Review Article

Jour Cas Stu Cas Rep, 4(2), 2025, 4-16

Journal of Case Studies and Case Reports

Open access peer reviewed international indexed journal Online ISSN: 2583-4428

Content Available at http://www.saapjournal.org/

A REVIEW ON CONCEQUENCES ON FOETAL DEVELOPMENT DURING ALCOHOL INDUCED MOTHER

Ravuru Jyothirlatha[1], M. Sowjanya[2], Y Prapurna Chandra[3], Venugopalaiah Penabaka[4], Afroz Patan[5]

[1]B. Pharmacy, IV Year, Ratnam Institute of Pharmacy, Pidathapolur (V & P), Muthukur (M), SPSR Nellore District-524 346, Andhra Pradesh.

[2]Assistant professor, Department of Pharmacy practice , Ratnam Institute of Pharmacy, Pidathapolur (V & P), Muthukur (M), SPSR Nellore District-524 346, Andhra Pradesh.

[3]Principal and Professor, Department of Pharmacology, Ratnam Institute of Pharmacy, Pidathapolur (V & P), Muthukur (M), SPSR Nellore District-524 346, Andhra Pradesh.

[4]Professor, Department of Pharmaceutics, Ratnam Institute of Pharmacy, Pidathapolur (V & P), Muthukur (M), SPSR Nellore District-524 346, Andhra Pradesh.

[5]Professor & HOD, Department of Pharmacy practice, Ratnam Institute of Pharmacy, Pidathapolur (V & P), Muthukur (M), SPSR Nellore District-524 346, Andhra Pradesh.

Received: 14 Aug 2025 Revised: 05 Sept 2025 Accepted 11 Oct 2025

Abstract

Maternal alcohol consumption during pregnancy remains a significant global public health concern, with severe and lasting consequences on foetal development. This review explores the broad spectrum of physical, neurological, cognitive, and behavioural abnormalities associated with prenatal alcohol exposure, collectively known as Foetal Alcohol Spectrum Disorders (FASDs). Among these, Foetal Alcohol Syndrome (FAS) represents the most severe end of the spectrum, characterized by distinct craniofacial abnormalities, growth retardation, and central nervous system dysfunction. Alcohol acts as a teratogen that interferes with cellular differentiation and proliferation during critical stages of embryonic development. It can cross the placental barrier and accumulate in the amniotic fluid, directly impacting the foetus, whose metabolic system is underdeveloped and thus unable to eliminate alcohol efficiently. The timing, frequency, and amount of alcohol consumed play a crucial role in determining the severity of developmental outcomes. First-trimester exposure often affects organogenesis and facial morphology, while third-trimester exposure more commonly impacts brain growth and synaptogenesis. This review also highlights emerging research linking prenatal alcohol exposure to epigenetic modifications and alterations in neurodevelopmental gene expression. Children born to alcohol-consuming mothers often show deficits in learning, memory, attention, language, and executive functions, which can persist into adolescence and adulthood. Behavioural disorders such as ADHD, conduct disorders, and emotional dysregulation are also frequently reported.

Keywords: Foetal Alcohol Spectrum Disorders (FASDs), Foetal Alcohol Syndrome (FAS), prenatal alcohol exposure, neurodevelopment, teratogen, epigenetics, cognitive impairment, behavioural disorders, maternal health, pregnancy.

***Corresponding Author**

M. Sowjanya

doi: https://doi.org/10.37022/jcscr.v4i2.755

Introduction

Maternal health during pregnancy is a cornerstone of public health-it refers to the physical, mental, and social wellbeing of women during pregnancy, childbirth, and the postpartum period. Ensuring good maternal health is vital not only for preventing maternal morbidity and mortality, but also for promoting healthy Foetal development, reducing neonatal and child health risks, and improving long-term outcomes for both mother and child.

Several dimensions highlight the importance of focusing on maternal health during pregnancy:

- **Preventing maternal deaths and complications**: Pregnancy and childbirth carry risks such as hemorrhage, infection, high blood pressure disorders (e.g. pre eclampsia), unsafe abortion, or obstructed labour.
- **Foetal and newborn health**: The health of the mother directly impacts Foetal growth, birth weight, risk of prematurity and even long-term childhood development.
- **Broader societal and health system benefits**: Healthy pregnancies reduce the strain on health systems, lower healthcare costs, and contribute to

better social and economic outcomes (e.g. reducing child mortality, improving maternal productivity, enhancing quality of life) [1].

Prevalence of alcohol consumption among pregnant women:

Alcohol consumption during pregnancy is a significant global public health concern. Several studies have documented its prevalence, patterns, and associated factors in different settings. Below are key findings from recent literature:

A. **Africa, Systematic Review / Meta-Analysis:** A recent meta-analysis covering Sub-Saharan Africa found that the pooled prevalence of any alcohol consumption during pregnancy was **20.83% (95% CI: 18.21–23.46%)**.

- Higher prevalence was found among women with low levels of education, unplanned pregnancies, partner alcohol use, and poor knowledge about the harmful effects of alcohol.

