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# FETAL ALCOHOL SPECTRUM DISORDER

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**Abstract**

The early description of foetal alcohol syndrome (FAS) was based on physical characteristics like as growth retardation and facial abnormalities, along with signs of mental or developmental delay. Based on four decades of research, FAS is at the very end of the range of conditions now known as foetal alcohol spectrum disorders (FASD). The growing brain and the ensuing cognitive and behavioural impacts are the most significant effects of alcohol intake during pregnancy. Numerous pathways, ranging from neurogenesis to myelination, are affected by alcohol exposure during all stages of brain development. For instance, aberrant brain development is brought on by the same mechanisms that result in the facial traits associated with FAS. A wide range of behaviours are impacted, including executive functioning and motor control. These alterations in the brain and behaviour, as well as the connection between them, are discussed in this special edition of Neuropsychology Review. Determining that FAS is a brain disorder rather than a physical one is one of the diagnostic goals.digestive complaints.



## Introduction

An individual who has had prenatal alcohol exposure may experience a wide range of impacts, which are collectively referred to as "Fetal alcohol spectrum disorders" FASDs. Physical, emotional, behavioral and /or learning problems can be permanent consequences of these events. There has been an increase in awareness of fetal alcohol spectrum disorders in both the lay and academic press of late. However, evidence from national, regional and local conferences as well as a pilot survey of awareness (unpublished data) suggests they remain a set of conditions that arepoorly understood in the UK both by the public and health practitioners. This is despite the conditions being relevant to specialties as diverse as obstetrics, pediatrics, general practice, neurology, public health and psychiatry. This article provides an overview to inform medical practitioners of important aspects related to their practice. A wide range of neuropsychological deficits have been found inchildren prenatally exposed to alcohol, including deficits in visuospatial functioning, verbal and nonverbal learning, attention, and executive functioning. These children also exhibit a variety of behavioral problems that can further affect their daily functioning. Children exposed to alcohol prenatally, with and without the physical features of fetal alcohol syndrome, display qualitatively similar deficits. Determining the behavioral phenotypes that result from heavy prenatal alcohol exposure is critical, because the identification of these children is crucial for early interventions. In addition, knowing which brain areas are involved might enable the development of better intervention strategies. However, intervention needs to go beyond the affected individual to prevent.

Knowledge of fetal alcohol spectrum disorders

Knowledge levels of fetal alcohol spectrum disorders by the general public and health professionals in the UK are not accurately known. Most relevant studies have taken place in the USA and Canada where there is greater general awareness of the disorder. Nanson et al. (1) Surveyed a group of pediatricians and general practitioners (GPs). She showed that whilst most people had heard of fetal alcohol spectrum disorders, less than 50% knew much about how to recognize it. Ten per cent of those who did recognize the condition did nothing about it. Stohler (2) studied 40 high risk pregnancies to see if fetal alcohol syndrome was detected in the offspring. A specially trained research assistant identified 16 cases resulting from these pregnancies. None had been identified by routine pediatric screening. Further, 73% of the case notes made no record of

maternal alcohol consumption despite the mothers being known to be in a high-risk group.

Kesmodel et al.6 studied a group of pregnant Danish women. The majority (74%) felt that drinking in pregnancy was acceptable; 65% reported they had received little or no information from their midwives about possible dangers. This is consistent with data collected by the UK government in their alcohol reduction strategy: it was found that 61% of women drank during pregnancy to some level. (3) MacKinnon studied a group of teenagers in America. Although 97% had heard ofalcohol causing problems during pregnancy, 48% thought that the condition related to the baby being addicted to alcohol and just over 50% felt the condition could be cured. Similar information needs to be collected in the UK urgently in order to inform health promotion strategies.

Causes: Alcohol consumption during pregnancy leads to fetal alcohol spectrum disorders. It is not inherited. Cell growth is harmed by alcohol. Alcohol consumption by the birthing parent during pregnancy affects the growing fetus. The developing fetus's body and brainmay suffer as a result.

The effect of alcohol on a fetus in development relies on:

- how often the pregnant parent drinks
- how much alcohol a pregnant person drink
- when the expectant parent drinks during pregnancy Other factors can affect fetus development, such as:
- Stress
- the birthing parent's age
- smoking or other drug use
- the birthing parent's nutrition TYPES:

FAS- This diagnosis needs a characteristic pattern of facial abnormalities; growth deficits, prenatally and/or after birth; and central nervous system abnormalities.

