

# The relationship between parental risk factors with degree of severity in myopia



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## ABSTRACT

**Background:** Myopia is one of the numerous visual problems that continue to increase in incidence throughout the world. Various genetic and environmental factors are thought to influence the onset of myopia. Myopia is known to have a significant impact on the economy, vision problems, and a decrease in quality of life so that it needs serious attention. This study aims to explore the relationship between parental risk factors with degree severity of myopia.

**Methods:** This study is an analytic observational study research design. The population of this study are patients diagnosed with myopia in the Ophthalmology Outpatient Clinic of Dr. Soetomo General Academic Hospital, Surabaya, Indonesia. Patients who met the inclusion and exclusion criteria were included as samples. Data are gathered through medical records and by questionnaire, this includes age and spherical equivalent (SE) in right eye or left eye. Degree of severity was classified based on SE. Myopia's degree of severity and parental history are then analyzed to determine the relationship.

**Results:** A total 72 patients were included in this study. The majority of participants have a familial history of parental myopia. The degree of severity with the highest frequency is low myopia. The results of statistical tests showed that there was no relationship between history of parental myopia and the severity of myopia in the right eye (RE) ( $p$ -value = 0.712) and the severity of myopia in the left eye (LE) ( $p$ -value = 0.565).

**Conclusion:** There was no relationship between the history of parental myopia and the severity of myopia.

**Keywords:** myopia, parental, risk factors.

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## INTRODUCTION

The most frequent factor affecting distant vision is uncorrected refractive error. Refractive errors were predicted to affect 108 million people in 2010, and they are also the second most common cause of vision loss worldwide.<sup>1</sup> Myopia continues to be one of many refractive illnesses whose prevalence is rising globally. Myopia prevalence varies between locations and ethnic groups, according to earlier studies. Myopia was found in 1.406 million people, or 22.9% of the world's population, in a research that included data from 145 investigations involving 2.1 million participants.<sup>2</sup> Myopia is thought to arise from the interaction of various genetic and environmental influences.<sup>3</sup> Various risk factors are associated with the onset of myopia, including genetic factors, nutritional factors, and environmental factors such as near work activities and outdoor activities.<sup>4-7</sup>

Myopia can be inherited genetically; myopic parents are more likely to have

myopic offspring.<sup>8</sup> The prevalence of myopia is 30%–40% in children with two myopic parents, 20%–25% in children with one myopic parent, and less than 10% in children without a myopic parent. Myopia is becoming more common due to near-work activities including writing, reading, using computers or smartphones, and playing video games.<sup>9</sup> Myopia is known to have a significant economic impact. In general, the economic burden of uncorrected refractive errors is estimated at 202 billion USD per year and most of it is caused by myopia.<sup>10</sup> In Singapore, the average annual direct cost of myopia for each Singaporean school child aged 7-9 years is estimated.<sup>11</sup> In the United States, the National Health and Nutrition Examination Survey (NHANES) reports the annual direct cost of correcting distance vision impairment due to refractive errors ranges from USD 3.9 - 7.2 billion.<sup>12</sup>

Based on research data conducted by the Indonesian Health Ministry, in 2013

there was a 0.9% prevalence of impaired visual acuity in residents aged  $\geq 6$  years in Indonesia. The Lampung region with the highest prevalence was found at 1.7%, followed by East Nusa Tenggara and West Kalimantan (1.6% each). The lowest prevalence of visual impairment was in DI Yogyakarta province (0.3%) followed by West Papua and Papua (0.4% each).<sup>13</sup> Myopia also brings other problems associated with vision. Severe myopia is known to increase the risk of pathological eye conditions such as cataracts, glaucoma, retinal detachment, and myopic macular degeneration, all of which can cause irreversible vision loss.<sup>14</sup> Myopic macular degeneration is reported to be the most prevalent and irreversible cause of blindness in some areas with a high prevalence of myopia.<sup>15</sup> Myopia-related macular degeneration causes 12.2% of visual impairment in Japan (about 200,000 people).<sup>16</sup> Myopia reduces the quality of life due to psychological, functional, and financial factors for the cosmetic needs

it causes.<sup>17</sup> Uncorrected refractive error increases difficulty in performing daily vision-related activities.<sup>18</sup>

