MEDS Clinical Medicine (2022)
Clausius Scientific Press, Canada

DOI: 10.23977/medsc.2022.030710
ISSN 2616-1907 Vol. 3 Num. 7

Environment Factors of Children's Attention Deficit Hyperactivity Disorder

Ziyu Zhao[1], Jinyu Yao[1], Liu xin[2], Mingzhe Liu[1], Qiling Liu[1,*]

[1]Shaanxi University of Chinese Medicine, Xianyang, Shaanxi, 712046, China
[2]Gansu University of Traditional Chinese Medicine, Lanzhou, Gansu, 730000, China
[*]Corresponding author

Keywords: Attention deficit hyperactivity disorder (ADHD), Environment factors, Children

Abstract: Attention deficit hyperactivity disorder (ADHD) is a common neurological disorder in children. The main symptoms are inattention, impulsivity and hyperactivity behavior, accompanied by learning difficulties and cognitive impairment. Symptoms can persist into adulthood [1]. According to the latest statistics, the prevalence of ADHD in children worldwide has exceeded 10% and is on the rise, which will bring great adverse effects on patients' normal life and study [2]. In recent years, the effects of environmental factors on neural development have caused the attention of people, a number of surveys, children with acute or long-term exposure to heavy metals such as plumbum, manganese will usually leave a permanent neurological sequelae, including attention deficit, emotional tendency and behavioral responses. The main influencing factor of ADHD is environment. This review mainly discusses and summarizes the environmental factors that may influence the incidence of ADHD.

1. Introduction

The incidence of ADHD is increasing day by day, and its related factors have also become the objects of research. Neurotoxic substances that affect growth and development include heavy metals and organic solvents, while children are easily affected by industrial chemical pollutants (such as pesticides used in crop treatment). And the situation is becoming more and more common which contact indirectly polluted water and food by air and other impurities during their daily life and learning process. This article focuses on summarizing the harmful effects of heavy metals associated with ADHD on children's developmental behavior.

2. Heavy Metal

2.1 Plumbum

Plumbum is one of the heavy metals that are widely present in soil, dust and water. As an environmental pollutant worldwide, plumbum (Pb) can affect brain development and neural development of growth even in low levels. Although overall blood plumbum level of children around the world has a downward trend, but a lot of teenagers are still taking the plumbum pollution,

and a number of research results during 2007-2017 show that there is a close relationship between the improvement of children's blood plumbum concentration in the body and the children hyperactivity and inattention. Plumbum has nervous system toxicity. High plumbum levels will hinder the consuming system function, reduce the immunity of children and make the excitation-inhibition process of cerebral cortex disorder, and then lead to intellectual retardation and abnormal behavior of children. Some researchers have found that Pb can affect the dopamine pathway, leading to the damage of dopaminergic neurons, thereby damaging the homeostasis of neurotransmitters [3], among which the dopamine pathway is one of the important neurotransmitter pathways of ADHD.

A study conducted in Gansu Province analyzed the intelligence characteristics of ADHD-related preschool children to prevent and intervene the learning and behavior problems of affected preschool children. The study found that the prevalence of ADHD was significantly lower than that of other regions in China. Therefore, the prevalence of ADHD was closely related to plumbum exposure and blood plumbum content, and it was a risk factor. The previous investigation on the hair microelement content of ADHD children showed that the plumbum content was higher than that of normal children. Therefore, the children in this survey in Gansu Province lived in the abdominal mountain of Qilian Mountain, which belongs to the national nature protection area, with slight environmental pollution and other contaminants, and a more natural diet. This may be a factor for the low prevalence of ADHD in this area [4]. ADHD-related behaviors increased as plumbum exposure. According to statistics, exposure to plumbum during pregnancy is positively correlated with the incidence of ADHD. In the blood plumbum level test of primary school students, the results show that the risk of ADHD in children with blood plumbum level of 5 mug/dl or higher is twice than that of normal children [5]. There was a specifical investigation and study between blood plumbum levels and ADHD children in 2015, they interviewed parents of more than 160 children with AHDH by a structured questionnaire and evaluate each registration of children's blood plumbum and plumbum levels. More than 100 children have plumbum exposure history, and boys have more dynamic behaviors than girls. Studies have shown that higher blood and bone plumbum levels are associated with higher hyperactivity/impulsivity levels in children [6]. In 2018, more than ten cohort studies of plumbum exposure and ADHD proved they had positive correlation. In the latest study, they compared the results of ADHD related inspection test from the children with ADHD and the control group. The observation group's plumbum levels was higher than that of the control group. The average levels of calcium, copper and zinc were lower than those in the control group [7].

