics of FAS, particularly the absence of some or all facial features and/or lack of growth deficiency, but have had PAE and some CNS dysfunction (7). Other terms referring to those with PAE who do not meet the full criteria for FAS include alcohol-related neurodevelopmental disorder, alcohol-related birth defects and partial FAS.

Currently, all alcohol-related diagnoses have been included under the umbrella term of FASD, which refers to individuals who may have physical, mental, behavioural and learning disabilities as a result of maternal alcohol consumption (10). Previously used diagnostic categories tended to focus on the presence or absence of facial dysmorphology; however, it has been learned that relatively few children prenatally exposed to alcohol have all of the physical features required to diagnose FAS (11,12). The FAS facial features occur during a short period of vulnerability early in the first trimester (based on a mouse model) (13), whereas the neurobehavioural consequences of PAE can occur with exposure throughout pregnancy. Furthermore, studies (14,15) directly comparing the degree of neuropsychological impairment in those with and without the physical features of FAS yield no meaningful differences, leading researchers to conclude that the neuropsychological deficits associated with PAE appear to be independent of the physical characteristics of FAS (14). Thus, the spectrum approach to terminology is advantageous over previous categorical approaches because diagnosis of alcohol-related disorders focuses more on CNS deficits since these are of greater functional significance

than the physical features. PAE can result in life-long primary and secondary disabilities. Primary disabilities reflect inherent CNS dysfunction (9). Secondary disabilities are not evident from birth, but result from the primary disabilities as well as limited understanding (and availability) of effective interventions.

OUTCOMES OF CHILDREN WITH FASD

Outcome and follow-up studies of children with PAE have mainly been conducted in the US by Streissguth et al (16), and in Germany by Steinhausen and Spohr (17). Poor outcomes, particularly in terms of behavioural, mental health, and adaptive and executive behaviour have been documented. However, there has been a lack of longitudinal and follow-up studies on children with FASD in Canada, as well as the impact of intervention programs and risk and protective factors on these outcomes.

Behavioural (Table 1)

Poor behavioural outcomes have been documented in a 14-year longitudinal study conducted by Streissguth et al (16). Significant deficits in antisocial and delinquent behaviours, as well as classroom and learning behaviours were noted among children with high levels of PAE (16). Olson et al (18) found behaviour and learning difficulties in adolescents with FAE, and noted that maternal binge drinking during pregnancy was related to adolescent antisocial behaviour, school problems and self-perceived learning difficulties. Sood et al (19) examined the relationship between PAE and child behavioural outcomes in children six to seven years of age, and found that low levels of PAE (greater than 0 fluid ounce [fl oz] of absolute alcohol per day but less than 0.3 fl oz of absolute alcohol per day) adversely affected externalizing and aggressive behaviour, and moderate/heavy levels (0.3 fl oz or greater of absolute alcohol per day) were related to delinquent behaviour, even after controlling for important confounding variables

(ie, maternal age and education; prenatal exposure to other substances; and postnatal factors such as socioeconomic status, violence, family structure, maternal psychopathology and substance use). Each of these studies averaged alcohol intake across the week and, thus, it was difficult to distinguish the impact of routine low-level consumption from periodic binge drinking, which again emphasizes the need for further longitudinal research. Moreover, other researchers have also noted persistent behavioural problems (particularly in aggressive and delinquent domains) that may increase with development among those with FASD (20).

Individuals with PAE have been shown to exhibit maladaptive behaviours such as impulsivity, teasing/bullying, dishonesty (lying, cheating and stealing), avoiding school or work, intentional destruction of property, sexual inappropriateness, physical aggression and self-injury (21). FASD has also been linked to behaviour problems and delinquency in adolescents, as well as problems related with alcohol and drug use (18). Nash et al (22) found that alcohol-exposed children displayed higher rates of problematic behaviours than children with attention-deficit hyperactivity disorder (ADHD), particularly in delinquent behaviours such as cruelty, bullying, lying or cheating, and stealing. Furthermore, 97% of children with fetal alcohol exposure lacked guilt after misbehaving. In a recent study (23) conducted in Alberta, young children with FASD (four to eight years of age) were found to lie more often than typically developing children. In a large-scale study of youth with FASD living in British Columbia, Fast et al (24) found that 23% of youth in the criminal justice system had FASD.

