Journal of Sustainable Solutions
ISSN : 3048-6947 | Vol. 1 | Issue 4 | Oct - Dec 2024 | Peer Reviewed & Refereed

NEUROTOXIC EFFECTS OF ENVIRONMENTAL POLLUTANTS ON PEDIATRIC BRAIN DEVELOPMENT

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DOI: https://doi.org/10.36676/j.sust.sol.v1.i4.20

Check for updates

Published: 02/10/2024

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Abstract

The development of neurological disorders such as Parkinson's disease, Alzheimer's disease, ADHD, Autism become and the presence of environmental pollutants. In this particular study, the impact of neurotoxicity of the environmental pollutants on a child's brain development are described. This study includes the formation of a literature review which was used for gathering concepts regarding the environmental pollutants, their relationship with neurological disorders, and the cognitive development of children. The method of this research holds the use of secondary data. The results have shown that high levels of pollution exposure ultimately decreases the cognitive characteristics of a child.

Key Words: Parkinson's disease, ADHD, Autism, Neurotoxins, Environmental Pollutants, Cognitive Development.

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1.0 Introduction

The term neurotoxicity denotes the damaging process of the brain or the peripheral nervous system. This damage in the brain or nervous system can be caused due to the exposure of either human-made or environmental toxins. It was identified that these toxins have the ability to affect the activities of the human brain by changing or disrupting the functions of nerve cells. Formation of a small damage in the human nervous system can influence the reasoning and cognitive capabilities of an individual. The main target of neurotoxins or environmental pollutants are the neurons and glial cells of a human being. Damage in these areas holds a significant impact on the heterogeneous functions. It ultimately means that the neurodevelopment of a human being can be heavily influenced by the exposure to neurotoxins or environmental pollutants. It was found that the development of a child's cognitive and mental factors are essential for their growth. This particular study investigates the impact of neurotoxic effects of environmental pollutants on pediatric brain development.

2.0 Literature review

2.1 Neurotoxins and Environmental Pollutants

According to Iqubal *et al*. 2020, pollutants found in nature, both organic and inorganic, have become the most vital challenge for public health in the entire world. These pollutants are the primary reason for the development of diseased neurological conditions. Because of these reasons, the most frequently found sources of pollutants are industrial waste, pesticides, gasses from vehicles, laboratory waste, ashes etc. It was identified from this research paper that the development of Nano-pollutants became the most significant reason for neurotoxicity.

2.2 Impact of Neurotoxins and Environmental Pollutants on Human Brain

According to Kim *et al*. 2020, among all of the environmental pollutants and neurotoxins, air pollutants were identified as the most dangerous components in the whole world. It was identified that the size of air pollutants are comparatively lower than other pollutants. Because of these reasons, these particles can easily transfer to the human body including lungs and brain. The findings of this particular study have shown that direct or indirect exposure to human health increases the aging process of the brain by killing the nerve cells. The authors have utilized the method of a comprehensive literature review to identify the effects of pollutants to the nervous system of a human being.