Although children's blood plumbum levels have declined significantly few decades, plumbum exposure, especially cumulative plumbum exposure remains a threat to later childhood development. Children are easier to absorb plumbum and be affected by plumbum exposure than adults. So we should reduce their contact situation and improve their growth environment, and we should always be aware of abnormal development of children with high bone plumbum levels and chronic plumbum exposure or those whose early lives are in the areas with high plumbum contamination.

2.2 Manganese

Manganese is a heavy metal. Excess amount of manganese is found in land, air, drinking water and plants (especially soybean and rice). Meanwhile, the latest research shows that the increasing levels of manganese in drinking water are strongly associated with ADHD risk. Manganese intake has adverse effects on concentration, locomotion and growth, but it doesn't change the impulse control, which is consistent with the inattention manifestations of ADHD [8].

Studies have shown that manganese exposure is positively correlated with the prevalence of

ADHD. In animal experiments, experimental results show that the dopaminergic system of rats is particularly sensitive to high manganese content. Studies on rodents show that manganese exposure reduces the level of DA in the striatum. This finding is also associated with neurocognitive deficits [9]. At the same time, manganese accumulated in dopaminergic neurons after DAT, so that the transporter was inhibited in the animal body. Therefore, the increase of Mn content affected the normal operation of dopaminergic system, which further demonstrated the relationship between ADHD and manganese [10]. In 2014, a number of studies showed that in the detection of manganese content in preschool children's hair, it was found that the increase of manganese content in hair was related to children's behavior and cognitive attention deficits. In the experiment, 225 children (aged 7-12 years) from four primary schools were selected to collect different degrees of manganese exposure in pillow hair, toenail and blood samples.

All the above research results showed that manganese exposure in the environment had a certain effect on the generation of ADHD.

2.3 Mercury

Mercury is ubiquitous in our living environment, mostly in the natural environment and daily products. Hg adversely affects enzymes, cell membrane function and neurotransmitter levels. Decreased Ach release and DA levels affect in the striatum and hypothalamus. Studies have proved that mercury exposure has an impact on the formation of ADHD in children [11]. Studies have found that children diagnosed with ADHD at the age of 11 by DSMIV Destructive Behavior Disorder rating scale are related to prenatal mercury contamination. The attentional function of children exposed to mercury was affected from 7 to 14. Developmental function of people have shown that early exposure to methylmercury is associated with impaired IQ, impaired memory, decreased attention level, and increased risk of ADHD[12]. These things tell us mercury during pregnancy and early childhood adverse impact the body, but more population-specific studies are needed to confirm the reliability of the relationship.

3. Air Pollution

Research on air pollution mainly comes from outdoor air pollutants related to traffic and industrial sources. As the progress of the times and the development of industry, our living environment and air quality have affected our physical condition, especially children and the elderly with low immunity. Of particular concern among the different organic compounds adsorbed to particulate matter are polycyclic aromatic hydrocarbons. Pahs adsorbed on particulate matter produced by combustion may be passed from the mother's blood to the fetus, have Harmful to the child's health.

From 2012 to 2017, a number of studies examined the relationship between prenatal exposure to hazardous air pollution and children's early and middle cognitive ability, and found that heavy metals in hazardous air pollutants were negatively correlated with children's poor development.

