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Does paternal pre-conceptional drinking affects development of autism spectrum disorder, FAS and ADHD in children?

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Abstract

Introduction and purpose

The aim of this study was to investigate the association between paternal drinking before conception and the development of autism spectrum disorder (ASD), fetal alcohol syndrome (FAS) and attention deficit hyperactivity disorder (ADHD). Parental alcohol consumption is mentioned as one of the main potential development factors of these disorders. There are already a large number of studies proving a strong link between maternal alcohol consumption during pregnancy and FAS and hypothesis concerning links with ADHD and ASD. Paternal pre-conceptional alcohol consumption impact on fetus neurodevelopment is not so extensively researched and discussed as the case of maternal drinking. However, a number of experimental studies on animals have demonstrated decreased litter size, increased prevalence of low-weight fetuses at birth, risk of malformations and cognitive and behavioral impairment, which include learning and memory deficits, hyperactivity, and poor stress tolerance. Both animal and human studies

proved the adverse impact of alcohol on sperm that may cause developmental disorders of offspring. In this study, the existing data on human paternal preconceptual alcohol consumption and its effect on ASD, FAS, ADHD are reviewed.

Materials and method

We conducted a literature review from 2000 to 2025 available in the PubMed database using the keywords: "autism spectrum disorder", "fetal alcohol syndrome", "attention deficit hyperactivity disorder", "paternal drinking", "pre-conceptional alcohol consumption "

Conclusions

The small number of studies on human preconceptual paternal alcohol drinking effects on fetus development and its impact on children's mental and behavioral disorders makes it difficult to draw firm conclusions. However, available data from human studies raise concerns, so further investigations are required in this area.

Keywords:

autism spectrum disorder; fetal alcohol syndrome; attention deficit hyperactivity disorder; paternal drinking; pre-conceptional alcohol consumption

1. Introduction

According to the World Health Organization, almost 60% of the global population aged 15 years and over have been reported consuming alcoholic drinks in one year. Binge drinking and alcohol dependency are estimated at the level of 4% in the whole population of adults. [1]

The adverse impact on the fetus of maternal drinking before and during pregnancy has been widely researched. It has been proved that it may cause fetal alcohol syndrome (FAS) and other disorders connected (FASD).[2,26]

Latest studies suggest that pre-conceptional paternal alcohol consumption may have a negative impact on fetus neurodevelopment due to its impact on sperm. Spermatogenesis takes approximately 74 days, which is considered as very sensitive to external disturbances. [3] Although the mechanism of alcohol influence on sperm is not definitely known yet, both chronic consumption of alcohol (over 14 units per week) and moderate alcohol intake (up to 5 units per week) have a detrimental effect on male reproductive hormones and on semen quality. [4,5,6,7]

Researches prove statistically significant decrease of sperm volume, motility, concentration and an increase of dead sperm as well as sperm defected in the head, neck and tail that negatively impacts fertilization rate. [4,8,9] Moreover, male alcohol consumption before conception negatively influenced sperm DNA fragmentation and methylation and blastocyst formation rate [4,9,10,11]. In terms of its impact on hormones, alcohol consumption was also linked to changes in testosterone and sex hormone-binding globulin (SHBG) levels. [6]

The studies on animals proved that pre-conceptional paternal alcohol consumption can induce genetic and epigenetic alterations, increasing the risks of adverse neurodevelopment in offspring, including attention deficit hyperactivity disorder-like behaviors, anxiety and depression-like behaviors, and cognitive impairment. [11] Despite wide evidence from experimental animal studies, there is limited data on the effects of human paternal preconception exposures to alcohol on children's health.

Autism spectrum disorder (ASD)

In the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10), autism falls under Pervasive Developmental Disorders (PDD), primarily coded as
F84.0. PDD is a group of disorders characterized by qualitative abnormalities in reciprocal social interactions and in patterns of communication, and by a restricted, stereotyped, repetitive repertoire of interests and activities. These qualitative abnormalities are a pervasive feature of the individual's functioning in all situations.
Childhood autism is a type of pervasive developmental disorder that is defined by the presence of abnormal or impaired development that is manifest before the age of 3 years, and the characteristic type of abnormal functioning in all three areas of psychopathology: reciprocal social interaction, communication, and restricted, stereotyped, repetitive behavior. In addition to these specific diagnostic features, a range of other nonspecific problems are common, such as phobias, sleeping and eating disturbances, temper tantrums, and mostly self-directed aggression. [12]