Mental health (Table 1)

Streissguth and O'Malley (12), among other researchers, have noted poor neuropsychiatric outcomes associated with FASD, particularly in terms of maladaptive behaviour and mental illness, which complicate treatment. In young adults, PAE is also associated with alcohol problems (25), as well as increased psychiatric disorders and traits (26). O'Connor et al (27) noted very high rates of psychiatric disorders among children with PAE, with 87% of their sample meeting the criteria for a psychiatric disorder; 61% for mood disorder; 35% for bipolar disorder and 26% for major depressive disorder. Furthermore, even among six-year-olds, PAE is associated with depressive symptoms, particularly in girls (28).

In one of the first studies on secondary disabilities in Canadian adults with FASD, Clark et al (29) tested 62 individuals (mean age of 22 years) living in British Columbia. The authors found that almost all of the participants (92%) had a mental health disorder diagnosis. Diagnoses included ADHD (65%), depression (45%) and panic disorder (21%). Post-traumatic stress disorder, obsessive compulsive disorder, oppositional defiant disorder and bipolar disorder were also reported.

Steinhausen et al (30,31) have noted persistent psychiatric impairments among children with FAS, and this

psychopathology may be related to environmental factors associated with living arrangements (institutions and foster care) (32). Although some of the morphological and dysmorphic abnormalities associated with FAS may become less prominent with age, cognitive impairments (33) and psychiatric symptoms are generally persistent and may increase (34). In a more recent long-term outcomes study, Steinhausen and Spohr (17) found high rates of psychopathology (hyperkinetic, emotional, conduct and sleep disorders, as well as abnormal habits and stereotypical behaviour) that were persistent over time. In fact, 63% of the sample had been diagnosed with one or more psychiatric disorders, and parents and teachers both rated attention and social problems as the most frequent deficits. The authors concluded that the impairments in FAS resulted in serious problems with life adaptation leading to a large proportion of affected individuals dependent on external support.

Adaptive and executive functioning (Table 1)

One of the most significant deficits among individuals with FASD is adaptive functioning (35), which refers to the personal and social skills needed to live independently. Poor adaptive functioning likely contributes to the high rates of secondary disabilities and associated adverse life outcomes. For instance, Streissguth et al (36) found that among adolescents and adults with FAS/FAE (mean age 17 years), adaptive functioning skills were at the level of a seven-year-old, with deficits being most pronounced on socialization skills. Streissguth et al (37) identified adaptive behaviours as one of the most striking deficits in children with FASD. In another study on adaptive functioning, Whaley et al (38) found that socialization decreased with age (relative to the norm) among children two to 10 years of age with PAE. This study was not longitudinal and, thus, causal interpretations could not be made; however, it may be that some adaptive deficits in FASD become more pronounced with age. Furthermore, in Germany, Spohr et al (20) found that individuals with FASD had significant difficulty with employment and independent living.

Another key area of deficit in FASD is executive functioning (11,39-41). Executive functions are higher-order cognitive processes involved in thought and action under conscious control (42), usually to achieve a goal (43). They may involve abilities such as planning, inhibition, working memory, switching between cognitive sets, flexible thinking, strategy use, fluency and behaviour regulation. Difficulties with executive functioning may be an important variable in the adaptive behaviour deficits in FASD. Executive functioning is highly correlated with adaptive behaviour among children with autism (44) and ADHD (45). Executive functioning difficulties can result in problems with planning, organizing and learning from past mistakes (46). These factors, combined with the lack of sufficient inhibitory control and difficulty understanding the consequences of behaviour (cause and effect reasoning),

could lead to life-long difficulties adapting to and functioning in society.

Rasmussen and Bisanz (40), and Rasmussen et al (41), found that adolescents with FASD performed worse (relative to the norm) than younger children with FASD on some neuropsychological and parental rating scales of executive function, indicating that some executive function deficits may be more pronounced with age (relative to norm samples) among children with FASD. Poor executive functioning, particularly during adolescence, may be a factor related to the prominent adaptive function deficits in FASD. In both of these studies, the same sample of children was not followed over time; thus, it is unclear whether executive functioning deficits actually become more pronounced with age in FASD or if the older children in these studies had worse executive functioning deficits to begin with (possibly because they were diagnosed at a later age and/or received less services). However, both of these questions could be addressed in a longitudinal study.