- This underscores considerable variation across countries within Sub-Saharan Africa, and highlights risk factors that tend to cluster with socioeconomic disadvantage [2].

B. **Ethiopia, Specific Antenatal Care Setting:** A study at Debre Tabor Comprehensive Specialized Hospital (South Gondar Zone) during May 2021 found that 26.3% of pregnant women attending antenatal care reported some alcohol use.

- Factors associated with increased odds of alcohol consumption in that setting included unplanned pregnancy, partner's alcohol use, lower knowledge about Foetal effects of alcohol, and whether they had prior antenatal care follow-ups.

C. **India, nationally representative data:** Using the National Family Health Survey-5 (2019-20), a study estimated the national prevalence of self-reported alcohol use during the most recent or current pregnancy in India at about **1.26%**.

- However, there were large regional disparities: for example, states like **Arunachal Pradesh** showed much higher prevalence (~13.03%), **Chhattisgarh** (~5.77%), and **Assam** (~5.62%).
- Correlates of higher alcohol use included being from Scheduled Tribes, having little or no formal education, and also concurrent tobacco use [3].

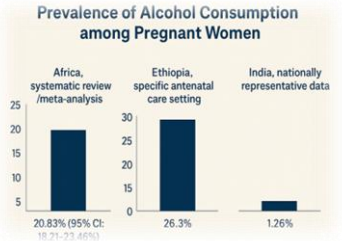

Fig 01: Image of Prevalence of Alcohol Consumption among Pregnant Women

Alcohol and Pregnancy

Alcohol consumption during pregnancy remains a major global public health issue, with significant implications for both maternal and Foetal health. When a pregnant woman consumes alcohol, it readily crosses the placenta and reaches the developing fetus, exposing the unborn child to nearly the same concentration of ethanol found in the mother's bloodstream. Epidemiological data reveal that alcohol use during pregnancy occurs worldwide, though prevalence varies widely across regions and cultures. In high-income countries, rates of alcohol use during pregnancy have been reported between 10–25%, whereas in low- and middle-income countries, prevalence rates are lower but still concerning. Even low or moderate levels of consumption have been associated with adverse outcomes such as miscarriage, stillbirth, preterm birth, intrauterine growth restriction, and neurodevelopmental disorders. Chronic and heavy use can result in Foetal Alcohol Spectrum Disorders (FASD)-a range of irreversible physical, behavioural, and cognitive impairments.[4]The teratogenic effects of alcohol are well-established and depend on factors such as the timing, quantity, and frequency of exposure. Despite widespread awareness campaigns, misconceptions persist about "safe" or "occasional" drinking during pregnancy. Scientific consensus affirms that no level of alcohol consumption is safe during pregnancy, and complete abstinence remains the best preventive measure [5].

How Alcohol Crosses the Placenta

Ethanol diffusion and equilibrium between maternal and Foetal compartments

- Ethanol is a small, water-soluble molecule. It crosses the placenta by simple diffusion, moving down its concentration gradient from maternal blood into Foetal blood.
- Once in Foetal circulation, ethanol also accumulates in the amniotic fluid, which acts as a reservoir: the fetus swallows amniotic fluid, which contains ethanol (and its metabolites), prolonging exposure.

Placental metabolism of ethanol and acetaldehyde transfer

- The placenta itself appears capable of metabolizing ethanol (oxidizing it) to acetaldehyde. When acetaldehyde is present in maternal blood, it is also transferred to the fetus, reaching about 50% of maternal levels in some perfusion studies.
- The relative incapacity of the Foetal liver to detoxify ethanol (via alcohol dehydrogenase, aldehyde dehydrogenase, etc.) means that exposure to acetaldehyde and ethanol persists longer in the fetus.

Limited Foetal metabolic capacity

Foetal ADH (alcohol dehydrogenase) activity is much lower than in adults (often <10%), which slows the breakdown of ethanol.

- Moreover, the other enzymes (e.g. aldehyde dehydrogenase) are also under-expressed, so acetaldehyde, a toxic metabolite, may accumulate. This contributes to teratogenic effects.

Amniotic fluid as reservoir and re-exposure

- Because ethanol (and acetaldehyde) accumulates in the amniotic fluid, the fetus is repeatedly exposed through swallowing and possibly through absorption across the skin of the fetus (especially before keratinization). This means even after maternal blood ethanol levels start declining, foetal exposure might persist.

Placental effects influencing transfer and exposure

- Alcohol exposure (and acetaldehyde) can damage the placenta itself: impairing nutrient transport, reducing placental size or functional surface area, altering vascular development, causing vascular dysfunction, affecting placental gene expression (e.g. of angiogenic factors) and epigenetic modifications.
- For example, prenatal alcohol exposure has been associated with changes in placental morphology, reduced blood flow through the placenta, and altered expression of genes related to placental vascularization (e.g. VEGF systems) in animal models [6].

