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ANALYSIS OF FACTORS INFLUENCING VISUAL ACUITY IN PRESCHOOL CHILDREN

Imamatul Hikmah*, Henry Sudiyanto, Rifaatul Laila Mahmudah
Master of Public Health Program, STIKES Majapahit Mojokerto, Jl. Raya Gayaman, Gayaman, Mojoanyar, Mojokerto, Jawa Timur 61364, Indonesia
*imamatulh@gmail.com

ABSTRACT
Visual impairment in preschool-aged children is a significant public health concern because it may adversely affect cognitive development, learning performance, social interactions, and overall quality of life. Several factors, including parental characteristics, outdoor activities, and exposure to digital devices, have been suggested as potential contributors to impaired vision in early childhood. This study was to identify the factors associated with visual acuity among preschool children attending TK Elfath, Sumenep Regency. An analytical observational study with a cross-sectional design was conducted involving 80 preschool children selected through a total sampling technique Data on respondent characteristics were collected using a questionnaire that has been tested for validity and reliability, Visual acuity is measured with a direct vision screening examination utilising an E card. (tumbling E chart) at a standard distance of 3 meters according to the guidelines of the Ministry of Health of the Republic of Indonesia. The data were analyzed by using Chi-square tests followed by multiple logistic regression to determine the most influential predictor of visual impairment. The findings revealed that 86.3% of participants had normal visual acuity, whereas 13.8% were identified as having visual impairment. Bivariate analysis demonstrated that parental educational level, child sex, outdoor activity, and parental history of visual disorders were not significantly associated with visual impairment ($p > 0.05$). In contrast, screen exposure showed a statistically significant relationship with impaired vision ($p < 0.001$). Multivariate analysis further confirmed screen exposure as the strongest determinant of visual impairment. These findings highlight the importance of limiting screen time and strengthening parental awareness to support healthy visual development in preschool children.

Keywords: constipation; pregnant women; prenatal yoga

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INTRODUCTION

Vision plays a crucial role in supporting a child's growth and development. Optimal vision helps children acquire information from their environment, develop motor skills, enhance language skills, and foster positive social interactions(Sun et al., 2025). If vision impairment occurs early in life, this development can be disrupted and impact a child's quality of life into adulthood. The World Health Organization states that untreated refractive errors remain the leading cause of vision impairment in children and are preventable through early screening and treatment(World Health Organization, 2023). Visual impairment rates in various countries remain high and are expected to increase in the coming years. In Indonesia, this issue requires attention because it can impact children's academic achievement and development. The government has recommended early detection using E-cards as a screening method, but implementation has been uneven due to limited resources, lack of public awareness, and technical challenges during early childhood screenings(Huang et al., 2021).

The occurrence of visual impairment in children is influenced by a combination of hereditary and environmental factors. Children whose parents have a history of refractive errors tend to have a

greater risk of developing similar problems. In addition to hereditary factors, lifestyle changes due to increased use of digital devices at an early age are also a concern because they can increase prolonged near-vision activities(Burton et al., 2020). Conversely, outdoor play is often associated with a protective effect against the development of myopia. Family characteristics, including parental education levels, also have the potential to influence children's visual habits through parenting patterns and daily supervision(Biswas et al., 2024).

Based on data screening conducted at Elfath Kindergarten in Sumenep Regency, the proportion of children with suspected visual impairment increased from 3.87% in 2023 to 8.28% in 2024. These findings indicate the need to identify factors associated with visual impairment in preschool children as a basis for developing more effective promotive and preventive programs. To date, research on factors influencing visual impairment in preschool children in Sumenep Regency is still limited, especially those that examine demographic, behavioral, and family history factors simultaneously. Based on the description, this study aims to analyze the relationship between parental education level, child gender, outdoor activities, exposure to gadgets, and parental history of visual impairment with the incidence of visual impairment in preschool children at Elfath Kindergarten, Sumenep Regency, and to identify the most dominant factors through logistic regression analysis.

METHOD

This study used an analytical observational cross-sectional design. In this design, all study variables were measured over the same period, allowing the relationship between risk factors and children's vision conditions to be evaluated at a single observation point. The study was conducted at Elfath Kindergarten, Sumenep Regency, from April to June 2025. The study population was all preschool-aged children (36–72 months) and their parents registered as students at Elfath Kindergarden. Inclusion criteria included children aged 36–72 months who were present during the study and had obtained parental consent to participate. Exclusion criteria were children with special needs who had developmental disabilities that could impact the visual acuity examination. The study sample was determined using the Slovin formula with a 10% margin of error. Sampling was conducted using a simple random sampling technique. A total of 80 parent-child pairs met the criteria and agreed to participate.

