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Prevalence of Myopia and its Risk Factors in Elementary School Children

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Abstract. *Myopia is a multifactorial disease, affected by various hereditary and environmental conditions. This literature review aims to evaluate the association between risk factors in incidence of myopia in children aged 6 to 12 years old. A cross-sectional study of elementary students in MI Patihan Kidul, Ponorogo, East Java was performed. Eligible samples were 6 to 12 years old students. Examination was performed on September 7th 2023. The students underwent short history taking, body mass index (BMI), and visual acuity examination. Age, sex, BMI, family history of myopia, sleeping time, screen time, and duration of outdoor activity were examined as risk factors. A total of 336 children met the inclusion criteria, of which 48 (14.2%) of them had myopia. Family history of myopia was proven to increase the risk for myopia on their children (p value 0.012, OR 0.436). Heredity is a well-established risk factor for myopia. This literature review provides evidence on the positive correlation between family history and the occurrence of myopia in children.*

Keywords: *BMI; Family History Myiopia; Myiopia; Outdoor Time; Screen Time; Sleep Time*.

1. INTRODUCTION

According to the World Health Organization, refractive error is the second most common cause of blindness worldwide, especially myopia. As much as 90% of the young population in East Asia are myopic. Aside from Asia, America and Europe also have an increasing number of near-sighted young populations. Researchers named this condition 'the myopia boom (Wu et al., 2020). They predicted that onethird of the whole population would be suffering from myopia by the end of this decade. In other words, by the year 2050, approximately 4.8 to 5 billion people worldwide are predicted to suffer from near-sightedness (Grzybowski *et al*., 2020; Liu *et al*., 2020)

Myopia is a multifactorial disease, affected by various hereditary and environmental conditions. Children born from shortsighted parents are more likely to develop myopia in the near future (Barliana, 2023). Past studies mentioned the possibility of outdoor activities as one of the protective factors in myopia. The increased exposure to light outdoors increased the release of dopamine retinal transmitter which reduces eye growth (Anandita & Barliana, 2015; Grzybowski *et al*., 2020). In contrast to outdoor activities, near work is a risk factor for myopia for children up to 6 years old (Grzybowski *et al*., 2020). Another study by Liu *et al.*, discovered the relationship between sleeping late and the development of myopia in children. Children who have shorter sleep duration and poorer sleep quality are more prone to near-sightedness.

Myopia can hinder a child's academic achievement if it is left untreated. According to a recent prediction, the prevalence of visual impairment among preschoolers would rise by 26% by the year 2060, with uncorrected refractive error accounting for 69% of cases (Li et al.,

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2022). Myopes are more likely to develop serious ocular morbidities like cataracts, myopic macular degeneration, glaucoma, and retinal detachment. Myopia and extreme myopia are both present in 4% and 39%, respectively, of 75-year-olds who have unrepairable visual impairment (Bhutia *et al*., 2021)

There is little data about the prevalence of myopia in Indonesia and its associated risk factors. Hence, this study aims to evaluate the potential factors associated with near-sightedness in children aged 6 to 12 years old living in Ponorogo, East Java, Indonesia (Morgan & Rose, 2019).

2. METHOD

This observational study employs a crosssectional methodology.with total sampling method. Primary data from the screening activities at *Upaya Kesehatan Sekolah* (UKS) in Puskesmas Ronowijayan work area at MI Patihan Kidul, Ponorogo, East Java, were used in this study. Data was collected on September 7th, 2023 starting from 07.30 AM. A total of 336 students were examined. The instruments utilized for this study are body scales, stature meters, penlights, auto-refractometers, Snellen Chart and E Chart, and trial lens sets.

The examination is performed in the following order: a brief history interview with the children and their guardian, body mass index (BMI), uncorrected visual acuity (UCVA), and best corrected visual acuity (BCVA) measurements.

Using the IBM SPSS version 21 application, the collected data will be recorded and analysed using the ChiSquare test. Both analytical and descriptive analysis techniques are applied.

3. RESULT AND DISCUSSION

Result

A total of 336 elementary students, ranging from first to sixth grade, participated in the UKS screening activities at MI Patihan Kidul. The pupils' age and gender are listed in table 1. There are more male pupils compared to female students (194 children, or 57.2%), and the largest percentage of kids were 11 years old (84 children, or 24.4%).

Table 1. Study respondents' characteristics.

	N	**%**
Age		
6 years old	28	8,4
7 years old	52	15.4
8 years old	55	16.3

9 years old	50	14.8
10 years old	41	12.2
11 years old	84	24.4
12 years old	28	8.4
	338	100
Sex Male		
	194	57.4
Female	144	42.6
	338	100

Source: Primary data 2023

Table 2. Distribution of visual acuity-relat.

	Frequency	**%**
BMI Lean		
	210	62.1
Normal	113	33.4
Overweight	15	4.4
Family history with myopia Present	73	21.6
Absent	265	78.4
Sleep time <09.00 pm		
	258	76.3
>=09.00 pm	80	23.7
Screen time <=2 hours		
	110	32.5
>2 hours	228	67.5
Outdoor activity <2 hours		
	135	39.9
>=2 hours	203	60.1
Visual acuity Emmetropia		
	290	85.8
Myopia	48	14.2

Source: Primary data 2023

As seen on table 2, 265 respondents (78.4%) did not have a history of myopia, whereas 73 respondents (21.6%) did.