Consequences of exposure due to the transfer:

- Because Foetal organs are developing (brain, heart, etc.), and because many cell processes (proliferation, migration, differentiation) are ongoing, exposure to ethanol and acetaldehyde (which can interfere with DNA, protein synthesis, oxidative status, etc.) may lead to congenital anomalies, growth restriction, developmental delays, and functional deficits. The prolonged exposure due to amniotic reservoir, low metabolic clearance [7].

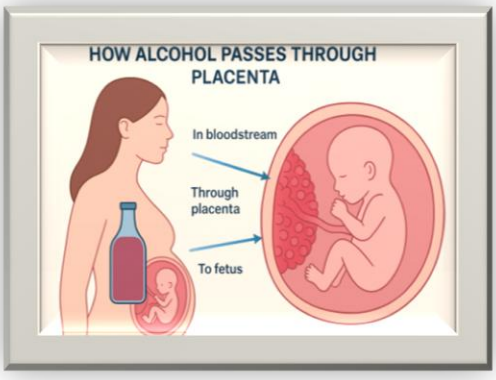

Fig 02: Image of Alcohol Passes through Placenta.

Teratogenic effects of alcohol on the developing foetus

Alcohol (ethanol) is a well-established teratogen: it can cross the placenta and directly affect the embryo/fetus, causing structural, functional, growth, cognitive and behavioural abnormalities. The nature and severity of effects depend on the dose, timing (which trimester / developmental stage), frequency (chronic vs binge), and individual susceptibility (maternal genetics, nutrition, other exposures).

Growth restriction & low birth weight: Prenatal alcohol exposure is associated with intrauterine growth retardation, lower birth weight, and decreased length. Foetuses exposed to alcohol often show postnatal growth deficits as well [8].

Spontaneous abortion, stillbirth & prematurity: High levels of alcohol use increase risks of miscarriage (spontaneous abortion), stillbirth, and premature delivery.

Facial Dysmorphology: One hallmark of full Foetal alcohol syndrome (FAS) is characteristic facial abnormalities including smooth philtrum (the groove between nose and upper lip), thin upper lip, short palpebral fissures, etc. These are most usually formed during early gestation [9].

Central nervous system (CNS) impairment

A variety of effects:

- Microcephaly (smaller head size) and overall reduction in brain volume.
- White matter abnormalities, disrupted connectivity (e.g., corpus callosum, other commissures), aberrations in regions such as cerebellum, hippocampus.
- **Cognitive, behavioural, and neuropsychological deficits:** Even in children without full FAS facial features, prenatal alcohol exposure (PAE) is associated with deficits in:
    - Intelligence/IQ
    - Learning, language, social skills, emotional regulation.

Critical Stages of Foetal Vulnerability

The Foetal development process includes specific periods when organs, systems, or cell populations are forming, differentiating, or undergoing rapid growth.

Table 01: Categories and Stages of Pregnancy.

Stage / Weeks (Human)	Developmental Processes Underway	Vulnerability / Known Effects of Alcohol Exposure
Pre-implantation (~fertilization to ~2 weeks gestation)**	Zygote → morula → blastocyst formation; implantation in uterine wall	Traditionally thought to follow an "all-or-nothing" principle (either the embryo fails to implant or survives without malformations), but more recent studies suggest that even at this early stage, alcohol exposure can affect epigenetic marks, possibly increase risk of early pregnancy loss or later deficits.
Gastrulation / early organogenesis (~3-8 weeks)	Differentiation into three germ layers (ectoderm, mesoderm, endoderm); initiation of organ formation (heart, neural tube, limbs, facial structures)	High sensitivity. Exposure during this period has been clearly linked to major structural abnormalities: neural tube defects, facial dysmorphology, heart defects, craniofacial malformations. For example, animal studies show that exposure on specific days in early gestation (mouse GD7-9 etc) produces characteristic facial anomalies.
First trimester more broadly (up to ~12 weeks)	Continued organogenesis; neural proliferation; early brain patterning; formation of major body plan, facial features, heart, limbs	Many of the classic structural defects of Foetal Alcohol Syndrome (FAS) occur from exposure in the first trimester. Moreover, even moderate drinking can result in physical anomalies. The risk is especially high for facial, skeletal, cardiac defects when exposure happens early.
Second trimester (~13-24 weeks)	Rapid growth, differentiation of various organ systems; brain regions developing; migration of neurons; maturation of sensory organs; growth of Foetal body; lung maturation starts (but more later)	Vulnerability remains high. Deficits in growth (e.g. Foetal growth restriction), some brain structure abnormalities, possibly increased risk of miscarriage. Evidence shows second trimester exposure strongly associated with reduced Foetal growth.
Third trimester (~24 weeks to birth)	Rapid brain growth ("brain growth spurt"), continued maturation of neural circuits, glia, synaptogenesis; growth of body mass and adipose tissue; lung maturation; final development of sensory systems; accumulation of damage effects	Although fewer gross structural abnormalities arise from exposure during third trimester compared to first, significant risk remains for brain (especially hippocampus, cerebellum, prefrontal cortex), cognitive, behavioural, executive function, possibly effects on birth weight and viability. Also functional deficits (learning, memory, behaviour) are often the result of exposure in late gestation. [10].