The dependent variable in this study was children's visual impairment, measured using an E-chart (tumbling E-chart) at a standard distance of 3 meters according to the guidelines of the Indonesian Ministry of Health. Children were categorized as having visual impairment if they were unable to recognize the letter E on the third line of the test. Independent variables included the education level of the father and mother, the child's gender, outdoor activities, screen time, and a history of visual impairment in the father and mother. Data on family characteristics and child behavior were obtained through questionnaires completed by parents.

Screen time was categorized as low (<1 hour/day), moderate (1 – 2 hours/day), and high (>2 hours/day) based on the recommendations of the American Academy of Pediatrics. Outdoor activity was categorized as none, short (<40 minutes/day), and long (≥40 minutes/day). A history of parental visual impairment was classified as present or absent. The collected data was then processed using the SPSS statistical program. Descriptive analysis was used to describe the respondents' characteristics, while relationships between variables were evaluated using the Chi-Square or Fisher Exact test, depending on the data characteristics. Variables that met the selection criteria were then entered into a multiple logistic regression model to determine the factors most influential in influencing visual impairment in children. This study obtained permission from the Elfath Kindergarten, and all parents provided informed consent after receiving an explanation of the study's

purpose and procedures. Respondents' identities were maintained, and all data was used solely for research purposes.

RESULT

This study involved 80 preschool children at Elfath Kindergarten in Sumenep Regency and their parents. Based on the results of the bivariate and multivariate analyses, it can be concluded that device exposure is the most dominant factor associated with visual impairment in preschool children at Elfath Kindergarten in Sumenep Regency. Meanwhile, parental education, child gender, outdoor activities, and parental history of visual impairment did not show a significant association. These findings emphasize the importance of monitoring device use in preschool children as a promotive and preventive strategy for maintaining children's visual health.

Table 1.
Frequency Distribution of Respondents in the Analysis of Factors Influencing the Visual Ability of Preschool Children

Variable	Category	f	%
Child Gender	Boys	51	63,7
	Girls	29	36,3
Childhood Visual Impairment	Visual disturbances	11	13,8
	No visual impairment	69	86,3
Father's Education level	High	67	83,8
	Low	13	16,3
Mother's Education level	High	64	80,0
	Low	16	20,0
Myopia in Father	No Myopia	64	80,0
	Myopia	16	20,0
Myopia in Mother	No Myopia	57	71,3
	Myopia	23	28,7
Gadget Exposure	Not exposed	10	12,5
	Short Exposure	41	51,2
	Long exposure	29	36,3
Children's Outdoor Activities	Never	19	23,8
	For A moment	22	27,5
	Long activity	39	48,8

Table 1, a bivariate analysis was conducted to identify the relationship between each independent variable and visual impairment in preschool children. The variables analyzed included father's education, mother's education, child's gender, outdoor activities, parental history of visual impairment, and exposure to mobile devices. The analysis showed that most variables did not have a statistically significant relationship with visual impairment.

Tabel 2.
Variable analysis test results

No	Variable	Statistical Test	p-value	Result	Significance	OR/RR	Conclution
1	Father’s educational Level	Fisher's Exact Test	0,196	Not significance	Very weak (CC=0,173)	RR=1,196	There is no relationship between the father's education level and visual impairment in children.
2	Mother’s educational Level	Pearson Chi-Square	0,551	Not significance	Very weak (CC=0,121)	Tidak dapat dihitung	There is no relationship between the mother's education level and visual impairment in children.
3	Child Gender	Fisher's Exact Test	0,311	Not significance	Very weak (CC=0,148)	OR=0,346 (95%CI: 0,069–1,724)	Child's gender is not a risk factor for visual impairment in children.

