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Early Intervention for Children with Fetal Alcohol Spectrum Disorders

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Introduction

First identified in the United States nearly 50 years ago,[1,2] Fetal Alcohol Syndrome (FAS) is a major birth defect resulting from prenatal alcohol exposure (PAE) and is characterized by a distinct pattern of facial abnormalities, stunted growth, and central nervous system dysfunction. The term fetal alcohol spectrum disorders (FASD;[3] is an umbrella term used to reflect the full range of effects associated with PAE, and in addition to FAS, includes partial FAS, alcohol related neurodevelopmental disorder (ARND), and alcohol related birth defects (ARBD).[4] FASD places a significant burden on both affected families and society. FASD is estimated to affect 3.1 to 9.9% of first grade children in the United States.[5] The annual cost estimate for all individuals with FASD in the U.S. ranges from $1.29 to $10.1 billion.[6,7]

Subject

This paper reviews recent progress in the development of early interventions for young children with FASD, current challenges in providing services for young children in this high-risk

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population, and potential directions for future research.

Problems

The deleterious effects of PAE are evident as early as infancy for both animals[8] and humans[9]. In infants and toddlers PAE has been associated with global developmental impairment, including deficits in cognition, motor skills, language skills, emotion and relational skills, information processing, and memory.[9] Studies have also identified that PAE is related to infant and toddler sleep abnormalities, sensory system challenges[10–12], as well as alterations in pain regulation[13], reactivity to stress[14], and higher rates of insecure attachment[15].

PAE has lifelong implications for child functioning and adaptation. Significant behavioural, cognitive and emotional difficulties have been reported among individuals with FASD throughout the life span, including intellectual and learning disabilities, executive dysfunction, memory problems, speech and language delays, and internalizing and externalizing behaviour problems.[16] Children with PAE are also at increased risk for many secondary disabilities, including comorbid psychiatric conditions, school failure, alcohol and substance abuse problems, and delinquency.[17–20] These challenges can then affect the whole family system. Parents of children with FASD report increased parental stress, decreasing family functioning, and decreasing parental attention to unaffected siblings.[21] However, it is important to note that children affected by PAE have very heterogeneous profiles of functioning within and across children. Most notably, many providers and parents can be misled when children affected by PAE have an average IQ range but perform poorly in many other domains of life.[22] It is essential that assessment be comprehensive in order to fully understand both areas of weakness and strengths. This allows providers to appropriately identify intervention targets and bolster children's strengths to promote lifelong resilience.

Despite the early onset of cross-domain challenges, many children may not be referred for screening until relatively late (if ever), thus missing out on the potential benefit of early intervention.[23] FASD appears to be under-recognized and under-treated, particularly in certain high-risk contexts, including both in- and out-patient psychiatric populations, the child welfare system, and juvenile detention and correctional facilities.[20,24–27] The importance of early identification is highlighted by findings that an early diagnosis is one of the strongest predictors of more positive outcomes for these individuals.[28] Further, early identification and treatment may better serve the entire family system, and mitigate downstream effects of PAE on parent stress,

sibling relationships, and whole family functioning.[21]

Research Context

In the last two decades, some progress has been made in the development of treatments for individuals with FASD, but those focusing on young children have been more limited. Early intervention studies present significant methodological challenges with this population. First, recruitment of study participants can be challenging when many children with FASD are not identified until school-age.[24] Additionally, many children impacted by PAE are involved in the child welfare system and thus may be even less likely to referred for and receive a diagnosis when indicated. Moreover, for those children in the child welfare system who have been accurately diagnosed, obtaining proper consent to enroll them in early intervention programs can be difficult. Additionally, selecting an appropriate control group can also be challenging.[27,29] Given the abundance of developmental challenges for this population, utilizing no-treatment control groups raises ethical issues, whereas utilizing standard of care control groups may work against finding any significant effects for programs in their early stages of development.

Key Research Questions

Several key lines of inquiry are currently being addressed in research on early intervention for FASD. Such questions include:

1. How can animal models inform our development of interventions for young children with PAE?
2. To what extent can early intervention programs address some of the primary developmental challenges seen in infants and young children affected by PAE?
3. What developmental domains are appropriate targets of intervention?