The World Health Organization (WHO) estimates the worldwide prevalence of ASD at 0.76%, in the United States 1,68% [2] and 1%-2% in Europe. [14]
ASD occurs in all racial, ethnic, and socioeconomic groups. ASD is more common in males and the current ratio is closer to 3:1 than the previously reported 4:1. A number of researches suggest that the change in ratio can result from improvement of diagnosis. [13]

Etiology of ASD is still the subject of research but evidence suggests that both genetic and environmental factors have an impact on its development. Environmental factors include the use of medicines, drugs, alcohol and smoking before and during pregnancy. [15]

No cure for ASD has been developed so the actual management options focus on reducing the symptom severity, such as atypical antipsychotics for aggression and irritability, SSRIs or SNRIs for anxiety, depression, and obsessive-compulsive disorder, and methylphenidate for ADHD and different forms of complementary therapies like music therapy, diet, and acupuncture. As ASD is highly variable, the treatment protocols must be individualized. [16]

Fetal alcohol syndrome (FAS)

In the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10) fetal alcohol syndrome (dysmorphic) is coded Q86.0 [12] used for confirmed cases with the presence of characteristic facial anomalies like short palpebral fissures, thin vermilion border, and smooth philtrum. In addition, a diagnosis of FAS requires evidence of growth deficiency (height and/or weight ≤ 10th percentile for chronological age), abnormal brain growth (head circumference ≤ 10th percentile, brain structure anomalies, or recurrent nonfebrile seizures), and neurobehavioral impairment, which can include cognitive impairment, behavioral impairment, or both [17]

P04.3 code in ICD-10 is used for a newborn affected by maternal use of alcohol. That is in case of newborns where maternal alcohol use is confirmed, but full FAS criteria aren't met, indicating a potential, but less defined, exposure effect. [12] Those cases are named fetal alcohol syndrome disorder (FASD).

Estimations of the worldwide prevalence show about 15 out of every 10,000 live births are estimated to have Fetal Alcohol Syndrome (FAS), from 17 to 33 out of 10 000 in Europe and from 2 to 15 in the United States. [6] Estimates across the full range of FASD are higher: 1% worldwide, from 200 out of 10 000 in Europe and 240 to 480 in the United States. [2,17,18]

FAS and FASD are not curable because the damage to the brain and other organs caused by alcohol during pregnancy is permanent and irreversible. However, its symptoms can be significantly alleviated, and the quality of life improved through early diagnosis and comprehensive, long-term therapeutic

support (psychological, speech therapy, pedagogical). Most importantly, FAS/FASD may be a largely preventable condition. Efforts should be made to educate society about the potentially harmful effects of pre-conceptual and prenatal alcohol exposure on the developing fetus. [2]

Attention-deficit hyperactivity disorder (ADHD)

In the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10), attention deficit hyperactivity disorder (ADHD) falls under Hyperkinetic disorder, primarily coded as F90. This is a group of disorders characterized by an early onset (usually in the first five years of life), hyperactivity, impulsivity, and inattention. Impairment of cognitive functions is common, and specific delays in motor and language development are disproportionately frequent. Secondary complications include dissocial behavior and low self-esteem. [12]

The estimated worldwide prevalence of ADHD is 4% to 7.5%, and it is increasing gradually. [19,20] ADHD is a chronic condition. 60-80% of cases diagnosed in childhood will remain in adulthood. [19] Children and young adults with ADHD are susceptible to risky problems including substance abuse, road accidents, unprotected sex, criminal behavior, and suicide attempts.

ADHD etiology is unknown but both genetic and environmental factors were pointed out and among them parental alcohol consumption. [21]

The core of ADHD treatment is stimulant medications; however, other treatments have been developed including cognitive training, neurofeedback, neuromodulation, and dietary and nutritional interventions. [20]

2. Aim of the Study

The aim of this study was to investigate the association between paternal drinking before conception and the development of autism spectrum disorder (ASD), fetal alcohol syndrome (FAS) and attention deficit hyperactivity disorder (ADHD). Parental alcohol consumption is mentioned as one of the main potential development factors of these disorders. There are already a large number of studies proving a strong link between maternal alcohol consumption during pregnancy and FAS and hypotheses concerning links with ADHD and ASD. Paternal pre-conceptional alcohol consumption impact on fetus neurodevelopment is

not so extensively researched and discussed as the case of maternal drinking. In this study, the existing data on human paternal preconceptual alcohol consumption and its effect on ASD, FAS, ADHD are reviewed in order to turn attention of future fathers on their lifestyle in terms of alcohol drinking and the well-being of children.