Mechanisms of Alcohol-Induced Fatal Damage

Fig 03: Mechanisms of Alcohol-Induced Foetal Damage.

1. **Ethanol Intake**: Alcohol is consumed by the pregnant individual.
2. **Metabolism by ADH**: Ethanol is converted to acetaldehyde primarily in the liver by **alcohol dehydrogenase (ADH)**.
3. **Formation of Acetaldehyde**: Acetaldehyde is highly toxic, more so than ethanol itself.
4. **Toxic Effects**:
    - **Oxidative stress**: Acetaldehyde generates reactive oxygen species (ROS).
    - Interference with cell signalling and gene expression.
    - DNA and protein adduct formation leading to impaired Foetal development.
5. **Placental and Neural Impact**:
    - Disrupts placental nutrient transport.
    - Damages neural crest cells → crucial for facial and brain development.
6. **Foetal Alcohol Spectrum Disorders (FASD)**
    - Includes physical, behavioural, and cognitive abnormalities [11-12].

➢ **Oxidative Stress in Alcohol-Induced Foetal Damage [13]**

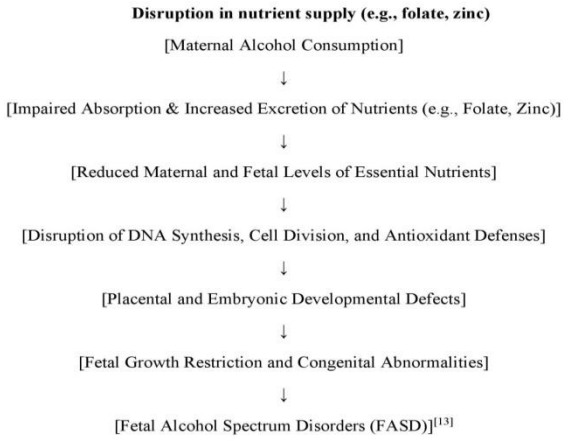

Fig 04: Oxidative Stress in Alcohol-Induced Foetal Damage.

Impaired blood flow and oxygen supply

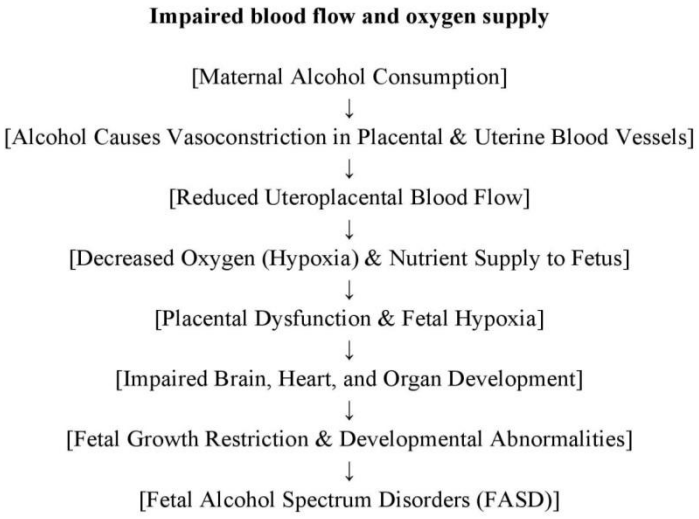

Fig 05: Impaired blood flow and oxygen supply.

1. Alcohol-induced vasoconstriction reduces blood flow through the placenta.
2. Oxygen and nutrient delivery to the fetus is compromised, leading to chronic Foetal hypoxia.
3. Hypoxia disrupts normal cell growth, organ development, and neural function.

Results in features of Foetal Alcohol Spectrum Disorders like low birth weight, brain abnormalities, and cognitive impairments [14].

Foetal Alcohol Spectrum Disorders (FASD)

Foetal Alcohol Spectrum Disorders (FASD) describes a range of effects that can occur in an individual whose mother consumed alcohol during pregnancy.

Classification of FASD

The classification of FASD typically includes [15]:

Table 02: Categories of Foetal Alcohol Spectrum Disorders.

Category	Key Features
Foetal Alcohol Syndrome (FAS)	Facial dysmorphology (smooth philtrum, thin upper lip, small palpebral fissures)
Partial Foetal Alcohol Syndrome (pFAS)	Some facial features of FAS but not all - CNS abnormalities -Confirmed prenatal alcohol exposure
Alcohol-Related Neurodevelopmental Disorder (ARND)	Neurodevelopment and behavioural abnormalities without facial features -Confirmed prenatal alcohol exposure
Alcohol-Related Birth Defects (ARBD)	Structural defects in organs such as the heart, kidneys, or bones -Confirmed prenatal alcohol exposure

Features of Foetal Alcohol Syndrome (FAS): Foetal Alcohol Syndrome (FAS) is the most severe form of Foetal Alcohol Spectrum Disorders (FASD) and is characterized by a triad of:

