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The Prevalence and Risk Factors Associated with Myopia among Different Ages Students of Tangail District, Bangladesh

Roksana Khanam*, Azra Shamiha Asha, Shahin Mahmud, Fatama Tous Zohora

Department of Biotechnology and Genetic Engineering, Mawlana Bhashani Science and Technology University, Tangail-1902, Bangladesh
*Corresponding author: roksanatoma@gmail.com

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Abstract In children and young adults, myopia is the leading cause of preventable blindness. Multiple epidemiological studies have confirmed that Asian countries have a high frequency of myopia. The aim of the study to determine the prevalence of myopia and to investigate factors associated with myopia/refractive error among different ages students in Bangladesh. The prevalence of myopia was measured in a cross-sectional study of 300 (three hundred) students in Tangail, Bangladesh. To investigate the relationship between different risk variables and myopia, Chi-square tests and logistic regression analysis were used. Out of total 300 students, 159 (53%) were myopic. Among the participants, 55 % were between the ages of 18 and 24 years, and there was a statistically significant relationship ($p < 0.001$). The prevalence of myopia was higher in female (58.7 % of myopic students) than male. Family history of myopia was positive in 62.9% myopic students. The sleeping hours of 36% students were < 6 hours, 6 hours in 31.3%, 7 hours in 24% and > 8 hours per day in 8.7%. There were a strong significant relationship between refractive error and insufficient time spent on outdoor activities, low light work activity, spending their time on electronic devices etc. No significant statistical relationship was found between refractive error and diabetes, steroidal medications, blood pressure, smoking, dietary intake and allergic problem. The study revealed some key determinants of myopia that will help to expand our knowledge about health and future research.

Keywords: *Bangladesh, myopia, refractive error, family history, sleeping hours*

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1. Introduction

In developed countries, myopia (nearsightedness) is the most prevalent cause of correctable visual impairment, and in developing countries, it is a leading cause of preventable blindness [1]. It is the most prevalent cause of vision loss in children [2-5], with myopia levels increasing as they become older [6]. Impaired vision as a result of uncorrected refractive error has been identified as a priority area by the World Health Organization (WHO) global initiative to eliminate avoidable blindness by 2020 [7].

Recent research suggests that the frequency of myopia is quickly increasing in many parts of the world, particularly in East and South Asia [8,9]. Myopia was shown to be prevalent in 96.5% of 19-year-old males in Seoul in 2010 [10]. In Taiwan, 86.1% of male military personnel aged 18 to 24 years had myopia in 2010–2011 [11] Myopia was shown to be prevalent in 95.5 % of university students in Shanghai [12] and 84.6% of school pupils in Shandong [13] in China. Dramatic increases were also seen in other parts of the world [14,15]. It is estimated that myopia will become a major public health challenge by 2050 and approximately 5 billion people will be affected [16].

There have been a few researches on the prevalence and risk factors of vision impairment in Bangladesh, but all were conducted more than a decade ago. A study conducted in Bangladesh found that myopia prevalence was 22.1% and hypermetropia was 20.6% [17].

However, no research has examined the general public's awareness, attitudes, and practices regarding common eye diseases, their risk factors, or their management, whether in rural or urban areas of Bangladesh. A study reported that, approximately 75% of parents were aware that vitamin A deficiency was the leading cause of childhood blindness, more than a quarter believed that eye infection was a major cause of childhood blindness, and half of the parents believed that childhood cataracts were preventable. This has significant consequences for healthcare service planning [18].

According to the literature review, a few studies on assessing early refractive errors in school-aged children

have been conducted in Bangladesh and other countries throughout the world. Bangladesh has more blind children than any other country in the world, with an estimated 1.3 million. The control of blindness in children is one of the main areas of the World Health Organization's (WHO) "Vision 2020: the right to sight" program, despite the fact that it accounts for a small percentage of total blindness. A survey done by the National Institute of Ophthalmology (NIO) in 2002 to evaluate the prevalence of blindness in Bangladesh indicated that 40,000 children (8 per 10,000 children) were blind and 1.3 million children had refractive defects. Another study was undertaken in 2002 among children aged 5 to 15 years in the Khulna district of Bangladesh, with the prevalence of refractive error estimated to be 1.1% for males and 0.95% for females, respectively, and poor vision assessed to be 0.15 %. In the same study, it was found that children between the ages of 11 and 15 had prevalence for refractive error at 1.38% and children between the ages of 5 and 10 at 0.62% [19]. The purpose of the study was to investigate the prevalence of myopia among students of different ages in Tangail district of Bangladesh. It was conducted to identify awareness, attitudes, practices, as well as risk factors associated with myopia.

2. Materials & Methods

2.1. Study Area and Data Collection

From literature review, a structured questionnaire was generated and used to conduct a descriptive, cross-sectional study. This study was done from June 2021 to September 2021 through online. The approval for conducting this study was obtained from the Institution of Mawlana Bhashani Science and Technology University under the Department of Biotechnology and Genetic Engineering.

2.2. Sampling Technique

The sample size was estimated at 300 participants. However, 159 people who were enrolled during the study period have refractive error. Students completed a semi structured questionnaire on online to assess the underlying causes. The questionnaire was divided into three sections: (1) socio-demography, (2) prevalence of myopia, and (3) risk factors associated with myopia. SPSS was used to examine the data. The frequency, percentage, mean, and standard deviation were calculated accordingly. The Chi-square test was applied and a P value of less than 0.05 was considered statistically significant.

2.3. Data Collection Tools

For collection of required information through online, a semi-structured questionnaire was created. Prior to data collection, the online Google form was pretested and updated accordingly. After data collection, 10% of the questionnaires were re-checked for data reliability and validity. The goal of the study was to identify the determinants of early refractive error among young students in both rural and urban areas along with their associated risk factors.