Recent Research Results

1. Animal Studies

Several lines of animal research suggest the promise of various prenatal and neonatal interventions. For example, in mice lithium has demonstrated some protection against ethanol-induced excessive cell death during development, and have lasting positive effects on cognitive functioning into adulthood.[30–32] The benefits of prenatal and postnatal treatment with

neuroprotective peptides in mitigating the effects of PAE on brain development have also been reported in studies of mice.[33–37] Additionally, studies with perinatal rodent models of FASD have also used antioxidant supplements at the same time they consumed alcohol and saw reductions in offspring oxidative stress and cell loss. Other rodent studies have used prenatal nutrients such as choline, docosahexaenoic acid, betaine, folic acid, methionine, resveratrol, and zinc and found promising results in their attenuation of the epigenomic effects of alcohol.[38] Animal models of post-natal supplementation of nutrients such as Vitamin C, Vitamin E, resveratrol, curcumin, melatonin, alpha-lipoic acid, selenium, omega-3, Choline, and EGCG have also demonstrated varying positive effects on cellular and neural development.[38]

Research on behavioural and environmental interventions with rat and mice models have demonstrated positive results. Research has supported the positive effects of neonatal handling, postnatal environment enrichment, and rehabilitative training on rats and mice with perinatal alcohol exposure.[39] For example, enriched environments in adolescent rats with PAE lead to decreased emotionality, increased attention, and fewer cognitive impairments in adulthood.40 Further, exercise has been found to improve learning and memory among alcohol-exposed rats[41], whereas introducing complex motor training during the postnatal period effectively remediated the motor deficits of alcohol-exposed rats[42].

2. Intervention for Mothers with Substance Abuse Challenges

One method studied in humans to mitigate the effects of PAE is to employ preventative intervention services for mothers with histories of substance abuse problems or who endorse alcohol use during physician screening. One program that attempts to prevent future alcohol exposed births is Parent Child Assistance Program (PCAP). PCAP is a comprehensive case management and recovery support program for women at risk for giving birth to a child with FASD. The intervention decreased alcohol and drug use among parents, increased the use of contraception, and increased medical and mental health care services.[43,44] However, there were no specific improvements in outcomes for children with FASD as a result of this intervention.[45] A similar program is New Choices, which provided addiction counseling, parent education and counseling, peer support and enrichment programs for children. A preliminary evaluation found that mothers demonstrated improvements in depressive symptoms and empathy for their children, and children exhibited improvements in social development.[46,47]

Several other wraparound service programs have been implemented in Canada and shown effectiveness in preventing PAE births.[48,49] Further, participation in programs such as Women-Infants-Child (WIC) program in the USA can increase use of prenatal care among women at risk for consuming alcohol when pregnant.[50] One intervention provided brief intervention services where parents were given nutritional counseling. Compared to an assessment only condition, parents who participated in the brief intervention were five times more likely to report abstinence, and their newborns had higher birth weight and decreased mortality.[51]

In general, population based screening and preventative strategies must be designed to reach populations at heightened risk for alcohol exposed pregnancies. This includes people with histories of substance use challenges, depression, anxiety, or histories of trauma including child welfare or legal involvement.[52–54] Most importantly, screening and intervention programs need to be non-judgemental and specifically target reducing stigma and bias around substance use challenges.[55] Generally, programs aimed at preventing PAE or targeting mothers who did consume alcohol during previous pregnancies are effective at improving mother mental health and decreasing the likelihood of another PAE birth. However, findings suggest limited effects of this type of intervention on outcomes for children with FASD, particularly if direct early intervention is not provided to the child.