Partial FAS- Some of the symptoms and indicators of full FAS, but not all three of the previously mentioned traits bullet.

Alcohol related birth defects (ARBD)- This category consists of only aberrant bodily changes brought on by alcohol.

Neurodevelopmental disorder (ARND) - associated with alcohol use. Anomalies of the central nervous system are also included along with behavioral and cognitive issues in this type.

Signs and symptoms:

Children who are born with FASD may experience a variety of issues, including physical, behavioral, academic, and social issues. Depending on the type of FASD they have, they may have different challenges.

Core areas of psychological deficits

- Hyperactivity.
- Attention deficits.
- Sustained attention.
- Focused attention.
- Cognitive flexibility.
- Planning difficulties.
- Learning/memory problems.
- New memories not consolidated.
- Lower IQ. Arithmetic difficulties.
- Receptive language difficulties.
- Verbal processing problems.
- Social understanding difficulties Common secondary difficulties seen
- Psychiatric problem.
- Disrupted school experience
- Trouble with the law.
- Confinement.
- Inappropriate sexual behavior.

Pathology:

Since the naming of fetal alcohol syndrome in 1973 there has been some controversy as to its actual existence. Further uncertainty persists regarding the level of maternal alcohol consumption that can cause damage. Evidence for pathogenic mechanisms comes from mainly animal studies. These have been corroborated by some human investigations. The difficulty with human research lies in the ethics of the methodology and the subsequent biases inherent in available approaches.

It is the combination of all the evidence that has given the most insight into the condition’s pathogenesis.

Maier and West (4) suggest that it is the rise in alcohol levels, as well as the subsequent withdrawal, which causes damage. Both raised acetaldehyde levels as well as subsequent apoptotic damage from excess glutamate activity following GABA (gamma amino butyric acid) withdrawal are implicated. Ikonomidou et al. report that exposure of rat brains to ethanol for a period of hours during a specific developmental stage induces an apoptotic neurodegenerative reaction that deletes large neurons from several developing sites. This process is further complicated by individual genetic differences, diet, and hormonal interactions as some of the multifaceted risk factors. Thus, the prediction of individual risk is particularly difficult if not impossible. The UK binge-drinking culture and lack of awareness of true drink size by the general public are additional risks (5)

Reports have shown increasingly that there are vulnerable periods of neonatal development that can be affected by teratogenic ingestion. In terms of neural development, which occurs throughout pregnancy, it is often the inter-neuron connections that are damaged. This is especially the case at lower levels of consumption. Charnes et al. (6) report that even at low concentrations of ethanol exposure, cell adhesion molecules are inhibited. These have subsequent effects on neuronal migration, fetal alcohol syndrome meciculation and synaptogenesis, which are all vital to

the developing brain. These risk factors, as well as protective factors, need further clarification. More recently, work by Hepper using ultrasound monitoring of fetal behavior where mothers consumed alcohol at levels within current UK government guidance, showed effects on fetal startle which did not habituate to a level achieved by those that consumed no alcohol. They suggest that this is a sign that even at the low levels of alcohol consumption (an average of 4.3 units/week+1.9) permanent damage to the developing fetal brains is occurring.

Variations in the fas and fased conditions:

The reasons for this range of outcomes are varied but like those that provide a range of phenotypes for most other teratogens. Undoubtedly, one of the major factors that influences outcomes is the amount of alcohol that reaches the developing embryo or fetus. This, in part, is determined by the dose and pattern of alcohol exposure. Similarly, genetic factors undoubtedly play a role, since these factors affect the metabolism of or functional sensitivity to alcohol. Nutritional factors could influence blood alcohol levels or operate through other means to determine the results. In addition, the timing of exposure will determine which developing structures are affected and how severely they might be affected. The age of the mother is another factor that has been identified as a risk factor for FAS. Thus, it is not surprising that not all individuals exposed to similar amounts of alcohol during gestation have the same outcomes. Some might be severely affected in multiple systems, whereas others may have no apparent effects.