Table 3 displays the p-value of 0.012 for the children's visual acuity in relation to their family history of myopia. Given that the p-value is less than 0.05, it may be inferred that there is a significant correlation between the family history of myopia and visual acuity. The odds ratio value was 0.436, indicating that respondents without a history have a 0,43 times higher likelihood of having emmetropic acuity compared to respondents with a history. The p-value for the connection between BMI, sleep time, screen time, and outdoor activity with visual acuity was greater than 0.05. This the null hypothesis (H0) is deemed to be accepted. factors,

such as the sample size, study location, race or ethnicity, nutrition, lifestyle, and hereditary factors, which may influence the occurrence of bias (Bhutia, 2021).

Table 3. Factors Relate to Visual Acuity.

		Ketajaman Virus						p-value	OR
		Emmetropia							
Myopia									Total
		N	%	N	%	N	%		
BMI	Lean	180	85,7	30	14,3	210	100	0.995	0.989
	Normal	97	85,8	16	14,2	113	100		0.932
	Overweight	13	86,7	2	13,3	15	100		0.923
Family history with myopia	Yes	56	76,7	17	23,3	73	100	0.012	0.436 (0.226-0.844)
	No	234	88,3	31	11,7	265	100		
Sleep time	< 09.00 pm	223	86.4	35	13.6	258	100	0.548	1.236 (0.618-2.417)
	>=09.00 pm	67	83.8	13	16.3	80	100		
Screen time	<= 2 hours	95	86.4	15	13.6	110	100	0.836	1.072 (0.555-2.069)
	> 2 hours	195	85.5	33	14.5	228	100		
Outdoor activity	< 2 hours	117	86.7	18	13.3	135	100	0.709	1.127 (0.601-2.116)
	>= 2 hours	173	85.2	30	14.8	203	100		

Source: Primary data 2023

Discussion

During the visual acuity examination in MI Patihan Kidul, it was discovered that 48 children, accounting for 14.2% of the total, have a refractive disease known as myopia. This finding aligns with a study conducted by Indah *et al.* in SD State in Padang, which reported a myopia incidence rate of 45.5%. The difference in prevalence may be attributed by several factors, such as the sample size, study location, race or ethnicity, nutrition, lifestyle, and hereditary factors, which may influence the occurrence of bias (Bhutia, 2021).

This study establishes a significant correlation between the hereditary predisposition of myopia and the occurrence of myopia in children. This is in line with the hypothesis that both environmental and genetic factors contribute to the occurrence of myopia. Multiple genes, rather than a single gene, contribute to the genetic variables involved in myopia. Parents with myopia are more likely to have myopic children (Asiyanto *et al*., 2020)

Despite the fact that the current study found no link between BMI and myopia, Lee *et al.'s* research proves otherwise. In Lee *et al.'s* study, a significant correlation between obesity in children and adolescents and high myopia from 1114 students was found. Insulin resistance

was proposed as the primary factor contributing to myopia. In non-diabetic individuals, the release of insulin is inhibited under hyperglycemic condition. This leads to lens thickening and an anterior shift of the anterior pole, which worsens myopia. Moreover, it is well known that elevated blood insulin levels stimulate the release of insulin-like growth factor 1 (IGF-1), which further stimulates cell growth and division, ultimately resulting in the axial elongation of the eye. Hence, it is highly possible that insulin resistance is the primary determinant for predicting the causal association between obesity and myopia (Theophanous *et al*., 2018)

In addition to BMI, this study also demonstrates the lack of link between sleep duration and myopia. This finding contradicts a previous study conducted by Liu *et al*., which proves that out of 6042 children aged 6 to 10 years who have a habit of sleeping late (after 9:30 p.m.), there is a considerably increased likelihood of developing myopia. The American Academy of Sleep Medicine has issued a consensus recommendation stating that children between the ages of 6 to 9 should get at least 9 hours of sleep (Sheppard, 2016). Sleeping late may cause prolonged exposure to artificial lights. During the evening, when a child is indoors, there is a strong probability that they may engage in activities that are focused on objects or displays that are close to them, such as reading or using digital devices (Liu *et al*., 2020)

Contrary with a study performed by Anandita *et al*., there was no correlation found between outdoor activities and the occurrence of myopia. Outdoor activities are believed to be a beneficial element in preventing myopia, as the high light intensity triggers the retinal dopamine transmitter production. Experiments have demonstrated that this transmitter has the ability to decrease eye growth.

The American Association of Pediatrics (AAP) recommends that children aged 2 years and older should limit their daily digital screen time to a maximum of 2 hours. This includes activities such as using a mobile phone, watching television, using a laptop, or staring at a computer screen (Irawati *et al*.,2022). Digital eye strain is a common problem associated with the use of outdated digital gadgets. It is characterized by symptoms like dry eyes, itching, sensation of foreign objects, wetness, impaired vision, and headaches (Sheppard, 2016).

4. CONCLUSION

Heredity is a well-established risk factor for myopia. This literature review presents evidence supporting the positive correlation between a family's medical history and the prevalence of myopia in children. Some possible explanation for the discrepancy in our study findings could be attributed to the limited sample size and the varying interpretation of the

term “time spent outdoors”. Some described it as sport activities, while others associated it with any general activities spent outdoors.

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