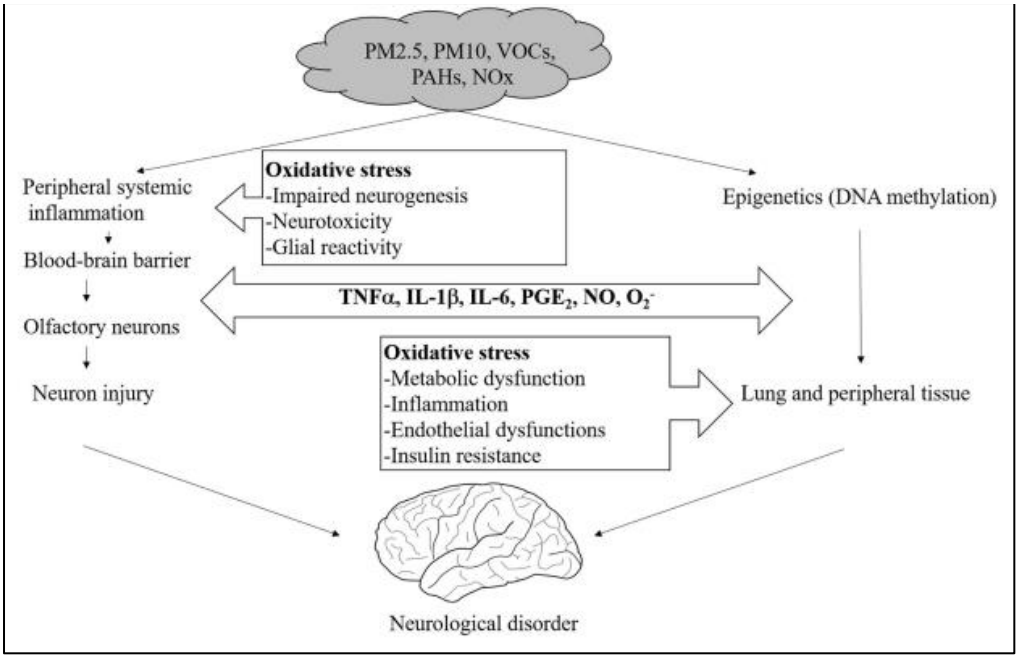

Figure 1: Mechanisms of direct and systemic pollutant-induced neurological disorders

(Source: https://www.frontiersin.org/articles/10.3389/fpubh.2020.575330/full)

The findings of this literature review have shown that the development of risk factors of dementia and Alzheimer's diseases are increased by exposure to fine PM (PM < 2.5μm). On the other hand, the formation of ADHD, Autism, neurodegenerative disease formation significantly increased by the effect of environmental pollutants.

According to Costa *et al*. 2020, excessive evidence has shown the possible impact of air pollution or other pollution types negatively influences brain development which ultimately forms central nervous system diseases. It was identified that the formation of neurological disorders such as Alzheimer's disease and Parkinson's disease, autism increased significantly with the exposure of environmental pollutants. The findings of this research have shown that the impact of these PMs Increase the percentage of oxidative stress and neuro-inflammation. In both models of human and animal similar outcomes have been investigated. The formation of neurotoxicity percentage can be significantly increased by the environmental pollutants.

2.3 Effects of Neurotoxins and Environmental Pollutants on pediatric brain development

The research paper of Lopuszanska and Samardakiewicz, 2020, mentioned that the data of World Health Organization or WHO shows that 90% of the global population breathes air which does not meet the quality standards. Not only physical health, the impact of air pollutants are also found on mental health of a person. In this particular research paper, the authors have examined the impact of environmental pollution on the cognitive function development of children with the help of a systematic review process. The findings of this particular systematic review have shown different previously completed literature have mentioned about the relation between the cognitive dysfunction of children and

pollutants. The findings have shown that the development of ADHD, Autism significantly increased by the exposure to environmental pollutants.

Cserbik *et al*. 2020, mentioned that the formation of hemispheric-specific pollutants and their effects have significantly changed the brain structure of children. This impact of PM exposure to a child was identified as the long-term impact of environmental pollutants. In addition, increased risk factor of neurodegenerative disorders in children because of exposure to environmental pollutants.

3.0 Methods

3.1 Research Method

The mono method of research was selected in this investigation report. It was identified that the use of mono research method denotes the implementation of only one type of data. This particular study also holds the use of only secondary data.

3.2 Research Approach

Deductive approach of research was chosen in this research formulation process. Using the deductive approach, the review of existing literature was completed to gather valuable concepts regarding neurotoxicity, environmental pollutants impacts on human brain, nervous system and child brain development.

3.3 Data Collection Method

The data collection procedure of this study holds the gathering process of secondary information. From authentic literature databases, books, journals, articles were selected on this particular research area (Xu *et al*. 2022). On the other hand, data from online websites and news articles are also used in this research.

3.4 Data Analysis Method

The data analysis method of this research includes the use of a secondary data analysis process. A comparative data analysis using the collected secondary materials are utilized in this research. The analyzed data become very important for the understanding of neurotoxins and environmental pollutants impact on the pediatric brain development.

4.0 Result

This particular section of this report holds the findings of this research. It described the impact of environmental pollutants and neurotoxicity on the cognitive development of a child.

4.1 Environment Pollution and Cognitive development of Children

It was identified that there is multiple research evidence are present which shows the relationship between environmental pollution and a child's cognitive development. A wide variety of previously completed cohort studies have shown this evidence.