One example of how the phenotype can differ as a function of exposure involves critical periods of exposure. Prenatal alcohol exposure during the first trimester interferes with the migration, proliferation, and organization of brain cells. Exposure in mice during a period of brain growth development equivalent to the first trimester in humans resulted in severe malformations of the face and brain. The degree of craniofacial malformations ranged from bilateral and unilateral cleft lip to small nose and maxillary region to exencephaly with median facial cleft or absent nostrils. These patterns of malformation were highly correlated with areas of cellular death in the anterior neural plate. During the third trimester, alcohol consumption is highly related to damage to the cerebellum, hippocampus, and prefrontal cortex.

Thus, the pattern of structural and functional abnormalities will vary, depending on how the exposure coincides with critical periods of development.

Given this range of outcomes, it is becoming increasingly clear that FAS is a diagnosis of exclusion, particularly when a history of maternal alcohol use is not available. Although one frequently hears of the characteristic facial appearance seen in FAS, other disorders share these characteristics (phenocopies) and therefore must be excluded before an individual receives a diagnosis of FAS. Some examples of disorders that can be mistaken for FAS include Williams, Delange, velocardiofacial, fetal hydantoin, and Dubowitz syndromes.

Protective factors:

1. Early detection:

A young child who receives a diagnosis can be enrolled in the proper classes and receive the social services required to support the child and his or her family. Early diagnosis also aids families and school staff in comprehending because the youngster may occasionally behave or react differently from other kids.

2. Involvement in social services and special education:

Children who receive special education tailored to their individual needs and learning preferences are more likely to realize their full potential. A variety of learning needs and behavioral issues may need to be addressed in children with FASDs. Programs for special education can better serve the needs of each child. Families of children with FASDs who receive social support, such as counselling or respite care, have more favorable experiences.

3. Loving, nurturing and stable home environment:

FASD-affected youngsters may be more sensitive than normal kids to interruptions, changes in way of life or routines, and unhealthy relationships. A child with FASD must, therefore, place a high value on having a loving, secure home life. Additionally, secondary problems like criminal activity, unemployment, and incomplete education can be avoided with the cooperation of the community and families.

4. Absence of violence:

Children who have been exposed to violence as children are far more prone to develop secondary conditions than people with FASDs who live in stable, non- abusive households or who do not get involved in juvenile violence. Teaching alternative strategies for children with FASDs to express their rage or frustration is necessary.

Types of treatment:

Treatment options for those with FASDs are numerous. Generally speaking, they fall into five categories:

- Health Care
- Medication
- Behaviour Therapy and Education
- Parent Education
- Alternative Methods

➢ Health care:

The health and medical needs of people with FASDs are the same as those of people without FASDs. They require basic medical care, well-baby care, immunizations, a healthy diet, exercise, and decent hygiene just like everyone else. The use of any drugs to treat FASDs has not been authorized. Nevertheless, a number of drugs can help with FASD symptoms. As an illustration, medication may be used to treat depression,

focus issues, or high levels of energy.

- Medication:

Here are some examples of drugs that are used to treat the signs and symptoms ofFASD:

1.Stimulants

Hyperactivity, difficulty focusing, poor impulse control, and other behavioral disorders are among the symptoms that are treated with this kind of drug.

2.Anti-depressant's

This kind of medicine is used to treat symptoms like depressed mood, loss ofinterest, sleep issues, Interruption of schoolwork, negativity, impatience, aggression, and antisocial behaviors.

3.Neuroleptics

Aggression, anxiety, and a few other behavioral issues are treated with the help ofthis particular kind of drug.

4.Anti-anxiety medications

The symptoms of anxiety are treated with this kind of medication.Fasd diagnosis:

Ongoing work seeks to define specific diagnostic criteria for each of the FASD conditions along the continuum, such as has been possible for FAS. The FAS diagnosis is made only when an individual meets all diagnostic criteria: prenatal and/or postnatal growth deficiency, the cardinal facial features (reduced palpebral fissure length, smooth philtrum, and thin upper vermillion lip border and any of a range of rognized structural, neurologic, and/or functional central nervous system deficits Confirmed PAE strengthens the evidence, but FAS can be diagnosed without this history when all of the specific FAS diagnostic criteria have been met. Diagnosing FAS also means a comprehensive history has documented any other in utero substance exposures, including tobacco, medications, or illicit substances of abuse, and that other possible genetic and environmental etiologies have been excluded, specifically Williams, Noonan, 22q deletion syndromes, trisomy, and fetal toluene embryopathy, because some dysmorphological features are shared with FAS (7).