1. Facial Abnormalities

Characteristic facial features usually include:

- Smooth philtrum (the groove between the nose and upper lip is flattened)
- Thin upper lip
- Small palpebral fissures (short eye
- midface and epicanthal folds

2. Growth Deficiency

- **Prenatal and/or postnatal growth retardation**
    - Low birth weight
    - Short stature
    - Failure to thrive (even with adequate nutrition)

3. Central Nervous System (CNS) Abnormalities

- **Structural**
    - Microcephaly (small head size)
    - Abnormal brain structure (e.g., corpus callosum agenesis)
- **Neurological**
    - Poor motor coordination
    - Seizures in some cases
- **Functional**
    - Intellectual disability (IQ often <70)
    - Learning disabilities
    - Poor memory, attention deficits
    - Hyperactivity
    - Poor problem-solving and judgment
    - Delayed speech and language development

4. Other Possible Features

- Cardiac defects (e.g., septal defects)
- Skeletal abnormalities
- Renal (kidney) anomalies
- Immune dysfunction[16]

Partial FAS and other related disorders: pFAS is diagnosed when some features of full FAS are present, but not all three criteria (facial features, growth restriction, CNS damage) are fully met.

Table 3: Categories of Diagnostic Features.

Criteria	Description
Facial features	At least **2 of the 3** facial features of FAS:
Growth deficits	May be present but **not required** for diagnosis
CNS abnormalities	Functional or structural impairments (e.g., learning disabilities, memory issues)
Confirmedalcohol exposure	Must be documented

Clinical Implications

Children with pFAS often have significant cognitive, behavioural, and social challenges, even without full FAS.

2. Alcohol-Related Neurodevelopmental Disorder (ARND)

A diagnosis given when a child has neurodevelopmental abnormalities (especially cognitive and behavioural) but does not have the facial or growth features of FAS.

Features

- Deficits in
    - Memory
    - Attention
    - Executive functioning
    - Impulse control
- Poor academic performance
- Social and behavioural problems
- Confirmed prenatal alcohol exposure is required

3. Alcohol-Related Birth Defects (ARBD): Involves physical anomalies in organs and structures, caused by alcohol, without neurobehavioral deficits necessarily being present.

Possible Birth Defects:

- Heart defects (e.g., atrial septal defects)
- Kidney abnormalities
- Bone and joint malformations
- Hearing and vision problems

ARBD diagnosis requires confirmed alcohol exposure during pregnancy and one or more major birth defects.[17]

Table 04: Categories of Summary Table.

Disorder	Facial Features	Growth Deficit	CNS Abnormalities	Alcohol Exposure Required
FAS	Yes (all 3 features)	Yes	Yes	No (but helpful for diagnosis)
pFAS	Yes (≥2 features)	Maybe	Yes	Yes
ARND	No	No	Yes	Yes
ARBD	No	No	Maybe	Yes + physical anomalies required

Consequences on Foetal Development

Physical Development in Alcohol-Induced Pregnancy

1. Growth Retardation

- **Description**

  Prenatal alcohol exposure disrupts normal Foetal cell growth and division, leading to intrauterine growth restriction (IUGR).
- **Features**
    - Below-average height and weight
- Growth deficiency may persist postnatal.
- Mechanism:

  Alcohol impairs placental function, nutrient transport, and hormone regulation essential for Foetal growth.

2. Low Birth Weight (LBW)

- **Description**

  Babies exposed to alcohol in utero are more likely to be born with a weight less than 2,500 grams (5.5 pounds).
- **Causes**

- Reduced oxygen and nutrient delivery due to placental insufficiency
- Chronic Foetal hypoxia caused by alcohol-induced vasoconstriction

- **Impact**
  Increased risk of neonatal complications, developmental delays, and chronic diseases later in life.

3. Craniofacial Abnormalities

- **Description**
  Facial malformations are hallmark signs of Foetal Alcohol Syndrome (FAS), especially when alcohol exposure occurs during the first trimester (when facial structures are forming).
- **Classic Features:**
  - Smooth philtrum (flattened groove between nose and lip)
  - Thin upper lip
  - Short palpebral fissures (small eye openings)
  - Flat midface, low nasal bridge
  - Microcephaly (small head circumference)
- **Mechanism**:
  Alcohol disrupts the migration of neural crest cells, which play a key role in craniofacial development.[18]

Neurological Development

Microcephaly and reduced head/brain size. Prenatal alcohol exposure (PAE) is associated with smaller head circumference and reduced total brain volume; cohort and imaging studies report higher rates of microcephaly in exposed children.

Global and regional volume loss. MRI studies show widespread reductions in gray- and white-matter volumes (frontal, temporal, parietal lobes), with relative vulnerability of specific regions (e.g., corpus callosum, cerebellum, basal ganglia). These volume changes relate to cognitive and behavioural deficits.

Corpus callosum abnormalities. Agenesis, hypoplasia, shape changes and thinning of the corpus callosum are repeatedly reported in FASD cohorts and animal models. Such midline defects are among the most consistent MRI findings.