3. Materials and methods

We conducted a literature review from 2000 to 2025 available in the PubMed database using the keywords: "autism spectrum disorder", "fetal alcohol syndrome", "attention deficit hyperactivity disorder", "paternal drinking", "pre-conceptional alcohol consumption "

4. Results

Extensive Swedish research (Sundquist et al, 2014) on 24 157 individuals diagnosed with ASD, 49 348 patients diagnosed with ADHD or both in the period between 1987 and 2010 shows a correlation between parental (both maternal and paternal) excessive preconceptual alcohol consumption and behavioral and development disorders in children. Among offspring whose fathers were diagnosed with alcohol dependency before childbirth, the corresponding risks of AUD and ADHD were 1.43 (95% CI 1.32-1.55) and 2.71 (95% CI 2.59-2.83), respectively, compared to individuals without an affected parent. The risk was equal for boys and girls. Moreover, the authors also studied the risk of ASD and ADHD in adoptees in order to assess the contribution of environmental factors like tension and stress at home. The study found that the risk of AUD and ADHD was increased only when the biological parents were addicted to alcohol, which suggests that genes as well as the environment play a role in disorders development. [21]

The study on 18 664 children from southern China (Liu et al 2025) focused on parental major life events, with the variable effect of alcohol drinking or smoking proved that for fathers' major life events combined with their alcohol consumption before or during pregnancy were associated with a higher risk of ASD in offspring. In children whose fathers experienced a negative major life event and drank alcohol before the mother's pregnancy, the risk of ASD was greater (OR:1.80, 95% CI 1.33, 2.45; $P = 0.03$) than in children whose fathers did not use alcohol while experiencing a negative major life event (OR: 1.21, 95% CI 1.02, 1.45). The study proves the negative impact of paternal alcohol consumption on offspring regardless of the environmental factors. [22]

Meta-analysis conducted on the impact of paternal alcohol, tobacco, caffeine and physical activity (Kayleigh et al, 2021) suggest that paternal preconceptual alcohol consumption is associated with poorer offspring mental health, (particularly hyperactivity/ADHD). However, the authors underline that out of 20 articles meeting the analysis criteria, only one article was dedicated to this subject. [23]

The study (Min Luan et al, 2022) conducted on 253 children born to fathers who drank alcohol during 3 months before conception shows statistically significant dependence between paternal drinking and offspring anxious/depressed, internalizing behavior and emotional reactivity, relevantly 23%, 16% and 19% (P-value <0,05) at the age of 4. The risk of anxious/depressed behavior grew in age of 6 to 28 %, the risk of internalization was at the same level and there was a lack of data on emotional reactivity. At age 6 the though problems were measured giving the statistically significant risk on the level of 28%. In terms of sex, girls tended to demonstrate more risk of anxious/depressed behavior and thought problems and boys aggressive behavior. In terms of the dose of alcohol consumed by father, even the low drinking (below 30 g/week) effected in though problems both in girls and boys while the highest drinking (above 68 g/week) in anxious/depressed behavior in girls. [3]

Another research from Sweden (Khemiri et al, 2023) was conducted on parental drug and alcohol use disorder and risk of intellectual disability (ID) in offspring. ID was described as low general intelligence and difficulties with adaptive behavior and impairments in cognitive, motor, language and social skills. Data on combined drug and alcohol usage by fathers before the mother's pregnancy shows the greatest risk of mild ID in children OR: 2.4 [2.2-2.6]. Unfortunately, there is no data in this research concerning paternal alcohol only consumption before pregnancy. Available data on paternal alcohol abuse diagnosed before childbirth conferred the greatest risk of mild ID in offspring OR: 2.6 [2.4–2.9]. However, due to the long development of alcohol addiction, it can be assumed that these fathers drank alcohol before conception. [24]

The results of study from China (Zhou et al, 2021) on 529 000 couples of which 16 415 were classified as having preconceptual paternal alcohol consumption shows the higher risk of birth defects in offspring in this group (OR, 1.35; 95% CI, 1.14-1.59; $P < .001$), among which higher risk of neural tube defect (OR, 1.16; 95% CI, 0.8-1.69; $P = .03$). [25] As the neural tube is the embryonic precursor to the central nervous system errors in its development can lead to congenital anomalies and neurodevelopmental disorders.

