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ORIGINAL ARTICLE

# Genetic factor, short-distance activity, and myopia among medical students

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**ABSTRACT**

Myopia, a common refractive error, has seen a significant global increase, particularly among young adults. This study aims to investigate the association between genetic factors, short-distance activity, and the incidence of myopia among medical students. A cross-sectional survey design was employed to collect data from medical students in batches 2022 and 2023. Chi-square tests were used to analyze the relationship between the variables. Demographic data revealed a predominantly young female population, with a high proportion of students enrolled in the 2023 academic year. A significant number of students were diagnosed with myopia, ranging from low to high degrees. Risk factor analysis indicated a strong association between reduced short-distance activity and increased myopia risk. Additionally, a family history of myopia emerged as a significant genetic predisposition to the condition. These findings highlight the importance of addressing both environmental and genetic factors to prevent and manage myopia among medical students. Future longitudinal studies with larger sample sizes are needed to further explore the temporal relationship between risk factors and myopia progression.

**Keywords:** myopia, refractive error, short-distance activity, genetic factors

## Introduction

The eye is one of the most vital sensory organs in human life. Through the eyes, humans perceive visual information, which is essential for daily activities. Impaired visual function can significantly diminish an individual's performance in various tasks.[1] A multitude of diseases can affect human vision, including myopia, hypermetropia, astigmatism, presbyopia, cataracts, glaucoma, retinopathy, and others. The onset of these diseases can hinder the eye's function and limit the intake of visual information. One common ocular disorder that causes a decline in visual acuity worldwide is refractive error.[2,3]

Myopia is a refractive error wherein parallel light rays from an object are focused in front of the retina of an unaccommodated eye. Based on its severity, myopia can be categorized into low, moderate, and high myopia.[4,5] Patients with high myopia are at a higher risk of developing retinal detachment, chorioretinal atrophy, lacquer cracks, and other abnormalities. Refractive errors are the second leading cause of preventable blindness.[6,7] Emerging evidence indicates a significant global increase in myopia. Recent studies estimate that 30% of the world's population is currently myopic, with projections suggesting that nearly 50% (5 billion individuals) will be affected by 2050.[8]

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Myopia development is influenced by both genetic and environmental factors. Parental myopia is a strong risk factor, with children of myopic parents having 2-5 times higher risk.[9,10] Environmental factors play a significant role, particularly in the recent increase of myopia prevalence in East and Southeast Asia.[11] Education is a major risk factor, with intensive schooling and near work associated with increased myopia risk.[9,11] Conversely, increased time spent outdoors (>40 min/day) has been shown to reduce myopia incidence.[9,10] Other potential risk factors include ethnicity, gender, and urbanization, though evidence is mixed for some of these (Lança, 2022).[12]

Myopia prevalence among medical students is high, ranging from 47% to 50%.[13,14] Several risk factors contribute to myopia development in this population. Genetic predisposition plays a significant role, with 66.39-80% of myopic students reporting a positive family history.[13,15] Prolonged near-work activities, including extended reading hours and increased screen time, are associated with myopia.[16] Medical students spend considerable time on electronic devices, with 64.2% using them for more than an hour daily. Academic achievement and career-related activities also correlate with myopia prevalence.[15,16] Interestingly, 56.3% of students reported worsening myopia during medical studies. Despite these findings, only 21% of students were aware of myopia risk factors, highlighting the need for increased awareness and preventive measures among medical students.[14] This study will investigate the association between genetic factors, short-distance activity, and the incidence of myopia among medical students.

## Method

This study employed a quantitative cross-sectional research design to examine the relationship between family history and short-distance activity as independent variables and the occurrence of myopia as a dependent variable among medical students at Universitas Prima Indonesia, batch 2022 and 2023. Data was collected through a survey using a questionnaire in September 2024. Data analysis was conducted using the chi-square test to examine the relationship between the research variables.

## Results

Table 1 presents demographic and ocular characteristics of 65 respondents. A majority of the respondents were female (69.2%), while 30.8% were male. Most respondents were in the 20-year-old age group (41.5%), followed by those aged 21 and above (47.7%). A smaller proportion was 19 years old or younger (10.8%). The majority of respondents were from the 2023 class (72.3%), with 27.7% from the 2022 class. A significant number of respondents had a low level of myopia (0-3 diopters) at 61.5%. Approximately one-third had moderate myopia (4-6 diopters), and a small percentage (3.1%) had high myopia (>6 diopters). Nearly half of the respondents (49.2%) had undergone an eye examination by an optometrist or ophthalmologist, while the rest had not. The majority of respondents spent 5-10 hours per day on short-distance activities (40%), followed by less than 5 hours (35.4%) and more than 10 hours (24.6%). A substantial proportion of respondents had a family history of myopia (80%), indicating a potential genetic predisposition. A significant number of respondents were diagnosed with myopia (67.7%), while 32.3% did not have myopia. In summary, the table provides insights into the demographic and ocular characteristics of the study participants, highlighting the prevalence of myopia and related factors among the respondents.

Table 2 provides insights into the relationship between specific risk factors, visual status (normal or myopic), and their statistical significance (p-value). Students who spent less than 5 hours on short-distance activities had a higher percentage of myopia (45.5%) compared to those who spent 5-10 hours (43.1%) or more than 10 hours (11.4%). This trend is statistically significant ($p = 0.001$), suggesting a strong association between reduced short-distance activity and increased myopia risk.