Cerebellar hypoplasia and brainstem changes. Reduced cerebellar volumes and brainstem anomalies are common and tie to motor/coordination deficits.

Clinical and imaging implications

- **Heterogeneity:** Not all exposed children show gross malformations; effects depend on dose, timing (which gestational window), pattern of drinking, genetics, and maternal health. Imaging is useful but group-level differences do not always predict individual outcome.
- **Utility of MRI:** Structural MRI (volume, shape, cortical thickness) and diffusion MRI (white-matter microstructure) are primary modalities for characterizing PAE effects and correlating them with neurocognitive profiles.[19]

Cognitive and Behavioural Issues in Alcohol-Induced Mother

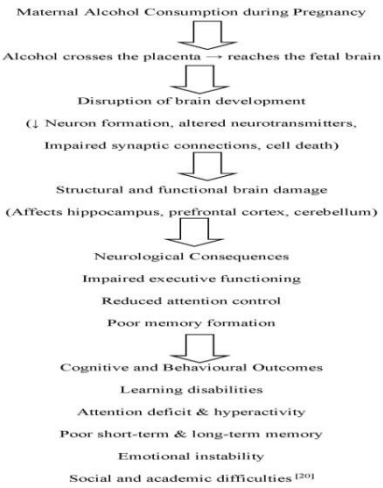

Fig 06: Image of Cognitive and Behavioural Issues in Alcohol-Induced Mother.

Psychological Effects

- Emotional Dysregulation: Individuals prenatally exposed to alcohol often experience mood instability, depression, and anxiety disorders due to altered limbic system function and neurotransmitter imbalance.

- Poor Impulse Control: Damage to the prefrontal cortex contributes to impulsivity, aggression, and difficulty managing frustration, leading to antisocial behaviours.
- Low Self-Esteem and Mental Health Issues: Chronic difficulties in learning, attention, and relationships often lead to low self-confidence and increased risk of mental health disorders in later life.

Social and Interpersonal Effects

- Poor Social Judgment: Alcohol-exposed individuals often fail to recognize social cues, leading to inappropriate or immature social behaviour.
- Difficulty Maintaining Relationships: Problems with empathy, communication, and understanding consequences make sustaining friendships and employment difficult.
- Academic and Occupational Challenges: Many individuals struggle to complete education or maintain consistent employment due to executive dysfunction and low adaptive skills.
- Risk of Secondary Disabilities: Adolescents and adults with FASD show higher rates of substance abuse, legal problems, homelessness, and unemployment.

Dose, Timing, and Frequency of Alcohol Consumption

1. Dose (Amount of Alcohol Consumed)

- The risk of Foetal damage increases with higher doses of alcohol.
- Heavy or chronic drinking is most strongly associated with Foetal Alcohol Syndrome (FAS), characterized by facial anomalies, growth retardation, and central nervous system abnormalities.

2. Timing (Gestational Period of Exposure)

- The first trimester is the most critical period, as this is when organogenesis occurs; exposure may cause structural malformations such as heart defects, facial abnormalities, and skeletal deformities.
- During the second trimester, alcohol can interfere with growth and neuronal migration, increasing the risk of miscarriage and Foetal growth restriction.
- The third trimester is crucial for brain development, and exposure at this stage can result in microcephaly, poor cognitive outcomes, and behavioural problems later in life.

3. Frequency (Pattern of Drinking)

- Binge drinking (defined as consuming ≥4–5 drinks per occasion) causes high peak blood alcohol levels, which are particularly harmful to the Foetal brain.
- Chronic or frequent drinking results in sustained exposure, leading to cumulative toxicity and widespread developmental defects.
- Even occasional drinking can affect brain development, as alcohol exposure is unpredictable in its effects on individual foetuses.

  Effect of binge drinking vs. moderate drinking:

- **Binge Drinking and Foetal Effects:** Typically defined as consuming ≥4 drinks within 2 hours for women, leading to high peak BAC.
- Causes acute high alcohol exposure to the fetus, leading to cell death (apoptosis), particularly during critical windows of brain development.
- Results in severe structural and functional brain abnormalities, including:
    - Microcephaly
    - Corpus callosum defects
    - Cerebellar and hippocampal damage
- Associated with Foetal Alcohol Syndrome (FAS), the most severe form of Foetal Alcohol Spectrum Disorders (FASD).
- Children exposed to binge drinking episodes exhibit greater deficits in IQ, attention, learning, and social behaviour than those with chronic low-level exposure.
- **Moderate Drinking and Foetal Effects:** Usually refers to 1 drink per day or fewer, spread over time without intoxication.
- Even moderate or "social" drinking during pregnancy has been linked with subtle neurodevelopmental effects, such as:
    - Reduced attention span
    - Lower academic achievement
- There is no established safe threshold of alcohol intake during pregnancy, as even low doses can alter brain connectivity and gene expression during critical developmental periods.
- Some studies suggest variability in outcomes due to maternal metabolism, genetics, and timing of exposure, but public health consensus remains: no amount of alcohol is safe during pregnancy.