The study conducted in Norway (Zuccolo et al, 2016) found higher odds of microcephaly at birth in line with increasing paternal, but not maternal, alcohol consumption before pregnancy 1–2 units vs none (OR 1.48, 95% CI 0.77–2.84), to 3–4 units vs none (OR 1.64, 95% CI 0.85–3.16), to 5+ units vs none (OR 1.93, 95% CI 1.01–3.70). The authors of the research underline that microcephaly is one of FAS characteristics. The study suggests that FAS may be linked not only to maternal drinking [26]

5. Discussion

The aim of this study was to investigate the association between paternal drinking before conception and the development of autism spectrum disorder (ASD), fetal alcohol syndrome (FAS) and attention deficit hyperactivity disorder (ADHD). Despite the wide usage of alcohol by society and proves from experimental studies on animal preconceptual male exposure to alcohol impact on fetus development the researchers focused mainly on maternal drinking. Authors (Bölte et al,2018) of a systematic review on potential environmental contributions to ASD development and presumed pathophysiological mechanisms stated that failed to identify any study examining the role of paternal alcohol use in the risk of autism [27].

We found only a few studies dedicated to measure the impact of alcohol consumption by fathers before pregnancy on offspring. One study indicated that fathers' alcohol dependency before pregnancy was associated with a higher risk of ASD or ADHD in children regardless of the environmental factors. A similar conclusion had authors of another study, who focused on the major life events combined with parental alcohol consumption before pregnancy. The study proves the negative impact of paternal alcohol consumption on offspring, regardless of the environmental factors that were associated with a higher risk of ASD in offspring. The meta-analysis suggest that paternal preconceptual alcohol drinking is associated with poorer offspring mental health (particularly hyperactivity/ADHD); however, the authors confirmed the lack of sufficient data due to the small number of researches. The above-mentioned studies were the only ones which examined children with a confirmed diagnosis of ASD, ADHD. There were also available studies which indicate disorders similar to ASD, FAS, ADHD but they do not make a full diagnosis. One study proves the association of preconceptual fathers' drinking and behavioral problems like anxious/depressed, internalizing behavior, emotional reactivity and thought problems in children. The research also showed that even light parental alcohol consumption before the mother's pregnancy adversely affected the offspring's mental development. The other research describes the impact of paternal alcohol addiction diagnosed before childbirth as low general children's intelligence and their difficulties with adaptive behavior and impairments in cognitive, motor, language and social skills. The

ID is characteristic to FAS. There is no data in the study on paternal preconceptual drinking; however, due to the long development of alcohol addiction, it can be assumed that these fathers drank alcohol before conception. Two researches focus on fetus congenital defects like microcephaly and neural tube defect proving it association with paternal drinking before conception. The authors of research underline that microcephaly is one of the major characteristics of FAS, which was assumed to be fully connected to maternal drinking during pregnancy. This study put a question mark to this assumption in terms of fetus head and brain development, as the authors of the study didn't find any evidence of maternal effect in this area, even with higher doses of alcohol consumed during pregnancy.

Our study suggests that paternal drinking habits before pregnancy may increase the risk of various neurodevelopmental problems, including ASD, FAS and ADHD. But the researches are very fragmented and insufficient. The available researches vary in methods and selection of samples. Paternal drinking behavior was declarative from fathers or mothers. Period and time and intensity of alcohol usage of fathers varies from study to study. Some researches focused on 3 months period before conception that is in line with spermatogenesis, while others examined fathers addicted to alcohol before the mother's pregnancy. So the pattern of alcohol consumption should be evaluated in future research. Additionally, the fathers' behavior was not adjusted by potential maternal exposure, which can have an impact on results.

Therefore, the present studies need to be confirmed by further studies.

6. Conclusions

The small number of studies on human preconceptual paternal alcohol drinking effects on fetus development and its impact on children's mental and behavioral disorders makes it difficult to draw firm conclusions. However, available data from human studies raise concerns, so further investigations are required in this area. The topic of research is important because it may occur that fathers' (as well as mothers') awareness of alcohol use is enough to limit the development of disorders in children.

Disclosure:

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