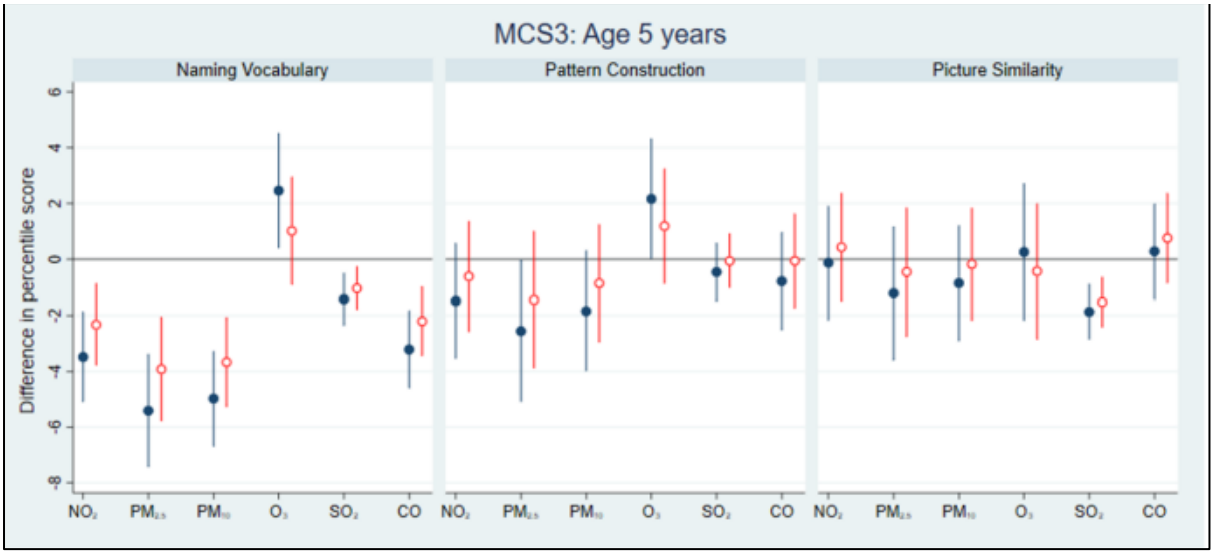

Figure 2: Percentile difference (95%CI) in cognitive performance of children due to pollution exposure

(Source: https://iopscience.iop.org/article/10.1088/1748-9326/abe90c/pdf)

This above-mentioned result is obtained from the research paper of Milojevic *et al*. 2021. In this particular study, the statistical analysis of 827 children's cohort data were used. The impact of air pollutants were examined based on particle sizes. This particular statistical finding has shown that among the children from age group 5, negative (adverse) associations between pollutant concentrations were identified. It ultimately means that exposure to pollutants have lessened the cognitive abilities of children.

4.2 Neurotoxicity and its impact on neurological disorders among Children

The time-period of pregnancy and early childhood of a human being is the most important lifespan of neurological development (Borisova and Komisarenko, 2021). It was found that pollutants can be exposed to a pregnant woman or child by the utero exposure and natural exposures.