3. Cognitive and Educational Interventions

Some studies of cognitive and educational interventions for FASD have also included young children in their samples. Children aged 3 to 10 years with FASD who participated in a socio-cognitive habilitation program in mathematics in addition to receiving educational support, called Math Interactive Learning Experience (MILE). Children in the intervention showed greater gains in math skills compared to those who received educational support only[56], and these gains were maintained six months later.[57] Children also demonstrated overall improvements in achievement and in parent reported behavioural challenges.[58,59] Another intervention using applied behaviour analysis to increase verbal skills found improvements in functional communication and in emotional and behavioural functioning as well.[60] Finally, children aged 4 to 11 years with FASD participated in an intervention to promote the use of rehearsal strategies. Children in the experimental condition demonstrated significant improvement on a measure of working memory, whereas the control group showed no such improvement.[61]

4. Adaptive Social Skills

Individuals with FASD show deficits across multiple domains of adaptive functioning, including social skills and personal and community skills.[16] To address the lack of safety awareness often seen in children with FASD, a computer-based intervention was designed to increase fire and street safety skills in children aged 4 to 10 years old with FASD. Children receiving the intervention demonstrated significantly greater gains in safety-related knowledge and appropriate behavioural responses in comparison to the control group.[62] Targeting impairments in social functioning, an evidence-based, manualized, parent-assisted social skills intervention, Children's Friendship Training (CFT),[63] was adapted for use with 6- to 12-year-old children with FASD. The intervention aimed to build social skills in a community mental health setting. CFT targeted social network formation, how to talk with peers about activities, how to join play, as well as conflict avoidance and negotiation. Children in the intervention group experienced reductions in behavioural challenges, fewer hostile attributions and increased social skills.[26,64,65] Another intervention, Families on Track, also targeted children's social skills by combining parent behavioural consultation with weekly child skill groups for 4 to 8-year-olds. Families who participated had improvement in child emotion regulation, self-esteem, and anxiety, as well as decreases in disruptive behaviours. Additionally, parents showed increased FASD knowledge, better advocacy, increased social support, self-care, and parenting efficacy.[66]

5. Self-Regulation Skills

To address challenges with self-regulation skills, three studies evaluated the effectiveness of ALERT,[67] a program specifically adapted for children with FASD and designed to improve executive functioning. This intervention involves training teachers to provide one-hour manualized ALERT session across eight weeks. Children (six to twelve years old) showed improvements in executive functioning[68–71], selective attention, disruptive behaviours, math skills, and reading skills[70,72]. Another program, GoFAR, is a manualized computer intervention given to caregivers and children five to ten years old. GoFAR teaches metacognitive strategies to assist with problem solving around behavioural control, attention and adaptive functioning. Children who participated in GoFAR demonstrated improvements in self-regulation, attention, and adaptive living skills.[73,74] The SEEDS Family School Readiness Program was designed to promote self-regulation skills in young children with PAE and who have had involvement with the child welfare system. Children aged three to six years old who participated in the program showed greater improvements in self-regulation and early literacy skills compared to children in a

waitlist control group. Additionally, compared to the control group, parents in the intervention group reported decreases in parent-child stress.[75]

Another approach is to target parent knowledge of the effects of PAE. While many parenting-focused and psychoeducation interventions are not exclusively focused on very young children with FASD, some interventions have included younger children in their samples. One study provided psychoeducation to parents about FASD and found improvements in knowledge, advocacy for care, parent behavioural regulation, and noted behavioural functioning improvement amongst children.[76] A recent app-based innovation of this program, Families Moving Forward Connect, was developed to provide care-giver self-delivery of psychoeducation and connection with other families who have children experiencing FASD.[77]

Another promising approach, has been to implement parent behavioural interventions that provide parents with skills to co-regulate with children, manage children's behavioural dysregulation, and ultimately assist their children in developing key self-regulation skills. Families Moving Forward (FMF), provides supportive behavioural consultation to promote parental self-efficacy and reduce child behaviour problems in families raising children aged 4 to 11 years with FASD. Caregivers in the FMF group reported greater improvements in parenting efficacy and greater reductions in child behaviour problems, compared to caregivers in the community standard of care group.[78] Another intervention, the Heart Start Model, used a relationship-based approach aimed at promoting children's healthy development, including their self-regulation skills, by enhancing early protective emotional relationships. Interventionists worked with parents starting when their children were 10 months old to form reciprocal relationships through the parent's own self-regulation processes and increased psychoeducation about infant development and cues. Children with heavy PAE and those with light/no exposure all improved in their social-emotional skills over the course of a year, with children with heavy exposure showing the greatest gains in skills.[79]