From the research and explanation presented above, it is clear that myopia is a serious public health issue that requires attention. Prevention of myopia can be done by determining its risk factors. Departing from this, this study aims to determine the relationship between parental risk factors and the degree of severity in patients with myopia at the Ophthalmology Outpatient Clinic of Dr. Soetomo General Academic Hospital, Surabaya, between 2020-2021 to further provide the basis for myopia management and prevention.

## METHODS

### Subjects and Methods

This was an analytic observational study with a cross-sectional research design. Data for comparison tests were taken from medical records and through interviews with patients by using questionnaires; this includes age, history of parental myopia, and spherical equivalents (SE) in left eye (LE) or right eye (RE). Myopia was defined as a SE refraction of  $\leq -0.5$  diopter. Degree of severity of myopia was classified into low, moderate, and high myopia based on the SE refraction.

The population of this study were patients diagnosed with myopia in the Ophthalmology Outpatient Clinic of Dr. Soetomo General Academic Hospital, Surabaya, Indonesia. Total sampling that satisfied the inclusion and exclusion criteria within a predetermined time frame was the sampling technique used for this study. Inclusion criteria were patients diagnosed with myopia based on medical records who visited between January - December 2020. Exclusion criteria were as follows: (1) the patient is not willing to be a research subject, (2) the patient has a history of trauma, (3) Patients with a history of eye surgery, (4) patients with diabetes mellitus disorders. According to earlier research, myopia prevalence is 53.5% and precision is 22%. The sample size for this investigation was determined using the World Health Organization (WHO) sample size calculator and a formula for estimating population proportion with specified relative precision.<sup>18</sup>

$$n = Z_{1-\alpha/2}^2 \frac{1 - P}{\epsilon^2 P}$$

The minimum sample size is 71, so 72 participants were recruited.

### Statistical analysis

Statistical analysis was performed using Statistical Package for the Social Science (SPSS) 22.0 software for Windows. Data was presented with descriptive analysis for the characteristics of the research subjects. Comparison test was done using Chi-Square for ordinal and nominal data.

## RESULTS

Table 1 showed distribution of patient data by age and spherical equivalents (SE) in right eye (SE RE) and left eye (SE LE). The mean age of participants was 28.42 years old. The mean of SE RE was 3.27 and the mean of SE LE was 2.84.

Table 2 showed that the degree of severity with the highest frequency was in low myopia, both in RE (39 participants, 54.2%) and LE (37 participants, 51.4%).

According to Table 3, the mean SE RE of individuals with parental myopia history was 3.58 (95% CI), while the mean SE RE of participants with parental myopia history was 3.19 (95% CI). Participants having a history of either parental myopia in their mother or father had an average SE LE score of 3.26 (95% CI), while participants with a history of myopia in both parents had an average SE RE score of 2.65 (95% CI).

The study found no relationship between parental myopia and the degree of myopia in both the right and left eyes. Patients with myopic parents had a higher prevalence of high myopia, while patients with parents without myopia did not have high myopia. The prevalence of high myopia was 9.7% in the right eye and 6.9% in the left eye.

Normality test in table 6 shows that the age and SE LE variables are not normally distributed.

Table 7 Spearman Rho correlation test reveals that the two variables have an inverse association and a very weak correlation because the correlation coefficients (r-values) are negative, specifically -0.184 and -0.190. Additionally, a p-value of  $> 0.05$  was obtained, indicating that neither

SE RE nor SE LE are affected by age.

