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Research Progress on Influencing Factors of Refractive Error in Preschool Children

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Abstract: Preschool is the key period of children's visual function development, which is called the "critical period of visual development plasticity". Any abnormal stimulus during this period can have an adverse impact on children's vision. Ametropia is the main cause of poor vision in preschool children. There are many reasons for ametropia. This paper reviews the influencing factors of ametropia in preschool children in recent years, which are classified into three aspects: demographic factors, physiological factors, and lifestyle factors.

Keywords: Influencing Factors; Ametropia; Preschool Children

1. Definition and research status of ametropia

Ametropia refers to that the parallel light cannot accurately focus on the retina of the fundus to result in a blurred image after the refraction of the refractive system of the eye. If the light is focused in front of the retina, it's myopia; When the light is focused behind the retina, it's hyperopia; Light cannot converge into focus, which is astigmatism; All three will lead to blurred vision.

In recent years, with the wide use of electronic products and bad eye habits, more and more preschool children with ametropia have been detected. The National Health Commission released the survey results of myopia among children and adolescents in 2018. The results showed that the overall myopia rate among adolescents was 53.6% in 2018. Therefore, it is necessary to carry out myopia screening, correction and health guidance for children and adolescents in China from the pre-school stage.

2. Influencing factors of refractive errors in preschool children

2.1 Demographic factors

2.1.1 Age

The detection rate of refractive abnormalities in children is related to age distribution. According to the visual acuity screening of 3352 infants aged 6 months to 3 years, Chen L.S.^[1] found that before the age of 3, the abnormal rate gradually decreased with the increase of age ($P < 0.01$). Zhang G.Y.^[2]'s survey of 4~7 years old children found that with the increase of age, the incidence rate of hyperopia decreased, and the incidence rate of myopia increased.

2.1.2 Gender

The differences in the investigation and statistics of refractive errors of children of different genders are not uniform. According to Gao H.Q.^[3]'s research, the abnormal rate of total anisometropia in girls (2.3%) was higher than that in boys (1.9%). However, some studies^[4] show that refractive errors of preschool children have nothing to do with gender, which may be related to regional differences and too few research samples.

2.1.3 Race

Research^[5] shows that in the United States, there are differences in the myopia rate of children of different descent. The

highest myopia rate is 18.5% for Asians, while only 4.4% and 6.6% for whites and black Americans. It points out that this is jointly affected by genetic and environmental factors. This may be due to related to the fact that Asian children are under more study pressure and the differences in educational methods between Asia and some western countries.

2.1.4 Regional distribution

The detection rate of ametropia in children is unevenly distributed in various regions, and the difference between urban and rural areas is obvious. The results of study^[6] show that the detection rate of refractive errors in urban children is higher than that in rural children. There are significant differences in the prevalence of myopia between urban and rural children, and they all show an upward trend. This may be related to the gap between urban and rural economic income levels, heavy study tasks for urban children, more exposure to electronic products, more rural population, but less testing.

2.2 Physiological factors

2.2.1 Genetic factors

Parental myopia is a risk factor for ametropia in preschool children. At present, the genetic patterns of abnormal vision in clinic are mainly divided into autosomal inheritance and X-chromosome inheritance. Autosomal inheritance has nothing to do with gender, and the prevalence of children is 50%. In X-chromosome inheritance, the prevalence of women and the probability of carrying disease genes are higher than that of men. Zhang G.Y.^[2] study showed that the incidence rate of abnormal vision in all age groups was significantly higher than that in family history without myopia and related ophthalmopathy ($\chi^2=48.08$, $P<0.001$), which is consistent with the results of Long Qi^[7].

2.2.2 Perinatal factors

Preterm birth, low-birth-weight infants, history of fetal protection treatment during pregnancy, history of asphyxia and oxygen inhalation in children, and history of smoking in mother's pregnancy are the influencing factors of children's ametropia. According to the screening of 7886 ametropic children in Haiyan County by Zhou Y.L.^[8], children with a history of preterm birth and low birth weight have a high rate of refractive abnormalities. Some studies believe that it is due to the improvement of the current technical level, the survival rate of some low-birth-weight infants and preterm infants has also increased, the incidence of retinopathy in preterm infants is higher, and the blindness rate is significantly higher than that of full-term infants. The investigation results of Fan T, Shi H.Q.^[9] and others showed that the infection of *Toxoplasma gondii*, rubella virus and other microorganisms during pregnancy and adverse drugs in patients with a history of pregnancy fetal protection treatment would lead to a higher rate of visual impairment during pregnancy than those without that, and the difference was significant. The research of Zhang G.Y.^[2] shows that the rate of low visual acuity of those with intrapartum asphyxia is higher than those without asphyxia, and the difference is significant. Therefore, avoiding intrapartum asphyxia can reduce the ultraviolet radiation in neonatal warm box phototherapy and reduce the occurrence of fundus lesions. At the same time, At the same time, a study^[8] found that the proportion of abnormal refraction of babies born to pregnant women with smoking and alcohol history was higher than that of normal children ($P<0.05$). Therefore, it is very important to prevent ametropia in children and carry out health care and physical examination during pregnancy.