Impact of alcohol in different trimesters:

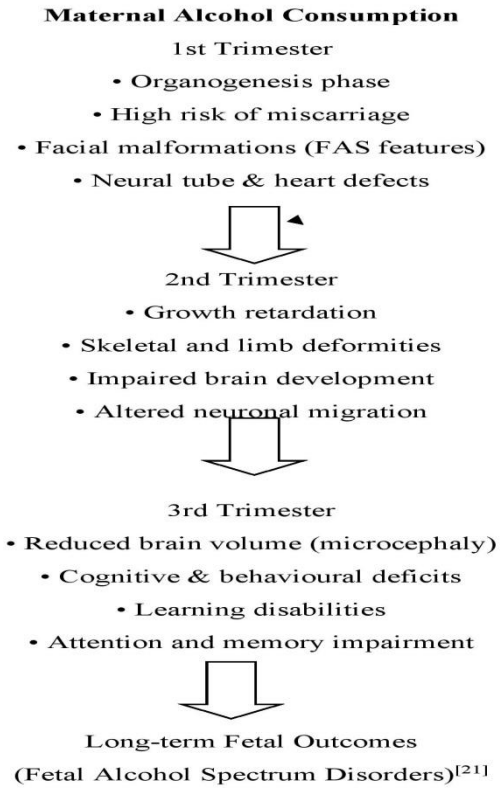

Fig0 7: Impact of alcohol in different trimesters.

No safe limit of alcohol during pregnancy:

- Alcohol consumption during pregnancy poses serious risks to Foetal development, as ethanol easily crosses the placental barrier and directly affects the developing fetus. Research has consistently demonstrated that **there is no known safe amount, type, or time of alcohol consumption during pregnancy**. Even low to moderate drinking can lead to subtle cognitive, behavioural, and physical abnormalities collectively referred to as **Foetal Alcohol Spectrum Disorders (FASD).**
- The fetus lacks the necessary enzymes to metabolize alcohol efficiently, leading to prolonged exposure and higher blood alcohol concentrations compared to the mother. Adverse effects have been reported with all patterns of consumption -including **binge drinking** and **occasional low-level intake.** Consequently, global health authorities such as the **World Health Organization (WHO)** and the **Centres for Disease Control and Prevention (CDC)** emphasize **complete abstinence from alcohol during pregnancy** as the only safe choice to prevent Foetal harm.[22]

Long-Term Outcomes of Prenatal Alcohol Exposure

Alcohol consumption during pregnancy can cause permanent effects on the baby's growth, brain, and behaviour. These effects may continue throughout childhood and into adulthood.

1. Physical Effects

- Slow growth and smaller head size (microcephaly)
- Facial abnormalities
- Organ problems (heart, kidney, liver)

2. Brain and Cognitive Effects

- Poor memory and learning ability
- Low IQ and slower thinking
- Difficulty paying attention or solving problems

3. Behavioural and Emotional Effects

- Hyperactivity and impulsive behaviour
- Trouble making friends or following rules
- Risk of anxiety, depression, or substance abuse later in life

4. Educational and Social Outcomes

- Poor school performance
- Difficulty keeping jobs as adults
- Challenges with independent living and social relationships

Preventive and Management Strategies for Alcohol Use During Pregnancy

1. Prevention

A. Public Awareness and Education

- Educate women of reproductive age about the dangers of alcohol use during pregnancy.
- Use mass media, antenatal classes, and community programs to promote abstinence.

B. Preconception Counselling

- Health workers should discuss alcohol risks with women before conception.
- Encourage planned pregnancies and alcohol-free lifestyle choices.

C. Screening and Early Intervention

- Use brief questionnaires (like AUDIT-C) during antenatal visits to identify alcohol use.
- Provide early counselling and referral to support services if drinking is detected.

D. Policy and Regulation

- Implement warning labels on alcoholic beverages.
- Enforce restrictions on alcohol advertising targeting women.

2. Management of Affected Children (Foetal Alcohol Spectrum Disorders – FASD)

A. Early Diagnosis and Intervention

- Identify affected children early through developmental screening.
- Begin speech, occupational, and physical therapy as needed.

B. Educational Support

- Provide special education programs to help with learning difficulties.
- Use individualized teaching plans for school performance.

C. Behavioural and Psychological Support

- Offer behavioural therapy for attention and social problems.
- Parental counselling and support groups help families cope.

D. Medical Care

- Manage associated health issues (e.g., heart defects, seizures).
- Regular monitoring by paediatricians, neurologists, and psychologists.

Screening and counselling of pregnant women:

1. Screening

Early screening for alcohol use in pregnant women is a crucial step in preventing Foetal Alcohol Spectrum Disorders (FASD). The goal is to identify at-risk mothers and provide timely support before harm occurs to the developing fetus.

a. Screening Tools

- AUDIT (Alcohol Use Disorders Identification Test): Assesses drinking habits and risk levels.
- T-ACE (Tolerance, Annoyed, Cut down, Eye-opener): Specifically designed for pregnant women.