No	Variable	Statistical Test	p-value	Result	Significance	OR/RR	Conclution
4	Children's Outdoor Activities	Pearson Chi-Square	0,953	Not significance	Very weak (CC=0,034)	cannot be counted	There is no relationship between outdoor activities and visual impairment in children.
5	Gadget Exposure	Pearson Chi-Square	0,000	Significance	Strong (CC=0,620)	cannot be counted	There is a significant relationship between exposure to gadgets and visual impairment in children.
6	Myopia in Father	Fisher's Exact Test	0,217	Not significance	Weak	OR=2,714 (95%CI: 0,685–10,759)	The father's history of visual impairment was not significantly related to the child's visual impairment
7	Myopia in Mother	Fisher's Exact Test	1,000	Not significance	Very Weak (CC=0,013)	OR=0,919 (95%CI: 0,221–3,821)	The mother's history of visual impairment was not significantly related to the child's visual impairment.

According to the findings of this study, gadget exposure is a significant predictor of the incidence of visual impairment in children, whereas parental education level, child gender, outdoor activities, and a history of myopia in either the father or mother have no significant association with visual impairment. These findings highlight the significance of monitoring and managing gadget use in children in order to prevent visual impairment.

DISCUSSION

Vision impairment in preschoolers and mother's or father's educational level

The study's findings demonstrated that there was no significant correlation between the occurrence of vision impairment in preschoolers and either the mother's or father's educational attainment. This finding suggests that parents' formal education level does not necessarily have a direct impact on children's eye health. The lack of a relationship is likely due to the relatively uniform characteristics of the respondents, with most parents having a college education. This uniformity of characteristics limited data variation, making it difficult to statistically detect differences between groups. This is in line with a study by (Liu et al., 2026), which reported that family demographic characteristics, including parental education level, showed no significant differences between groups of children with visual impairment and those with normal vision. Similar findings were also reported by (Williams, 2022), who stated that the success of early detection of visual impairment was more influenced by health literacy and access to health information than by formal education level (Saffir et al., 2023).

However, other research has shown contradictory findings. Higher educated parents typically know more about myopia and the health of their children's eyes, according to(Qian & Lu, 2024) research. Nevertheless, better eye health outcomes for kids or effective preventive measures are not necessarily the result of this enhanced understanding. This implies that there is an indirect association between schooling and children's eye health, which may be mediated by a number of other elements like family culture, parenting styles, and access to medical care(Qian & Lu, 2024). The characteristics of Elfath Kindergarten, which actively involves parents through health literacy and education programs, likely explain the results of this study. A school environment that provides equitable health information can reduce the knowledge gap among parents, thereby reducing the influence of formal education. Therefore, the concept of health literacy appears to be more relevant than formal education level in explaining eye health behaviors in families of preschool children.

Visual impairment and gender

The analysis showed that gender was not a factor associated with visual impairment in preschool children. Although descriptively, the number of cases was more in boys, the difference was not large

enough to show a statistically significant relationship. These results indicate that the odds of developing visual impairment in preschool age are relatively similar in boys and girls. This finding is consistent with the study by Sun et al. (2025), which showed that gender is not a major determinant of visual acuity in the preschool age group. A large population study in Beijing involving over 1,000 children aged 3–6 years also reported that the prevalence of visual impairment did not differ significantly between boys and girls(Sun et al., 2025).

Biologically, the development of the visual system in preschool age is still in the emmetropization phase, the natural adjustment of the eye's refraction toward optimal conditions. During this phase, the influence of sex hormones and biological factors related to gender is relatively minimal compared to environmental factors and everyday visual behavior(Cui et al., 2026). Therefore, variations in near-vision activities, digital device use, and environmental visual stimulation are thought to contribute more significantly than gender(Biswas et al., 2024). Furthermore, boys and girls at Elfath Kindergarten experience relatively similar learning experiences, school activities, and visual stimulation. This similarity in environmental exposure has the potential to result in a nearly equal risk of visual impairment in both groups. These findings reinforce the view that gender is not a major risk factor for visual impairment in preschool.

History of visual impairment in parent

This study did not find a significant association between a history of visual impairment in parents and the child's vision. This finding suggests that the influence of hereditary factors may not be clearly visible in the preschool age group. The development of refractive disorders is a process influenced by various factors, so the presence of a family history alone does not necessarily cause the appearance of visual impairment in early childhood. Theoretically, hereditary factors are an important determinant in the development of refractive disorders, particularly myopia. Several studies have shown that children with myopic parents have a higher risk of developing refractive disorders than children without a similar family history (Kim & Choi, 2024). However, the development of visual impairment is a multifactorial process involving a complex interaction between genetic and environmental factors.

