The Impact of Maternal Environmental Factors on the Development of Autism Spectrum Disorder

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ABSTRACT:

Autism spectrum disorder (ASD) is characterized by difficulties in social interaction, communication, and behavior, with both genetic and environmental factors playing a role. The ongoing research focuses on understanding the complex interplay between genes and the environment, including maternal factors, to unravel ASD's origins. This exploration into specific triggers and protective elements is essential for informing preventive strategies and enhancing the overall well-being of individuals with ASD. I hypothesize that the environmental factors that the maternal parent has experienced cause a higher chance for the child to develop autism. Utilizing a PRISMA flow chart, articles from PubMed were screened for relevance to maternal parent and environmental factors during pregnancy. Out of 8 considered articles, 5 were selected based on alignment with the hypothesis, clarity on the maternal aspect, and reliable data. The chosen articles form a foundation for the subsequent analysis of maternal environmental factors and their impact. The findings underscore the multifaceted nature of environmental factors influencing ASD risk and the need for ongoing research to unravel the complexities involved. While the hypothesis was partially confirmed, the consensus across articles emphasizes the necessity for further exploration and concrete evidence to establish more definitive connections between maternal factors and ASD outcomes.

INTRODUCTION:

Autism spectrum disorder (ASD) is a neurodevelopmental disorder defined by difficulties with social interaction, communication, and behavior. It affects people differently, resulting in a wide range of symptoms and skills. ASD is characterized by difficulties recognizing and interpreting social cues, difficulties creating and maintaining relationships, repetitive behaviors or restricted interests, and, in certain cases, sensory sensitivity. ASD affects a person's ability to communicate effectively, participate in normal social activities, and adapt to changes in routines or situations [1]. Individuals with ASD who get early diagnosis and intervention, as well as tailored support, can optimize their strengths and overcome the challenges associated with the disease to lead productive lives [2].

The current standard understanding of ASD recognizes its complex and multifactorial nature, involving a combination of genetic and environmental factors [1]. While research has made significant strides in identifying genetic markers associated with ASD and understanding certain prenatal risk factors, much remains to be explored. One critical area is the intricate interplay between genes and the environment, as well as epigenetic influences, during crucial

developmental stages. Further investigation is needed to uncover the specific environmental triggers and protective factors that may contribute to or mitigate ASD risk [1,2,5]. Additionally, enhancing early detection and intervention strategies, improving access to support services, and promoting inclusive communities are ongoing priorities in the effort to provide better outcomes and quality of life for individuals with ASD. The field of ASD research continues to evolve, emphasizing the importance of a holistic, multidisciplinary approach to unraveling the complexities of this condition and addressing the unmet needs of those affected.

I hypothesize that the environmental factors that the maternal parent has experienced cause a higher chance for the child to develop autism. The information gap in ASD revolves around understanding its exact causes, including the complex interaction between genetics and the environment [3]. While genetics plays a significant role, identifying specific genetic markers and mechanisms remains a challenge. Additionally, we need improved early detection methods, individualized treatments, and research on co-occurring conditions. Addressing the unique needs of adults with ASD, fostering societal acceptance, and tracking long-term outcomes are also vital areas for further exploration to enhance our knowledge and support for individuals with ASD [4].

METHODS:

I used PubMed to identify the original 37,527 articles for this scoping literature review. The inclusion criteria for this literature review focused on articles that covered the maternal parent and the environmental risk and protective factors that affect the maternal parent in pregnancy when giving birth. The exclusion criteria was a main focus on genetics.

The PRISMA flow chart shows that I excluded two articles that focused mainly on genetic factors, which was outside of the scope of the literature review and one outside the year range I was researching for (2013-2023). I included articles that were directly related to my hypothesis, which were clear when talking about the maternal parent and environmental factors.

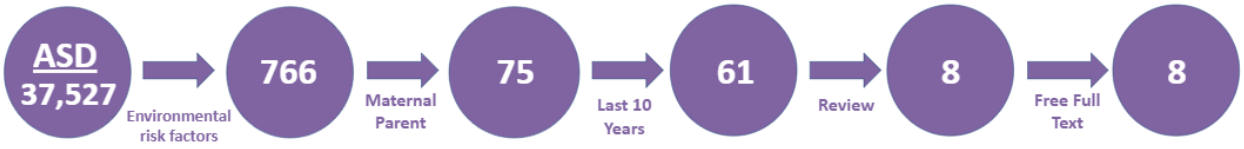

Figure 2. A PRISMA flow chart/diagram summarizes the screening process. It records the number of articles initially found, then records the number of articles per stage of the selection process.

RESULTS:

The collective findings from the five articles converge on the understanding that ASD is a multifaceted condition arising from the intricate interplay between genetic predisposition and various environmental factors. A consistent theme across the research is the recognition of advanced parental age, both maternal and paternal, as a potential risk factor associated with an increased vulnerability to ASD in children [2,3]. Prenatal environmental factors take center stage in these discussions, encompassing aspects such as maternal immune activation, stress, drug exposure during pregnancy, and complications related to birth [1,2]. The articles also delve into the intricate relationship between nutrition and ASD, exploring the potential impact of nutritional elements like folic acid, vitamin D, iron, zinc, and copper, despite acknowledging some inconsistencies in the existing evidence [1,5].