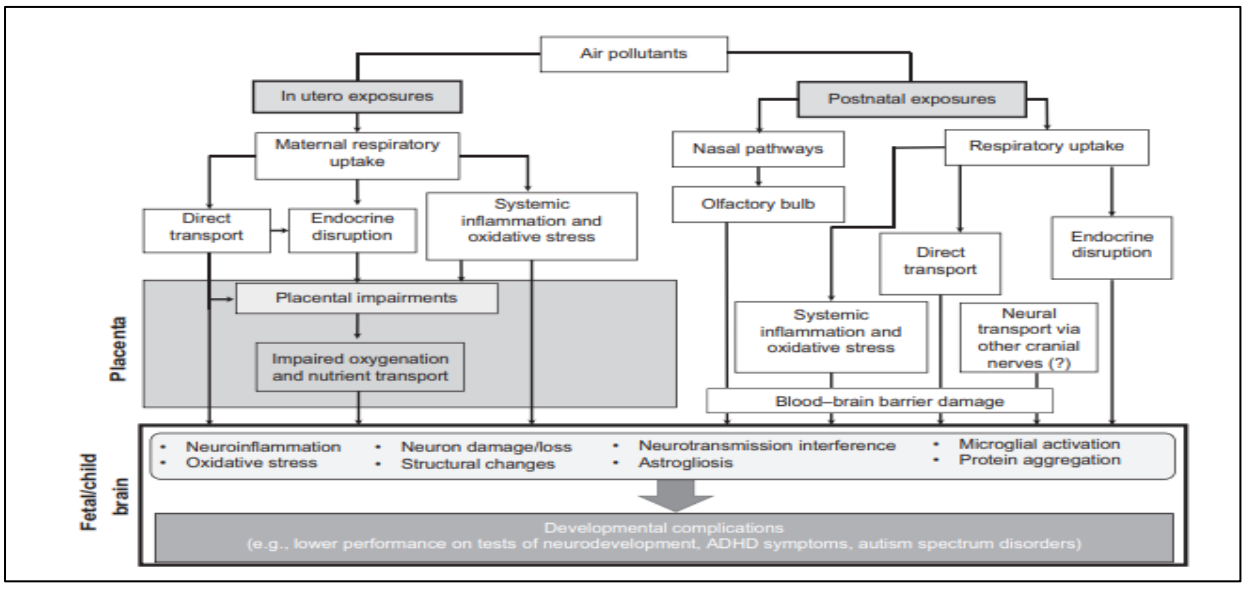

Figure 3: Biological mechanisms linking air pollution exposures to neurological developmental complications. ADHD, attention-deficit/hyperactivity disorder.

(Source: https://onlinelibrary.wiley.com/doi/pdfdirect/10.1111/dmcn.14758)

Figure 3 shows the biological mechanism of the air pollution exposures and the formation of diseased neurological conditions among children. The findings of this particular study have shown that these neurological diseases include ADHD, attention-deficit/hyperactivity disorder, Autism etc. These above-mentioned findings are obtained from the research paper of Ha *et al*. 2021.

5.0 Discussion

In the above-mentioned part of this study, the most accurate findings from the collected secondary research data are represented. The results are linked with the impact of environmental pollutants and neurotoxins on the cognitive and neurological development of children.

Research also showed that from the age of 5, children demonstrate their development concerning the cognitive aspects. Through the combined analysis of the weights of the cognitive factors and the effects of pollutants, the present study revealed that there is a negative correlation rate of 95%. From this particular finding, the bigger percentage of exposure to pollution affects the brains of children negatively. Likewise, diminished contact with pollution is extrapolated to be the actual leading cause of more intelligence in the body, quite recently the research paper presented by Ni *et al.* 2022 has also depicted similar results. Thus, in the present work, the authors analyst the cohort data of 1,967 children. Outcome of this specific research work carried out works reveals that NO2 and PM as the two main childhood exposures make a child be the cause of causing poor behavioral functioning and cognitive performance of any human child.

On the other hand, the second part of the result section has compared the effects of neurotoxicity to the development of neurological disorders. In this particular section the description of diseases forming mechanisms to neurological diseases including ADHD, Attention Deficit Hyperactivity Disorder, and Autism as a result of exposure to environmental pollutants is provided. From the nostril and uterus, it was realized that small PMs can infiltrate the human body. The neurotoxic effects of these pollutants become very crucial for the progression of neurological diseases. Similar results have also discovered by the research study of Lopuszanska and Samardakiewicz, 2020. On the same note, the study has revealed that the percentage of risk that is associated with the development of ADHD, Autism has been found to increase due to impacts of environmental pollutants.

6.0 Future Directions

It was found that the development of experimental research regarding evidence of air pollution has become a very significant research area. Exposure of pollution was identified as a very crucial risk factor for the development of different types of neurological disorders in a human being (Alasfar and Isaifan, 2021). However, there is less research are present which has selected their population group as children. Formation of diseases such as ADHD, attention-deficit/hyperactivity disorder, Autism become

a significant issue for global healthcare. Therefore, the future research work of this research should focus on an experimental and cohort study design using children as their sample.

7.0 Conclusion

Throughout this entire research report, the investigation regarding the neurotoxic effects of environmental pollutants on pediatric brain development is described properly. In the initial section of this study, a literature review was completed which includes the review of most appropriate research papers linked with this research area. This literature review has become very essential for the identification of valuable concepts regarding environmental pollution, neurotoxicity and its impact on human and a child's cognitive development. A secondary data analysis was performed in this research by using authentic information. It was found that the formation of high levels of pollution exposure ultimately decreases the cognitive characteristics of a child. On the other hand, the result section of this particular study shows the formation of biological mechanisms which influences the etiology of various neurological disorders among children. These diseased neurological conditions are identified as ADHD, attention-deficit/hyperactivity disorder, Autism etc.

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