Students with parents who had myopia were significantly more likely to develop myopia themselves. A staggering 97.7% of students with a family history of myopia were myopic, compared to only 2.3% of those without a family history. This difference is highly statistically significant ($p = 0.000$), reinforcing the strong genetic influence on myopia development. Overall, the table highlights the combined impact of genetic predisposition and reduced short-distance activity on the incidence of myopia among medical students.

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Table 1. Characteristics of respondents

| Variable | n=65 | % |
|---|---|---|
| Gender | | |
| Male | 20 | 30,8 |
| Female | 45 | 69,2 |
| Age (year) | | |
| ≤ 19 | 7 | 10,8 |
| 20 | 27 | 41,5 |
| ≥ 21 | 31 | 47,7 |
| Class | | |
| 2022 | 18 | 27,7 |
| 2023 | 47 | 72,3 |
| Dioptri | | |
| 0-3 D | 40 | 61,5 |
| 4-6 D | 23 | 35,4 |
| >6 D | 2 | 3,1 |
| Have examined by an optometrist or ophthalmologist | | |
| Yes | 32 | 49,2 |
| No | 33 | 50,8 |
| Short-distance activity (hours) | | |
| < 5 | 23 | 35,4 |
| 5-10 | 26 | 40,0 |
| > 10 | 16 | 24,6 |
| Parent have myopia/genetic | | |
| Yes | 52 | 80,0 |
| No | 13 | 20,0 |
| Miopia | | |
| Yes | 44 | 67,7 |
| No | 21 | 32,3 |

Table 2. Association between genetic factors, short-distance activity, and the incidence of myopia among medical students

| Risk factor | Visus | | | | p |
|---|---|---|---|---|---|
| | Normal | | Myopia | | |
| | n | % | n | % | |
| Short-distance activity (hours) | | | | | 0.001 |
| < 5 | 3 | 14.3 | 20 | 45.5 | |
| 5-10 | 7 | 33.3 | 19 | 43.1 | |
| > 10 | 11 | 52.4 | 5 | 11.4 | |
| Parent have myopia/genetic | | | | | 0.000 |
| Yes | 9 | 42.9 | 43 | 97.7 | |
| No | 12 | 57.1 | 1 | 2.3 | |

## Discussion

The study population primarily consisted of young female medical students, a demographic group known to be at increased risk for myopia. This is consistent with previous studies that have identified a higher prevalence of myopia among young adults, particularly females. A significant proportion of the study participants exhibited varying degrees of myopia. The prevalence of low, moderate, and high myopia aligns with global trends, highlighting the increasing burden of myopia.

The findings suggest a strong association between decreased time spent on near work and increased myopia risk. This is in line with the hypothesis that near work, especially in dim light, can contribute to the development of myopia. The research papers collectively suggest a significant association between near work activities and myopia in children. Increased time spent on reading, using mobile phones, and playing video

games was correlated with higher myopia prevalence.[17] Close reading distance (<30 cm) and continuous reading (>30 minutes) were independently associated with increased odds of myopia.[18] A meta-analysis found that more time spent on near work activities was associated with higher odds of myopia, with a 2% increase in myopia odds for every additional diopter-hour of near work per week.[19] Even in young children aged 4-6 years, those engaging in 3 or more hours of near-work classes outside school had higher myopia rates.[20] Additionally, reading in dim light showed a significant positive correlation with myopia prevalence.[17] These findings emphasize the potential role of near work in myopia development among student.

The substantial impact of family history on myopia development underscores the genetic predisposition to this condition. Genetic factors play a crucial role in the etiology of myopia, and identifying specific genetic markers may help in early detection and prevention. Recent research underscores the significant role of genetic factors in myopia development, with family history being a strong predictor of early-onset myopia.[21] Genetic studies have identified hundreds of genes associated with refractive error and myopia, suggesting a complex genetic architecture involving retinal signaling and eye growth mechanisms.[22] While genetics can explain up to 80% of the variance in refractive error, environmental factors also contribute to the increasing prevalence of myopia worldwide.[22,23] Lifestyle factors, such as screen time and physical inactivity, can exacerbate myopia risk, particularly in genetically susceptible individuals (Ba & Li, 2024). However, proactive lifestyle modifications, especially increasing outdoor activity, may help prevent myopia development.[24] As our understanding of myopia's genetic basis improves, it may lead to better early detection and prevention strategies, although more research is needed to clarify the molecular mechanisms involved.[22,23]

While this study provides valuable insights, it is important to acknowledge its limitations. The relatively small sample size and the cross-sectional design limit the ability to draw definitive causal conclusions. Future longitudinal studies with larger sample sizes are needed to further investigate the temporal relationship between risk factors and myopia progression. In conclusion, this study highlights the significant prevalence of myopia among medical students and emphasizes the importance of addressing both environmental and genetic factors to prevent and manage this condition. Further research is warranted to explore the underlying mechanisms of myopia development and to develop effective interventions for early detection and treatment.

## Conclusion

This study investigated the prevalence of myopia and its associated risk factors among medical students. The findings reveal a significant prevalence of myopia, with a substantial proportion of students exhibiting varying degrees of myopic refractive error. Key risk factors identified include reduced short-distance activity and a family history of myopia. These findings underscore the importance of adopting preventive measures, such as regular eye exams, adequate lighting during near studying or using gadget, and sufficient outdoor time, to mitigate the progression of myopia. Future research should delve deeper into the underlying mechanisms of myopia development, explore the potential benefits of early intervention strategies, and develop innovative approaches to prevent and manage this increasingly prevalent eye condition.

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