Risk and protective factors

Streissguth et al (47) conducted a landmark longitudinal study on secondary disabilities among individuals with FASD. As previously noted, secondary disabilities result from the primary consequences of PAE (ie, cognitive deficits), possibly in interaction with environmental factors. The Life History Interview, which measures common secondary disabilities, was administered to 415 individuals (six to 51 years of age) with FAS and FAE. The results were astounding – more than 90% of the sample had mental health problems, 49% of the adolescents/adults and 39% of the children demonstrated inappropriate sexual behaviour, 14% of the children and more than 60% of adolescents/adults had disrupted school experience, and 14% of the children and 60% of adolescents/adults had been in trouble with the law. One in two of the adolescents/adults had been confined (ie, incarcerated, admitted to inpatient mental health programs, or alcohol and drug treatment programs); and over one in three of the adolescents/adults had alcohol- and drug-related problems.

Streissguth et al (47) identified five protective factors that resulted in lower rates of secondary disabilities which included living in a good quality stable home environment, infrequent changes in living arrangement, not being exposed to violence, receiving services for developmental disabilities and being diagnosed before six years of age. Three risk factors were identified that were associated with higher rates of secondary disabilities – being diagnosed with FAE rather than FAS; having an IQ above 70; and higher scores on the Fetal Alcohol Behavior Scale, which measures behaviours typical of individuals with fetal alcohol exposure. Thus, having less severe physical effects (FAE instead of FAS) and a higher rather than lower IQ were associated with a higher rate of secondary disabilities. This counterintuitive finding may be a consequence of later diagnosis and fewer services for individuals with FAE, which increases the risk for developing secondary disabilities. This hypothesis is

supported by findings that highlight the significant relationship between the timing of diagnosis and secondary disabilities (the later the diagnosis, the greater the adverse life outcomes), as well as the importance of a good stable home environment in helping prevent the secondary disabilities associated with PAE (37).

Another factor that might influence the outcome of individuals with FASD is ‘vulnerability to manipulation’. Clark et al (29) found that 92% of participants were identified by their caregivers as being vulnerable to manipulation, which may have implications for affected adults involved in the legal system. For example, a vulnerable individual may be more inclined to acquiesce, provide a false confession, or have problems understanding cautions and consents. Clark et al (29) also reported that 87% of the participants in their study had been victim to some form of violence, and 77% of individuals had experienced physical and/or sexual abuse.

IMPACT OF FASD ON FAMILIES

The prevalent primary and secondary disabilities common in FASD, combined with the very poor outcomes of these children, undoubtedly has an effect on the family of the affected individual. Although it is commonly noted that support and resources for families are essential (9,10,12), very few researchers have examined the impact of raising a child with FASD on the family. Interviews with parents/caregivers of children with FASD identify that they perceive needs for social support; material support; structured home environment; organization skills; understanding from others; collaboration with school, health care and social services; child management skills and recognition that each child is unique (48,49). Others have found that PAE is associated with externalizing behaviours in childhood, which is related to increased maternal stress (50). In a more recent study, Paley et al (51) found that internalizing and externalizing behaviours, as well as executive functioning and adaptive functioning deficits among children with FASD were significantly related to parental report of child-related stress. Executive functioning deficits were the strongest predictor of parental stress, indicating that among children with FASD, difficulties with skills required for everyday tasks (ie, problem solving, planning and organizing) were particularly stressful for parents. Furthermore, adoptive and foster parents reported more stress than biological parents (51). This US study is one of the only studies to specifically examine the impact of raising a child with FASD on parental stress. To provide appropriate services and resources for Canadian families of children with FASD, a more detailed understanding of the specific and direct impact of FASD on the various facets of daily living is required.

Recently, Stade et al (52) published a Canadian study on health and quality of life outcomes of children with FASD. This study, the first of its kind, sets the stage for future outcomes research in Canada and provides direct evidence for the devastating impact of PAE on child outcomes. A questionnaire measuring health-related quality of life was

completed by children with FASD (eight to 21 years of age) and their parents. These children displayed significantly poorer health-related quality of life scores compared with the norm sample, and these impairments were most notable on cognitive and emotional variables. When compared with other published data using the same questionnaire, children with FASD had lower mean health-related quality of life scores than children with significant disabilities (ie, blindness, cerebral palsy, deafness and cognitive impairment) and those who were survivors of childhood cancers. The authors concluded by highlighting the importance of having specialized educational programs for children with FASD, focusing on the emotional and mental health of these children, the necessity for early diagnosis, research on effective interventions and longitudinal research on quality of life outcomes.