2.3 Lifestyle factors

2.3.1 Activity factors

Outdoor activities, bad eye habits, use of electronic products and participation in after-school interest classes are the influencing factors of children's ametropia. Bad eye habits, including long-time eye use, not paying attention to active rest, too close eye use, etc., lead to excessive or harmful eye use, which will lead to abnormal vision of children. Tang M.H.^[10]'s research shows that outdoor exercise is a protective factor for ametropia because appropriate outdoor activities are conducive to reducing the synthesis of melatonin in the retina and increasing the content of dopamine. Long Qi^[7] showed that many

kinds or long time of bad eye use are independent factors affecting children's abnormal vision. Xie J.Y.'s research shows that children who participate in after-school interest classes are more likely to have abnormal vision. This result may be related to the fact that children who participate in after-school interest classes spend too much time with their eyes and do not pay attention to maintaining good eye habits.

2.3.2 Disease factors

Some disease factors may also lead to abnormal vision, which may be caused by the transmission of some pathogens to the eyes. For example, Jia Wei^[4] found that allergic rhinitis is an independent risk factor for ametropia in children. Allergic rhinitis can lead to long-term eyes without rest and visual development disorders.

2.3.3 Dietary factors

Children's picky eating and chewing will affect children's nutritional status, resulting in abnormal vision. Xie J.Y.^[11] found that children with picky eating habits will lead to abnormal vision ($\chi^2=6.398$, $P<0.05$). Picky eating habits will lead to the lack of some trace elements (such as selenium, zinc, chromium, and other elements closely related to the incidence of myopia), and damage the structure of eye fundus tissue, thus affecting vision. Picky eating habits may also lead to children's light weight. Zhang G.Y.^[2] found that the abnormal visual acuity rate of children in the group with weight lower than two standard deviations was higher than that in the group with normal weight ($X^2=7.70$, $P<0.05$). Zhou M.Y.^[12] showed that regular eating of green vegetables (OR=0.122) and hard food (OR=0.357) are the protective factors of children's refractive error.

2.3.4 Sleep factors

Children have enough sleep time is the protective factor of ametropia. Fan T^[9] found that sleep time (≥ 8 hours) is a protective factor for children's vision. Less sleep time can affect people's overall mental state and physical constitution, which is associated with myopia.

2.3.5 Family environmental factors

Family environmental factors include physical environmental factors such as family lighting environment, social environmental factors such as parents' educational level and income level, parents' cognitive behavior of children's vision protection, etc. Some studies have pointed out that led lamps at home are more likely to cause myopia in children than incandescent lamps or fluorescent lamps. The reason is related to the continuous flashing light of LED lamps. Experiments have proved that the continuous flashing light can induce the binding of 5-HT and 5-HT_{2A} receptor, resulting in progressive myopia in guinea pigs. Zhang G.Y.'s research shows that the children of fathers with higher education have a higher rate of normal vision. This may be related to the fact that parents with higher educational level pay more attention to their children's vision protection and can scientifically arrange their children's learning and activity time. Zhou Y.L.'s survey showed that the proportion of children with refractive abnormalities in low-income families was higher than that in other families ($P < 0.05$). This is contrary to the results of Xu LAN^[13]. The reason may be that parents with higher education have high demands on children's study, which increases the length of children's eye use, and children in high-income families may use more electronic products.

Conclusion

Preschool children are the key period of visual development, in which demographic factors, physiological factors and lifestyle factors have important influence on children's visual development. Therefore, it is of great significance to strengthen the visual screening of preschool children, publicize the knowledge of perinatal prevention and health care and the basic health knowledge of correct eye use, to improve the adverse environment and take active outdoor activities, these are of great significance in restoring the visual development of preschool children.

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