## DISCUSSION

In this study the results showed that the average age of the patients was 28.42 years, this was in line with research conducted by Pratiwi, et al 2018 that found most myopia disorders were young adults, ages 21 to 40 years. In adulthood myopia usually persisted and there was usually a decrease in the prevalence of myopia to hypermetropia or farsightedness in older age.<sup>19</sup> The highest frequency of myopia severity in this study was low myopia. The health awareness of individuals with mild myopia has a significant impact on the risk of severe myopia, therefore they often consult with a doctor. The close-range activity factor, prolonged near work and not consulted to a doctor, can pose a high risk of developing severe myopia.<sup>19</sup> In this study, the results showed that the average myopia of RE and LE patients was higher in participants with parental myopia. This research was in line with research conducted by Muthie et al, 2022 which shows that there were most factors of hereditary history from one parent.<sup>20</sup>

Another study conducted by Liao et al, 2019 found similar results. The study showed children with parental myopia had a longer axial length elongation and a more myopic SE at the age of 7 years led to conclude that the influence of parental myopia applies at an early age. Given that most emmetropization occurred during the preschool years, researchers concluded that parental myopia accelerated the emmetropization process thereby increasing the risk of children suffering from myopia.<sup>21</sup> Children who have parents with myopia tend to get myopia. This was due to the regeneration of genes that are passed on from parents to children, resulting in the shape of the eyeball becoming more oval and having a longer axial axis. Usually parents who experience myopia tend to apply habits that are carried out on a daily basis which result in myopia in their children.<sup>19</sup>

It was statistically shown that there was no relationship between parental myopia and severity degree, because the p-value was  $> 0.05$ . The prevalence of high myopia is 9.7% of the total study subjects and without parental myopia

**Table 1.** Distribution of patient data by age, SE RE, and SE LE

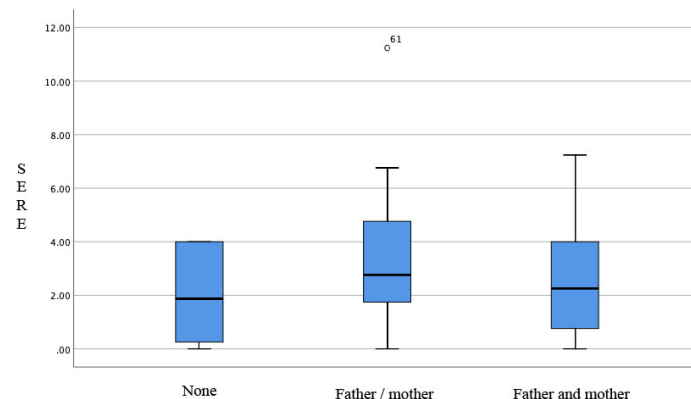
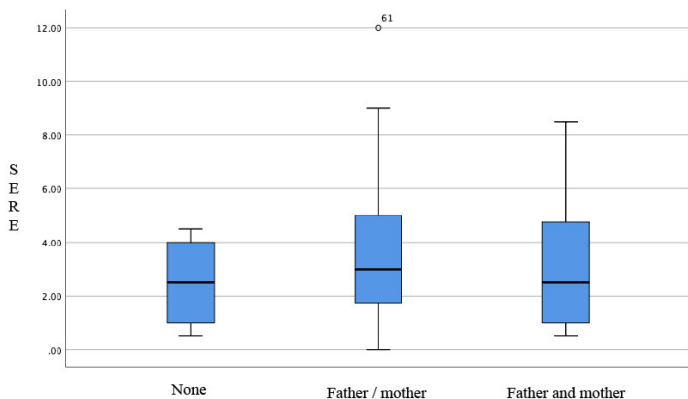
	Age	SE RE	SE LE
Mean	28.42	-3.27	-2.84
Median	29.00	-2.88	-2.25
Standard deviation	5.49	-2.44	-2.17
Minimum	8.00	0.00	0.00
Maximum	41.00	-12.00	-11.25

**Table 2.** Distribution of myopia severity degrees

Degrees	RE		LE	
	N	percentage (%)	n	percentage (%)
Without myopia	1	1.4	6	8.3
Low myopia	39	54.2	37	51.4
Moderate myopia	25	34.7	24	33.3
High myopia	7	9.7	5	6.9
Total	72	100	72	100