All other FASD conditions have a range of PAE-associated findings that meet only some of the FAS diagnostic criteria. A computer-based 3-dimensional facial image analysis is showing promise in identifying PAE affected children who have cognitive impairments but lack the FAS diagnostic facial features. ARBD refers to children with confirmed PAE and certain physical findings related to congenital structural malformations and dysplasia's affecting organ systems and/or specific minor anomalies but normal neurodevelopment. (8,9,10) A confirmed history of PAE should also prompt careful developmental screening and assessment for ARND/ ND-PAE, which is among the possible diagnoses when there are no physical stigmata of FAS, yet evidence of brain abnormalities, and either structural or functional neurocognitive disabilities manifest as problems with neurodevelopment, behavior, adaptive skills, and/or self-regulation (11,12).Other individuals whose features meet most but not all of the diagnostic criteria for FAS are described as having partialfetal alcohol syndrome.

Medical, behavioral and cognitive problems:

Although a classic FAS diagnostic triad has long been identified, other findings, including microcephaly, behavioral abnormalities, and “noncardinal” abnormal facial features, such as maxillary hypoplasia, cleft palate, or micrognathia, are also well recognized to co-occur with PAE.

Children and adolescents with known PAE experience a variety of behavioral and cognitive difficulties, ranging from subtle learning and/or behavioral problems to significant intellectual disability.PAE is associated with a higher incidence of attention-deficit/hyperactivity disorder (ADHD) and specific learning disabilities, such as mathematics difficulties.(13) The neurocognitive profile associated with FASDs results from deficits in visual-spatial and executive functioning, including impaired impulse control, memory skills, and problem-solving, but also difficulties with abstract reasoning, auditory comprehension, and pragmatic language use.(14) PAE-associated executive dysfunction is evident as slow information processing and integration, and children with FASD

Lip-Philtrum Guide 1 is one of two Guides used to rank upper lip thinness and philtrum smoothness. The philtrum is the vertical groove between the nose and upper lip. The guide reflects the full range of lip thickness and philtrum depth observed among Caucasians with Rank 3 representing the population mean. Ranks 4 and 5 reflect the thin lip and smooth philtrum that characterize the FAS facial phenotype. Guide 1 is used for Caucasians and all other races with lips like Caucasians. This guide is available from fasdpn.org as a free digital image for use on smartphones. © 2015 Susan Astley, PhD, University of Washington. Legend written by Susan Astley, PhD.

Show deficits in cognitive planning, concept formation, set shifting, verbal and nonverbal fluency, social interaction skills, and peer relationships. Because attention deficits are considered a common characteristic of people with FASD, these skills have been extensively investigated. Children with FASD have demonstrated attention deficiencies with their capacity to hold information temporarily in memory while coding it or performing a mental operation on it and with the ability to shift attention flexibly compared with those with ADHD, who display greater difficulty with focus, concentration, and staying on task. (15,16) Children and adolescents with PAE have difficulty rapidly processing relatively complex information and perform worse on visual than on auditory sustained attention tasks. Although a few case reports have associated extreme PAE with autism spectrum disorders, most reports have delineated qualitative differences in the social difficulties experienced by those with FAS compared

with individuals with autism spectrum disorders. (18)

Treatment:

An integrated multifactorial FASD model that includes genetic, PAE, and environmental factors, among others, provides an approach to understanding and assisting this complex and diverse highrisk population. FASDs have no cure, but affected individuals experience improved medical, psychological, and vocational outcomes through longitudinal intervention and treatment that maximize protective factors and build capacity in identified strengths. Multimodal symptom treatments that improve long-term outcomes include optimizing environmental modifications, parenting strategies, social support, and developmental and educational interventions that address the neurologically based problems related to FASDs. Children with FASDs prescribed neuroleptic medication have shown improved outcomes, but stimulant medication either failed to improve or worsened ADHD symptoms. The heterogeneity of FASD manifestations calls for tailoring treatments to meet individual needs and addressing these constellations of lifelong disabilities across the lifespan.