Controversial associations, such as those between ASD and vaccination, maternal smoking, thimerosal exposure, and assisted reproductive technologies, are collectively dismissed based on evidence from systematic reviews and meta-analyses [1]. The researchers stress the importance of evidence-based approaches and advocate for continued research using advanced molecular biology and big data methods to unravel the complexities of gene-environment interactions in ASD development [3]. The articles highlight the need for a nuanced and holistic understanding of ASD, acknowledging the dynamic interplay between genetic and environmental components. They call for ongoing efforts in personalized risk assessments, preventive measures, and potential therapeutic interventions based on a comprehensive comprehension of the intricate influences shaping neurodevelopmental disorders like ASD [2,3].

Articles from Boelte et al. and Modabbernia et al. provide a comprehensive overview of the association between nutrition and ASD, and while they share common themes, there are some differences in their emphasis and findings [2,3]. Modabbernia et al. reviews various nutritional factors and their potential links to ASD, including folic acid, vitamin D, protein, calcium, zinc, and omega-3 fatty acids [3]. It highlights the inconclusive nature of many studies, pointing out limitations such as assessing nutritional elements after ASD development [3]. The article suggests that while there are indications of deficiencies in certain nutrients, causal interpretations should be approached cautiously [3].

On the other hand, Boelte's article delves into specific nutrients like vitamin D, iron, zinc, and copper, emphasizing the role of maternal nutrition during pregnancy [2]. It discusses the potential impact of short interpregnancy intervals on autism risk and explores the association between vitamin D deficiency and ASD, with evidence suggesting that deficiencies in early development may contribute to the etiology of autism [2].

While both articles agree on the need for caution in interpreting findings, they slightly differ in their emphasis. Modabbernia et al. provides a broader overview of various nutritional elements,

highlighting the inconclusive nature of many studies [2]. Boelte et al. on the other hand, focuses more specifically on individual nutrients and their potential roles, with a notable emphasis on protective factors [3]. Ultimately, the articles collectively suggest that there is ongoing research and debate in understanding the nuanced relationship between nutrition and ASD, emphasizing the need for further investigation, well-designed studies, and a holistic approach to unraveling these complex associations [2,3].

Doi et al. explores the Developmental Origins of Health and Disease (DOHaD) theory, focusing on its application to ASD [4]. The DOHaD theory suggests that environmental factors during prenatal and postnatal development can induce predictive adaptive responses, impacting future health outcomes [4]. Specifically, the review delves into the prenatal environment, highlighting factors such as maternal immune activation (MIA), stress, and drug exposure as potential risk factors for neurodevelopmental disorders (NDDs) including ASD [5]. It discusses how inflammatory responses triggered by infections or autoimmune diseases in pregnant mothers can affect fetal brain development and increase the risk of ASD. Additionally, the article explores the impact of drug exposure, such as thalidomide and valproic acid, on neural development and the potential link to ASD. The discussion extends to the effects of preterm birth, low birth weight, and intrauterine growth restriction on the onset of ASD and other NDDs [4]. Overall, the review emphasizes the importance of understanding the prenatal environment and its influence on fetal development to inform preventive medicine and therapeutic interventions for individuals at risk of ASD and related disorders.

DISCUSSION:

In summary, these articles collectively emphasize the intricate interplay of genetic and environmental factors in ASD. Advanced parental age, prenatal environmental factors, and nutritional elements are recognized as key contributors, calling for a holistic understanding of ASD etiology. The dismissal of controversial associations underscores the importance of evidence-based approaches, while ongoing research, utilizing advanced methodologies, is encouraged. The nuanced perspectives from Modabbernia et al. and Boelte et al. highlight the ongoing debate around the nutritional dimensions of ASD, emphasizing the need for well-designed studies [2,3]. The focus of Doi et al. on the DOHaD theory adds depth, emphasizing the critical influence of the prenatal environment and the potential for tailored preventive and therapeutic interventions [4]. In navigating the complex realm of ASD, these insights underscore the ongoing pursuit of knowledge and precision in unraveling the mysteries of gene-environment interactions in neurodevelopmental disorders.

REFERENCES:

1. Emberti Gialloreti, Leonardo et al. “Risk and Protective Environmental Factors Associated with Autism Spectrum Disorder: Evidence-Based Principles and Recommendations.” *Journal of clinical medicine* vol. 8,2 217. 8 Feb. 2019.
2. Bölte, Sven et al. “The contribution of environmental exposure to the etiology of autism spectrum disorder.” Cellular and molecular life sciences : CMLS vol. 76,7 (2019): 1275-1297.
3. Modabbernia, Amirhossein et al. “Environmental risk factors for autism: an evidence-based review of systematic reviews and meta-analyses.” *Molecular autism* vol. 8 13. 17 Mar. 2017.
4. Doi, Miyuki et al. “Prenatal Environment and Neurodevelopmental Disorders.” *Frontiers in endocrinology* vol. 13 860110. 15 Mar. 2022.
5. Sato, Atsushi et al. “Influence of Prenatal Drug Exposure, Maternal Inflammation, and Parental Aging on the Development of Autism Spectrum Disorder.” *Frontiers in psychiatry* vol. 13 821455. 9 Feb. 2022.