Among them, PAHs are key components of environmental contaminant, which is inextricably linked to air pollution, causing adverse effects on the human body. Experiments have shown that prenatal exposure to polycyclic aromatic hydrocarbons, as neurodevelopmental toxic substances, can harm children's body and development. In addition, population investigation studies have shown that the increased attention problems of children aged 6-7 years are associated with gestation period [12]. Statistics proved that dopaminergic system disorders are a key component in the development of disease, so animal experiment results indicate that in childhood exposure to PM is likely to change the neurotransmitter dopamine in the brain of mice system or its metabolites, a strong relationship has been demonstrated among contact to components of air contamination

during pregnancy and ADHD.

All the above surveys have illustrated the involvement of air pollution in children's behavioral problems.

4. Conclusion

ADHD is a complex disease caused by a combination of genetic, social and environmental factors. Many scholars at home and abroad have done a lot of research on the etiology and pathogenesis and got many research results. Children are susceptible to receiving chemical contamination from industrial use, so we should pay more attention to the environment problem to prevent ADHD. Let's provide a good living environment for children, develop healthy living habits and pay attention to the environmental health around you. The prevention and control of the disease requires the joint efforts of parents and children.

References

[1] Boucher O, Jacobson S W, Plusquellec P, et al. "Prenatal methylmercury, postnatal plumbum exposure, and evidence of attention deficit/hyperactivity disorder among Inuit children in Arctic Quebec". Environ Health Perspect, vol.120, no. 10, pp. 1456-61, 2012.

[2] Debes F, Budtz-Jorgensen E, Weihe P, et al."Impact of prenatal methylmercury exposure on neurobehavioral function at age 14 years".Neurotoxicol Teratol, vol.28, no.02, pp. 363-375, 2006.

[3] Oulhote Y, Mergler D, Barbeau B, et al. "Neurobehavioral function in school-age children exposed to manganese in drinking water".Environ Health Perspect, vol.122, no.03, pp. 1343-50, 2014.

[4] Volk H E, Perera F, Braun J M, et al. "Prenatal air pollution exposure and neurodevelopment: A review and blueprint for a harmonized approach within ECHO".Environ Res, vol.196, pp. 110320-, 2021.

[5] Edwards S C, Jedrychowski W, Butscher M, et al."Prenatal exposure to airborne polycyclic aromatic hydrocarbons and children's intelligence at 5 years of age in a prospective cohort study in Poland". Environ Health Perspect, vol. 118, no. 09, pp. 1326-31, 2010.

[6] Perera F P, Wang S, Vishnevetsky J, et al. "Polycyclic aromatic hydrocarbons-aromatic DNA adducts in cord blood and behavior scores in New York city children".Environ Health Perspect, vol.119, no.08, pp.1176-81, 2011.

[7] Margolis A E, Herbstman J B, Davis K S, et al. "Longitudinal effects of prenatal exposure to air pollutants on self-regulatory capacities and social competence". J Child Psychol Psychiatry, vol. 57, no.07, pp.851-60, 2016.

[8] Perera F P, Tang D, Wang S, et al. "Prenatal polycyclic aromatic hydrocarbon (PAH) exposure and child behavior at age 6-7 years".Environ Health Perspect,vol.120,no.06,pp.921-6, 2012.

[9] Cowell W J, Bellinger D C, Coull B A, et al. "Associations between Prenatal Exposure to Black Carbon and Memory Domains in Urban Children: Modification by Sex and Prenatal Stress".PLoS One,vol.10,no.11,pp. e0142492,2015.

[10] Perera F P, Wheelock K, Wang Y, et al."Combined effects of prenatal exposure to polycyclic aromatic hydrocarbons and material hardship on child ADHD behavior problems".Environ Res, vol.160, no.09, pp. 506-513, 2018.

[11] Allen J L, Liu X, Pelkowski S, et al. "Early postnatal exposure to ultrafine particulate matter air pollution: persistent ventriculomegaly, neurochemical disruption, and glial activation preferentially in male mice".Environ Health Perspect, vol.122, no.09, pp.939-45, 2014.

[12] Ribas-Fito N, Torrent M, Carrizo D, et al. "Exposure to hexachlorobenzene during pregnancy and children's social behavior at 4 years of age". Environ Health Perspect, vol.115, no.03, pp.447-50, 2007.