Young man presenting with the 3 facial features of FAS (small eyes, smooth philtrum, and thin upper lip) at 2 years of age and 20 years of age. Legend written by Susan Astley, PhD. 2015, Susan Astley PhD, University of Washington

Washington State continues to be a national and international leader in FASD diagnostic, prevention, and intervention practices through a long-standing coordinated effort of diverse programs focused on their collective FASD-associated needs and building a strong FASD research and evidence basis. The 2014 recommendations from the Washington State Fetal Alcohol Spectrum Disorders Interagency Work Group highlight evidence-based practices that include identifying risk and protective factors, engaging early intervention, addressing the high FASD risk for substance abuse problems, and applying screening-informed treatment planning, including neuropsychological assessment guided treatment plans Children with FASD are not explicitly designated to receive special education services in the Individuals with Disabilities Education Act; however, some school districts serve affected children through the "Other Health Impaired" category. PAE is not specifically listed in this category but does qualify a child as "at risk" and eligible for early intervention services. The developmental and behavior difficulties in young children with FASDs qualify for special education services. Various school-based educational accommodations have been effective in helping children with FASDs reach their developmental and educational potential, but the transition to the post educational setting and adulthood poses additional challenges where support services such as vocational training and life skills development are needed.

Economics effects:

The constellation of medical, surgical, behavioral, educational, custodial, judicial, and other services required to care for an individual with FASD results in a large economic burden to the individual, the family, and society. In the 1980s, the estimated annual FAS-related expenses for the United States increased from $75 million to $4 billion, with the lifetime cost of care approaching $1.4 million. Cost estimates are similarly high in Canada but also vary widely depending on the methodologies used. During 2005, children with FAS incurred average medical expenditures 9 times higher than those without FAS.[1] When FAS with intellectual disability was considered in making these calculations, average expenditures increased an additional 2.8 times the costs for FAS alone. Because FAS is only 1 subset of FASD, the true economic effect of FASD is much larger. It has been documented in Canada that an FASD evaluation requires 32 to 47 hours for 1 individual to be screened, referred, evaluated, and given the diagnosis of an FASD, resulting in a total cost of $3110 to $4570 per person. On the basis of the cost of a comprehensive multidisciplinary FASD assessment in Canada, the total cost estimate of all FASD screening and diagnosis ranges from $3.6 to $7.3 million per year, excluding treatment costs. The estimated lifetime cost of care, including social and health care services, for each child born with FASD is up to $2.44 million. The calculated expense of raising a child with FASD is 30 times the cost of preventing the FASD. In 2005, the annual Medicaid cost to care for a child with FASD was 9 times that of a child without FASD.

The role of the pediatrician and the medical home:

The main role of a pediatrician and the medical home regarding FASD is to be knowledgeable about the disorder to guide prevention, to suspect and screen for FASD, and to recognize, manage, and refer patients. Pediatricians, medical home team members, and other health professionals are in prime position to provide both primary and secondary FASD prevention education and counseling because young women of childbearing age are among their patient population. Pediatricians build trusted relationships with their adolescent and young adult patients and the parents of these patients, and a routine and expected part of medical home care is to discuss personal health responsibilities, including preventing pregnancy, alcohol, and other substance use and abstaining from sexual activity. Many women have misconceptions about the "safety" of alcohol use and as a result continue to consume alcohol during pregnancy despite the Surgeon General warnings. (18)

There is no known absolutely safe quantity, frequency, type, or timing of alcohol consumption during pregnancy, but having no PAE translates into no FASD. Despite research evidence clearly documenting the spectrum of detrimental consequences of PAE, too many

women continue to drink alcohol during pregnancy. Progress continues to be made in understanding the mechanisms of alcohol's deleterious effects and identifying the most efficacious intervention strategies for preventing and ameliorating deficits associated with FASDs, but each discovery also
reveals new challenges. From an economic, societal, educational, family, or health or medical home perspective, FASDs represent a major public health burden.

## Conclusion

A significant public health issue is foetal alcohol spectrum disorder. The person, the family, the communities in which these people reside, and society at large are all impacted by these impacts. FASDs have a startlingly large economic impact. The issue of foetal alcohol spectrum disorders is a global concern, as it affects women of all ethnicities and social groups and is not limited to those in certain groups.If these issues could be avoided, patients' quality of life and financial situation would greatly improve. If alcohol is not consumed during pregnancy, foetal alcohol spectrum disorders can be avoided. In order to improve public health, we must target high-risk populations, educate the public, and give these problems top priority.compared to one of physical attributes.digestive complaints.

## Author contributions

All authors are contributed equally.

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## Declaration of Competing Interest

The authors have no conflicts of interest to declare.

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