The findings of this study align with longitudinal studies showing that parental myopia is associated with changes in ocular biometrics, such as increased axial length of the eyeball, but does not directly lead to significant refractive changes in preschool age (Yingyan Ma, 2022). Similar results were reported by Yum et al. (2023), who stated that clinical manifestations of refractive disorders due to genetic predisposition generally only become apparent at school age when exposure to environmental risk factors increases (Yum et al., 2023). Furthermore, the educational environment that supports physical activity and environment-based learning at Elfath Kindergarten may act as a protective factor. Exposure to a healthy environment prevents genetic predispositions from developing into overt visual impairments at an early age. These findings support the concept that genetic factors require specific environmental triggers to produce clinical manifestations of refractive disorders.

Children’s Outdoor activities

The results of this study indicate that the duration of outdoor activities does not have a significant relationship with the incidence of visual impairment in preschool children. Although there is a tendency for children who are more active outdoors to have a lower proportion of visual impairment, this difference is not strong enough to show a statistically significant relationship. This condition is likely influenced by the similarity of children's activity patterns in the school environment, which limits variation in exposure to outdoor activities among respondents. Theoretically, outdoor activities play an important role in preventing the development of myopia through exposure to natural light,

which stimulates the release of retinal dopamine (Xiong et al., 2017). Dopamine is known to inhibit axial elongation of the eyeball, which is the main mechanism of myopia (Huang et al., 2021). A recent meta-analysis showed that increasing the duration of outdoor activities can reduce the incidence of myopia and slow its progression in children and adolescents(Cheng et al., 2020).

The insignificant relationship in this study is likely due to the characteristics of the school environment. Elfath Kindergarten implements environment-based learning and regular outdoor activities, resulting in nearly all children receiving relatively uniform exposure to natural light. As a result, variation in outdoor activities among respondents is limited, making their protective effects difficult to observe statistically. Furthermore, the effect of outdoor activities may be overshadowed by the much more dominant effect of device exposure. Multivariate analysis indicates that device use is the primary determinant of vision impairment in this study population. Therefore, the benefits of outdoor activities for children are not strong enough to offset the negative impacts of excessive digital device use(Zong et al., 2024). Overall, the findings of this study suggest that, while outdoor activity has a strong biological basis as a protective factor, its effects on preschool children may be influenced by school environment characteristics as well as other more dominant behavioural factors, particularly exposure to technology.

Gadget Exposure

Device use was found to have the highest correlation with vision impairment in preschoolers among all the variables examined. According to the investigation, a child's risk of acquiring vision impairment increased with the amount of time they spent using digital gadgets. This implies that excessive screen time may be a major risk factor that needs to be taken into consideration while trying to keep kids' eyes healthy from a young age. These findings are consistent with a number of recent research that identify children's usage of digital devices as a significant risk factor for visual impairment. A meta-analysis by Zong et al. (2024) involving thousands of children and adolescents demonstrated a dose-response relationship between screen time and an increased risk of myopia. The longer the screen time, the greater the likelihood of developing refractive disorders.

Prolonged use of digital devices causes the eyes to continuously focus on objects at close range. This activity increases the workload of the visual system, which can cause eye discomfort, visual fatigue, and changes in accommodation function. If repeated over a long period of time, this condition has the potential to increase the risk of refractive errors, including myopia (Richards et al., 2024). This finding is also supported by the Longhua Child Cohort Study, which reported a link between early screen exposure and an increased risk of astigmatism and other refractive errors. In line with the results of this study, (Zuhroh, 2022) reported that visual acuity impairment was found in 68% of preschool children studied in Palembang. The study also identified that relatively long-term device use (≥3 hours/day) and personal device ownership were dominant factors in the group of children with poor visual acuity. These findings strengthen the hypothesis that excessive exposure to digital devices contributes to visual function decline in early childhood. According to these findings, restricting young children's usage of digital devices is a crucial tactic for maintaining and improving eye health. To prevent children's visual impairment from getting worse, public health interventions should include parental supervision, healthy device usage rules, and more outdoor play activities.

CONCLUSION

This study found that the duration of device use is strongly connected with the incidence of visual impairment in preschool children, and it is the most important factor compared to the other variables evaluated. Meanwhile, no significant link was found between parental education, child gender,

outdoor activities, or a history of vision impairment in the parents. As a result, restricting digital gadget use from a young age should be a top priority in attempts to safeguard children's eye health.