A number of existing early childhood evidence-based interventions have been adapted for children with PAE to support their social emotional development through attachment with caregivers. Interventions adapted from Parent Child Interaction Therapy (PCIT), Circle of Security, and Child Parent Psychotherapy (CPP), have shown efficacy in reducing caregiver stress, improving attachment and/or the parent-child relationships, and/or improving child self-regulation and behavioural challenges[80–82] among children and families impacted by FASD.

6. Nutritional Supplementation and Interventions

Recently, there has been increasing interest in the role of nutrition as a protective factor against the deleterious effects of PAE. Women who drink during pregnancy often have poor nutritional intake and demonstrating low levels of key vitamins and minerals.[83,84] Poor perinatal nutrition may play a part in magnifying the effects of PAE on child development. Prenatal supplementation of multivitamins/minerals including vitamin A, C, E, B1, folate, choline, iron, selenium, zinc, and DHA for women consuming alcohol has demonstrated better cognitive development, and improved infant growth among children with PAE.[25,58,85–87] Postnatally, a study of choline supplementation during early childhood found a dose-dependent improvement in memory.[88] At a four year follow up, the choline supplementation group had higher non-verbal intelligence, visual spatial skills, working memory, and verbal memory.[89] However, a study with 5-10-year-olds found no effect of choline on cognitive performance[90], suggesting that there may be a sensitive period effect, where choline may only have effects when administered in specific developmental periods. Despite this promising emerging evidence, it is important to note that the majority of this work is in the preclinical phase and more work needs to be done in this area.

7. Pharmacological Interventions

Young children are increasingly likely to receive pharmacological interventions to address behaviour problems,[91] and children with FASD are likely to receive such interventions given their increased risk for behaviour problems. Community and clinic-based surveys, as well as large commercial claims databases indicate that about 57% of children with FASD received psychotropic medication, and stimulants were the most commonly used in children with FASD.[92,93] However, evidence to support stimulant medication for FASD is conflicting. For example, one RCT[94] found that there was no difference in attention or impulsivity but did show improvements in hyperactivity. Another RCT[95], showed no effects, with several adverse side effects. Preclinical data also suggest conflicting results of stimulant effectiveness[96]. Neuroleptics, most often Risperidone, is another commonly used medication to address behavioural challenges in children. In a study examining the efficacy of a social skills intervention, some children were assigned to also receive a neuroleptic. Those receiving neuroleptics exhibited greater improvements on all measures following completion of the intervention compared to children who were not receiving neuroleptics.[97] Another study looking at a combined Risperidone and stimulant found a decrease in aggressive behaviours and impulsivity in eight of the ten cases observed.[98]

Despite the common use of medication in this population, research on the efficacy of these medications for children with FASD has been limited by small pre-clinical studies or has entailed retrospective chart reviews rather than large-scale, double-blind, randomized controlled trials. Medication results often yield inconsistent and mixed results, with a higher likelihood of atypical responses to medication.[96,99] New work, given the complex heterogenous presentation of the effects of FASD, is exploring the use of algorithms and machine learning based on past chart reviews, to identify ideal medication prescription.[100] Until more systematic studies are done examining both the benefits and potential adverse effects of pharmacological regimens with this population, it is important to use caution in prescribing medications for children with FASD, particularly young children whose still-developing brains have already been impacted by PAE.

Emerging Areas of Research

Several lines of research are ripe for further investigation. The first is continued investigation on effective strategies to identify children affected by PAE and engage them with early intervention services. Improving diagnostic processes are one important step to enhancing access to services that may help mitigate the negative effects of PAE. For example, the term Neurobehavioural Disorder associated with PAE was proposed as a diagnosis in the Diagnostic Static Manual of Mental Disorders, 5th edition, to clarify the range of neurodevelopmental and mental health sequalae associated with PAE.[74] Diagnosing and treating children impacted by PAE implies the need for cross system collaboration and coordination of efforts to support families and young children affected by substance use challenges.