QUALIFICATIONS

It is clear that children with FASD (at least in the US and Germany) are at high risk of very poor developmental outcomes, and many questions remain to be answered, particularly within a Canadian context. Previous studies have been conducted using many different outcome measures, diverse samples and cohorts, and varying diagnostic categories, which complicates previous findings and makes it difficult to generate general conclusions and make comparisons across studies. Research using more sound and informative methodologies, and consistent diagnostic categories and samples is crucial. Previous research has thoroughly documented the poor outcomes of children with FASD and PAE. However, what is lacking in the majority of this research is the examination of what factors (or combination of factors) actually lead to or 'cause' these poor outcomes. Most children with FASD are not typically challenged by PAE and resulting CNS damage alone; many also face numerous other serious social and environmental adversities that place them at even greater risk for poor outcomes. The seminal study by Streissguth et al (37) provided an excellent starting point for the understanding of some of the risk and protective factors related to six secondary disabilities in individuals with PAE. The interactive role of PAE, and the environmental and social factors on the many different negative outcomes in FASD, need to be examined.

FUTURE DIRECTIONS

Future directions for Canadian research should address questions regarding how environmental factors and service utilization influence FASD, whether there are mediators and/or moderators that impact outcomes, and also whether there are other factors that make some children with FASD particularly resilient to these poor outcomes. Furthermore, information on the impact of the alcohol dose and binge drinking on various outcomes is critical. Connor and Streissguth (53) suggested that further research is needed on cognitive and emotional outcomes of individuals with FASD, as well as research examining the effect of intervention techniques to best tailor treatment to the unique needs

of children with FASD. Streissguth (54) stressed the need for research on effective interventions for FASD, individual differences in FASD, the interaction between cognitive outcomes and therapeutic environment, as well as psychiatric outcomes of FASD. In the review by Streissguth and O'Malley (12), four key recommendations were made aimed at improving outcomes of children with FASD – focusing on the importance of early diagnosis (ie, before entering school), lifelong support services for families, ongoing support services for adolescent and adults with FASD, and mental health supports for affected individuals and their families.

In the recently published Canadian guidelines for diagnosis of FASD, Chudley et al (10) strongly recommended education of affected individuals and their families, linking families to services to improve outcomes and follow-up of outcomes since the diagnosis. The lack of outcomes research among children with FASD in Canada is very disconcerting considering the high number of youth in the criminal justice system in Canada who have FASD (24), which is an indicator of poor outcomes. It cannot be assumed that the outcomes of Canadian children with FASD will be the same as those in previous research because previous studies were typically conducted with a small number of different cohorts living in the US and Germany with differing ethnic backgrounds, living situations (a greater proportion of affected Canadian children live in rural and remote communities), health care systems and access to services. Furthermore, in Canada, special attention needs to be given to the circumstances surrounding FASD in Aboriginal communities and the impact of family and community environmental issues such as poverty, family breakdown, and isolated communities on the risk of substance and alcohol abuse during pregnancy.

Implications

Understanding the profile of behavioural, mental health and adaptive outcomes of children diagnosed with FASD is key to improving treatment and resources for children with FASD. Such research will provide new insights into how to tailor interventions and services to address the unique needs of these children, and to ultimately improve outcomes and reduce secondary disabilities of Canadian children with FASD. Identifying protective factors that are associated with positive outcomes will guide future assessment and care of children with FASD by providing clinicians and social workers with key variables (ie, services, early diagnosis and stable home environment) that must be carefully examined during diagnosis and assessment to enhance and/or maintain these protective factors and in turn improve outcomes. Insight into the impact of FASD on the family across various domains of family living will inform service and resource allocation to assist families in specific areas of need.

From a clinical perspective, it is essential to have more specific information on the disability and on brain function. There is the need for information on specific behavioural

and cognitive strategies that may improve functioning. It is also important to understand the use of medications to target specific symptoms in the person with FASD, recognizing that the basic brain receptors for drug binding and effect may have been altered by PAE (55). Policy makers and funding agencies want to know the evidence for the supports in the short-term and long-term for planning across all environments of home, school, community living and employment for FASD. All these questions drive future research that requires longitudinal follow-up of a large number of individuals with FASD and rigorous evaluation of outcomes of interventions and support strategies. The starting point needs to include accurate diagnosis of FASD and availability of the diagnosis to multidisciplinary teams trained on a national standard across Canada. This will enable the

study of larger samples in different intervention groups. Also, increased diagnostic capacity will assist in understanding the prevalence of FASD in Canada, as well as the effect of prevention programs, which will aid in planning for future resources. Research on neurobehavioural outcomes of Canadian children diagnosed with FASD is essential to enhance services, treatment and overall life chances for these children. Furthermore, longitudinal research is needed to understand how neurobehavioural deficits may change with time and how interventions and services can be designed to address the needs of affected individuals and families.

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