These tools are simple, non-judgmental questionnaires that can be administered during antenatal visits by healthcare providers.

b. Clinical Indicators

- Irregular antenatal visits
- Poor nutrition or history of miscarriage

Screening should be routine, confidential, and empathetic to encourage honest disclosure.

2. Counselling

a. Brief Interventions

- Once alcohol use is identified, brief motivational counselling can help reduce or stop drinking.
- Counselling should focus on Foetal risks, maternal health, and family support.

b. Multidisciplinary Support

- Involvement of obstetricians, psychologists, and social workers helps address emotional and social factors contributing to alcohol use.
- Referral to rehabilitation or addiction services may be necessary for women with dependence.

c. Ongoing Monitoring

- Regular follow-ups ensure abstinence maintenance.
- Continuous support helps manage relapse and strengthens maternal–Foetal bonding [23].

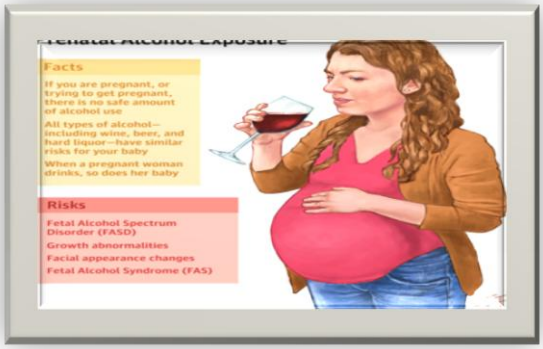

Fig 08: Image of Prenatal Alcohol Exposure.

Need for Strict Policies Regarding Alcohol Consumption During Pregnancy:

1. Introduction

Alcohol consumption during pregnancy remains a major public health concern due to its irreversible effects on Foetal development, including Foetal Alcohol Spectrum Disorders (FASD).2. Importance of Policy Intervention

- Public health policies play a vital role in reducing alcohol-related harm by establishing legal restrictions and promoting preventive education.
- Strict regulations help ensure that pregnant women receive accurate information, and that alcohol industries are held accountable for responsible messaging.

3. Key Policy Measures Needed

A. Warning Labels and Packaging Regulations

- Mandatory health warnings on alcohol bottles about risks of prenatal alcohol exposure.
- Clear pictorial labels to reach low-literacy populations.

B. Restriction of Alcohol Advertising

- Limit alcohol promotion targeting young women and reproductive-age groups.
- Ban misleading ads suggesting alcohol is safe in moderation during pregnancy.

C. Screening and Reporting Systems

- Implement routine alcohol screening in antenatal clinics as part of national maternal health guidelines.
- Establish national surveillance programs for tracking FASD cases and alcohol use during pregnancy.

D. Legal and Policy Frameworks

- Introduce national laws mandating abstinence from alcohol during pregnancy through education, not punishment.
- Integrate alcohol-use prevention modules in maternal health programs.

E. Community and Health Professional Training

- Train healthcare workers to educate and counsel pregnant women on alcohol risks.
- Strengthen community-based interventions for awareness and prevention.

4. Global Recommendations

- The World Health Organization (WHO) recommends comprehensive policy action including taxation, labelling, and health warnings to reduce alcohol use in reproductive-age women.

Epidemiology

Worldwide: Approximately 1 in 13 pregnancies involve some alcohol exposure, and about 0.77% of the global population is affected by FASD.

High-income countries: Prevalence is higher, with North America and Europe reporting 2–5% of school-aged children with FASD.

Developing countries: Prevalence varies, but under-reporting and lack of diagnostic resources mask the true burden.

India: Reliable large-scale data are scarce, but smaller community-based studies indicate rising alcohol use among women of reproductive age, raising concerns about Foetal vulnerability [24].

Conclusion

Alcohol consumption during pregnancy has serious and lasting effects on both the mother and the developing fetus. Because alcohol easily crosses the placenta, it interferes with normal growth and brain development, leading to Foetal Alcohol Spectrum Disorders (FASD). Babies born to alcohol-induced mothers may suffer from low birth weight, facial deformities, learning disabilities, and behavioural problems that can persist throughout life. Alcohol use during pregnancy can cause permanent damage to the developing baby, leading to physical, mental, and behavioural problems. Research shows that no level of alcohol is safe at any stage of pregnancy. Even small amounts can harm Foetal brain development and cause lifelong disabilities. Therefore, the safest and most effective approach is to completely avoid alcohol before and during pregnancy. Promoting awareness, routine screening, and supportive counselling for mothers are key steps to prevent Foetal Alcohol Spectrum Disorders (FASD) and ensure healthy pregnancy outcomes.

Acknowledgement

Not Declared

Conflicts of Interest

The authors declare no conflicts of interest.

Author Contribution

Both are contributed equally

Financial Support

None

Ethical Considerations and Inform Consent

Not Applicable

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