Further, there remains a need for long-term follow-up studies to examine whether early intervention programs are robust enough to reduce the emergence of secondary disabilities later in life. It may be also important for future studies to continue to investigate whether children with FASD do benefit from existing early intervention programs that support the parent-child relationship. Existing evidence suggest promising results for adapting these evidence-based interventions.[80–82] Further, using interventions like Attachment Biobehavioral Catch-Up[101] and Multidimensional Treatment Foster Care Program for Preschoolers[102] may better address the multifaceted environmental challenges many children with FASD in the foster care system also face. Early interventions involving the family system may also need to be adapted in different ways depending on the family context (i.e., birth families vs. adoptive/foster families). Further, there is a need to consider larger systems and understand cultural barriers to addressing FASD with current screening and intervention methods. For example, normative data for physical

measurements often necessary to receive an FASD diagnosis are not available in many countries and/or subsets of races. There are also varying cultural attitudes towards drinking while pregnant or receiving mental health care that may decrease engagement in services. Researchers need to work with cultural liaisons and stakeholders to address these implementation and intervention development challenges.[66]

Additionally, there have been recent theoretical shifts in which researchers and practitioners are asked to move from a deficits-focused approach to a strength-based perspective that celebrates neural differences in functioning. Rather than focusing exclusively on areas of impairment, strength-based approaches aim to also identify and amplify skills and resources of children affected by PAE and their families in order to enhance their quality of life. Clinicians may identify skill areas to target collaboratively with children and families, while encouraging self-advocacy, and continuing to grow areas of relative strength for children.[100,103] Although more work needs to be done in this area, one recent paper identified several strengths of individuals with FASD including, social motivation, persistence, positive mood, and several other person characteristics.[104]

Conclusions

PAE can significantly compromise young children's early development, particularly their capacity for self-regulation, which in turn may place them well on course for negative developmental trajectories. Deficits in self-regulation may confer further vulnerability by compromising early parent-child relationships (and potentially jeopardizing stable placements), impairing a child's ability to manage stressful situations, and interfering with their mastery of developmentally-appropriate tasks. Encouragingly, a growing number of studies have demonstrated that early intervention can at least partially remediate some of the primary deficits associated with PAE. In particular, over the last decade there has been growing support for family and child-based interventions focused on self-regulation in early childhood as mitigating self-regulation challenges and improving related outcomes.[73–75,80–82,85] Such approaches in early childhood are promising as they may also have the potential to mitigate some of the serious adverse outcomes often seen in individuals with FASD later in life. However, there is still a need to further expand services that target these skills. A recent study of families who received early childhood services noted that while many of their child's cognitive, motor, language, and sensory needs were being met, their self-regulatory and relational needs were not. Further, parents reported a need for assistance with basic survival needs such as respite care, and navigating many transitions in

care.[105] Parents are essential agents of change and it is necessary to integrate them into interventions with young children. It is also essential to support the needs and functioning of parents so that they can effectively provide care and advocate for their children. There remains much work to be done in order to identify affected children as early as possible and to develop a comprehensive continuum of services for these children and their families.

Implications for Parents, Services and Policy

1. Continued efforts must be made to improve training of professionals who work with young children, such as pediatricians, pediatric nurses, child welfare workers, daycare providers, preschool teachers and early childhood mental health consultants. Such training should include a better understanding of the full range of effects that may be associated with PAE, the importance of asking about and documenting a history of prenatal exposure to alcohol and illicit substances. This training can improve early diagnosis and increase the potential for early intervention to promote more positive outcomes for these children and their families.
2. Better collaboration across different systems of care (e.g., hospitals, child welfare, regional centers, Early Start and Head Start programs) is critical to identify, track, and coordinate services for children with FASD. Improved collaboration can help ensure that parents feel supported, and that these children do not slip through the cracks and are directed towards effective interventions.
3. It is critical that interventions for children with FASD start early and involves the entire family system. By bolstering the child's relationship and the family's social network we may be able to enhance the daily functioning and quality of life for these children.

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