**Table 3.** Distribution of SE RE and SE LE based on parental myopia

SE	Parental myopia	Mean	95% CI for mean		Median	Minimum	Maximum
			Lower bound	Upper bound			
RE	None	2.48	1.37	3.58	2.50	0.50	4.50
	Father/mother	3.58	2.65	4.51	3.00	0.00	12.00
	Father and mother	3.19	2.25	4.14	2.50	0.50	8.50
LE	None	1.98	0.74	3.21	1.88	0.00	4.00
	Father/mother	3.27	2.47	4.08	2.75	0.00	11.25
	Father and mother	2.65	1.85	3.46	2.25	0.00	7.25



**Figure 1.** Box plot of SE RE based on parental myopia.

**Figure 2.** Box plot of SE LE based on parental myopia.

**Table 4.** Relationship of parental myopia and severity degree in RE

Parental myopia	Severity degree of myopia in RE					p-value
	Without myopia	Low myopia	Moderate myopia	High myopia	Total	
None	0 0%	6 8.3%	4 5.6%	0 0%	10 13.9%	0.712
Father/mother	1 1.4%	16 22.2%	13 18.1%	3 4.2%	33 45.8%	
Father and mother	0 0%	17 23.6%	8 11.1%	4 5.6%	29 40.3%	
Total	1 1.4%	39 54.2%	25 34.7%	7 9.7%	72 100%	

0%, single parental myopia 4.2%, both parental myopia 5.6%. Parental myopia with one or both parents has a role in high myopia. The results of this study were in line with research conducted by Xiang et al, 2012 showing that there was no significant relationship between a history of myopia in parents and myopia in children.<sup>22</sup> The myopia status of parents has little impact on the development of myopia in children, because children with single parental myopia and both parental myopia were 30% and 21% more likely to become myopia, compared to those without parental myopia, at the age of 15 years.<sup>22</sup> An important risk factor for myopia was heredity. Myopia parents tend to have myopia children. If both

parents are myopia, the child's risk of developing myopia will be even greater. The prevalence of myopia is 33-60% in children with both myopia parents. In children who have one of myopia parents the prevalence is 23-40% and only 6-15% of children have myopia who do not have myopia parents.<sup>23-24</sup> Other factors that are also known to increase the risk of myopia in previous studies include age, near work activity, lack of physical activity and lack of outdoor activity.<sup>25</sup>

There were several limitations in this study that need to be considered when generalizing results to a wider population in society. First, other variables that could affect the severity of myopia were not assessed, for example environmental factors and nutritional factors. Second, the study sample was limited to patients in the outpatient clinic of dr. Soetomo who may have similar characteristics. Third, the cross-sectional design in this study was not strong enough to assess the causal

relationship between variables. Lastly, the number of samples between each degree of severity was not the same.

## CONCLUSION

There was no relationship found between the history of parental myopia and the degree of severity in myopia. However, high myopia was only found in subjects with a history of parental myopia. Further studies were needed to support these findings.

## CONFLICT OF INTEREST

The authors affirmed that there were no conflicts of interest in this study.

## FUNDING

The authors were responsible for all research funding without obtaining financial support.