REFERENCES

Biswas, S., Kareh, A. El, Qureshi, M., Mei, D., Lee, X., Sun, C. H., Lam, J. S. H., Saw, S. M., & Najjar, R. P. (2024). The influence of the environment and lifestyle on myopia. Journal of Physiological Anthropology, 1–22. https://doi.org/10.1186/s40101-024-00354-7

Burton, M. J., Ramke, J., Marques, A. P., Bourne, R. R. A., Congdon, N., Jones, I., Tong, B. A. M. A., Arunga, S., Bachani, D., Bascaran, C., Bastawrous, A., Blanchet, K., Braithwaite, T., Buchan, J. C., Cairns, J., Cama, A., Chagunda, M., Chuluunkhuu, C., Cooper, A., … Faal, H. B. (2020). The Lancet Global Health Commission The Lancet Global Health Commission on Global Eye Health : vision beyond 2020. https://doi.org/10.1016/S2214-109X(20)30488-5

Cheng, H., Chang, K., Shen, E., & Luo, K. (2020). Risk Factors and Behaviours of Schoolchildren with Myopia in Taiwan. 1–12.

Cui, Y., Yang, F., Zhou, Q., Wang, X., Zhao, N., & Shen, L. (2026). Visual development cohort study on refractive parameters among preschool children in Sucheng district.

Huang, L., Schmid, K. L., Yin, X., Zhang, J., & Wu, J. (2021). Combination Effect of Outdoor Activity and Screen Exposure on Risk of Preschool Myopia : Findings From Longhua Child Cohort Study. 9(March). https://doi.org/10.3389/fpubh.2021.607911

Kim, J. M., & Choi, Y. J. (2024). Nutritional intake , environmental factors , and their impact on myopia prevalence in Korean children aged 5 – 12 years. Journal of Health, Population and Nutrition, 1–13. https://doi.org/10.1186/s41043-024-00506-6

Liu, S., Wang, Y., Chen, J., Wang, F., & Shih, S. (2026). Parent engagement in children ' s eye care behavior and vision-related quality of life : a cross-sectional study.

Qian, Y., & Lu, P. (2024). Parents ' or Guardians ' Knowledge , Attitudes and Practices in the Prevention and Management of Childhood Myopia. Ophthalmology and Therapy, 13(12), 3095–3109. https://doi.org/10.1007/s40123-024-01045-3

Richards, J., Jaskulski, M., Rickert, M., & Kollbaum, P. (2024). Digital device viewing behaviour in children. December 2023, 1–8. https://doi.org/10.1111/opo.13288

Saffir, A. R., Sella, S., & Eli, H. Ben. (2023). Development and validation of a questionnaire for assessing parents ' health literacy regarding vision screening for children : a Delphi study. Scientific Reports, 1–10. https://doi.org/10.1038/s41598-023-41006-7

Sun, Y., Zhu, B., Li, L., Li, H., Qiu, Y., Wang, S., Qin, X., Cui, J., Jiang, M., & Li, Y. (2025). Prevalence of visual impairment and refractive error-related risk factors in preschool children in beijing , China.

Williams, A. M. (2022). Addressing Social Determinants of Vision Health. 1371–1382. https://doi.org/10.1007/s40123-022-00531-w

World Health Organization. (2023). Improving early child hood development :

Xiong, S., Sankaridurg, P., Naduvilath, T., Zang, J., Zou, H., Zhu, J., Lv, M., He, X., & Xu, X. (2017). Time spent in outdoor activities in relation to myopia prevention and control : a meta-analysis and systematic review. 1–16. https://doi.org/10.1111/aos.13403

Yingyan Ma, et al. (2022). Effect of Parental Myopia on Change in Refraction in Shanghai Preschoolers : A 1-Year Prospective Study. 10(April), 1–9. https://doi.org/10.3389/fped.2022.864233

Yum, H. R., Park, S. H., & Shin, S. Y. (2023). Longitudinal analysis of refraction and ocular biometrics in preschool children with early - onset high myopia. Scientific Reports, 1–6. https://doi.org/10.1038/s41598-023-50004-8

Zong, B., Li, L., Cui, Y., & Shi, W. (2024). Effects of outdoor activity time , screen time , and family socioeconomic status on physical health of preschool children. August. https://doi.org/10.3389/fpubh.2024.1434936

Zuhroh, D. F. (2022). Relation Between the Use of Gadget and the Visual Acuity in School Age Children in MI Tsamrotul Ulum Bungah Gresik. 2(1), 173–178.