## ETHICAL CLEARANCE

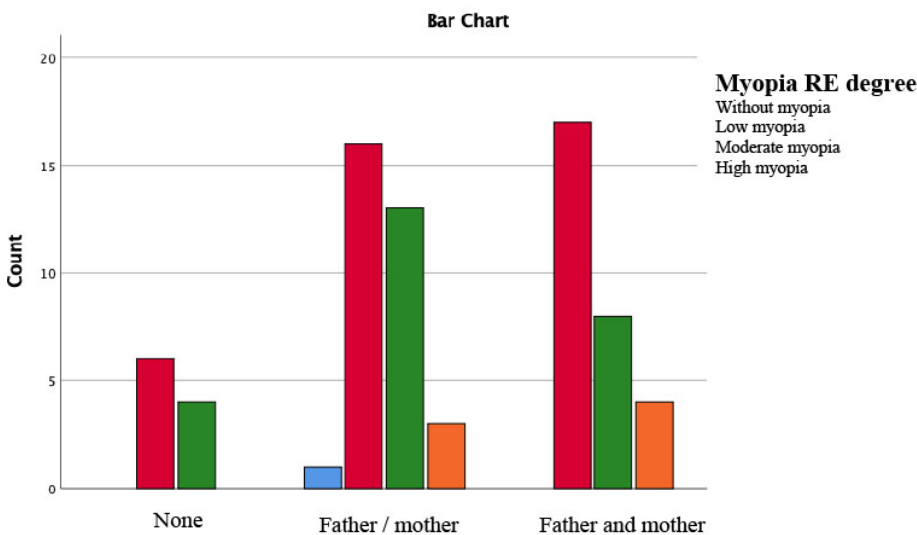
Ethical eligibility was obtained from the Health Research Ethics Committee at Dr. Soetomo General Academic Hospital with reference letter number 0483/KEPK/IX/2022.

## AUTHOR CONTRIBUTION

All authors contributed equally in this research and publication of this manuscript.

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**Figure 3.** Graph of myopia in RE degrees based on parental myopia.

**Table 5.** Relationship of parental myopia and severity degree in LE

Parental myopia	Severity Degree of Myopia in LE				Total	p-value
	Without Myopia	Low Myopia	Moderate Myopia	High Myopia		
None	2 2.8%	4 5.6%	4 5.6%	0 0%	10 13.9%	0.565
Father/mother	1 1.4%	19 26.4%	11 15.3%	2 2.8%	33 45.8%	
Father and mother	3 4.2%	14 19.4%	9 12.5%	3 4.2%	29 40.3%	
Total	6 8.3%	37 51.4%	24 33.3%	5 6.9%	72 100%	

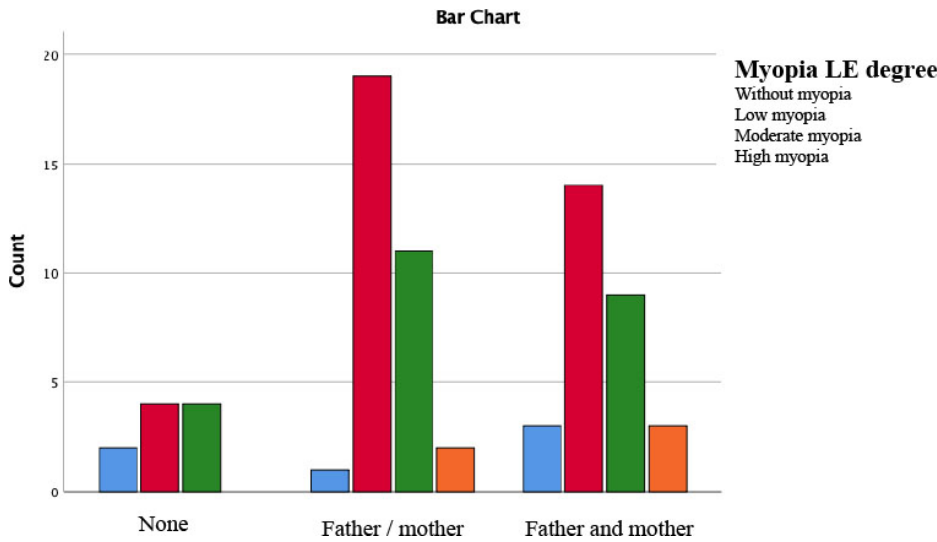


Figure 4. Graph of LE myopia degrees based on parental myopia.

Table 6. Test for normality of the age, SE RE, and SE LE variables

Variable	p-value	Description
Age	0.000	Not normally distributed
SE RE	0.061	Normal distribution
SE LE	0.010	Not normally distributed

Table 7. Spearman Rho correlation test of age with SE RE and SE LE

Variable	r-value	p-value	Description
SE RE	-0.184	0.122	No significant
SE LE	-0.190	0.111	No significant

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