2.4. Statistical Analysis

IBM SPSS version 20 was used to evaluate the collected data from the survey. Using descriptive statistical analysis, population ratios were estimated with a corresponding 95% confidence interval. To determine statistical significance ($p < 0.05$), cross tabulations were used in conjunction with Chi-square testing. The association between several parameters related with refractive error was investigated using logistic regression analysis. Microsoft Excel version 2016 was used to create graphs and bar diagrams.

3. Results

3.1. Demographic Characteristics of the Study Population

Table 1 summarizes the basic characteristics of study population. A total of 300 participants (124 males and 176 females) were investigated. Myopia was shown to be common among students. The average refractive error was 1.41. Myopia affected 58.7% of females and 41.3% of males. Myopia was more common among undergraduate students, with 44.7% of them being myopic. Myopia affects 39% of myopic people between the ages of 19 and 25, 21% between the ages of 16 and 18, and 27% between the ages of 10 and 15. Out of 300 students, 154 (51.3%) had a positive family history (myopia among first blood relatives), while 146 (48.7%) had no family history. It demonstrated a highly statistically significant association.

Table 1. Demographic characteristics of the participants

Variables		N	Marginal Percentage (%)
Age	Below 18	53	17.7
	18-24	165	55.0
	25-30	62	20.7
	Above 30	20	6.7
Gender	Female	176	58.7
	Male	124	41.3
Living place	Rural	83	27.7
	Urban	217	72.3
Educational Status	Secondary	32	10.7
	Higher secondary	43	14.3
	Undergraduate	134	44.7
	Graduate	91	30.3
Have any family member who also suffer from myopia	No	146	48.7
	Yes	154	51.3

3.2. Baseline Characteristics and Prevalence of Myopia

The data comprised 300 young students on online platform. Participants' baseline characteristics were described, including age, gender, educational status, living location, low light work, daily meal intake, computer use, duration of computer/video game/television use, sleeping hours, physical activity/play outside, parents wearing spectacles, and medication.

Among all participants, 159(53%) have refractive error. Considering the 5% significance level of parents using

spectacles, medications, food intake and duration is found to be significant with refractive error. The prevalence and symptoms of myopia were summarized in Table 2. These includes have myopia, headache, visual stress, eye pain, eye redness, several eye disorders, glaucoma, blood pressure etc.

Table 2. Prevalence and symptoms of myopia

Variables		N	Marginal Percentage (%)
Have refractive error (Myopia)	No	141	47.0
	Yes	159	53.0
Suffering from headache	No	152	50.7
	Yes	148	49.3
Suffer from visual stress	No	101	33.7
	Yes	134	44.7
	Maybe	65	21.7
Suffer from eye pain	No	178	59.3
	Yes	122	40.7
Eye redness	Yes	53	17.7
	No	247	82.3
Have a severe eye injury	Yes	12	4.0
	No	271	90.3
	Maybe	17	5.7
Any other eye disorder	Yes	18	6.0
	No	282	94.0
Have glaucoma	Yes	35	11.7
	No	265	88.3
Have high blood pressure	Yes	23	7.7
	No	277	92.3

3.3. Factors Associated with Myopia

3.3.1. Interaction of Refractive Error and Age

Age is considered to be a continuous variable and a bar chart related to age and refractive error is made. Figure 1 (bar chart for age) shows that younger students (18-24) are more affected by refractive error compared to the age of above.

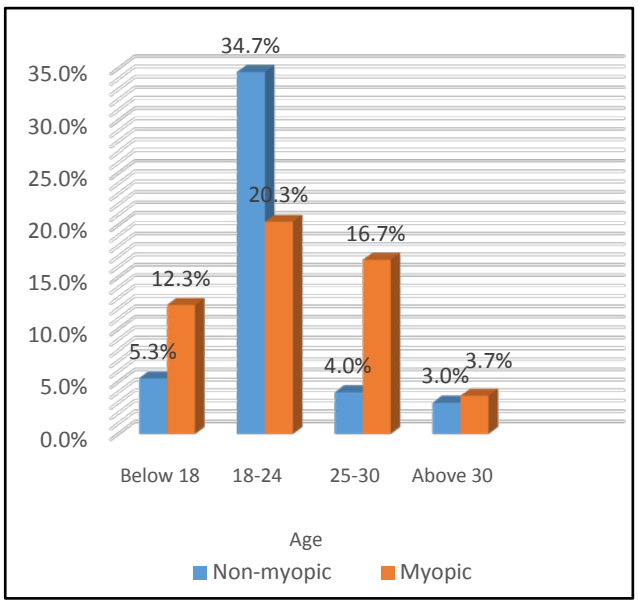

Figure 1. Graphical representation of the association between myopia and age

3.3.2. Gender: Males vs. Females

Females had a higher prevalence of total myopia than males when comparing genders. In all, 30.0% of female students (mean = 1.51±.501) and 23.0% of male students (mean = 1.56 ±.499) were myopic.

3.3.3. Relationship between Myopia and Educational Level

Myopia was found to be strongly linked to educational status (Table 3). Graduate students (P <0.05) and undergraduate students (Chi square value, 15.234 and P<0.05) had a considerably increased risk of myopia than those with lesser academic achievement (≤ high school graduation). Myopia was more common among undergraduate students, with 31.0% of students being myopic (Figure 2).

Table 3. Regression analysis on risk factors associated with myopia

Variables	OR	95% CI		Chi-Square	Sig. (P value)
		Lower bound	Upper Bound		
Age	1.100	0.943	1.283	42.089	<0.001***
Educational Status	2.563	0.436	1.230	20.164	<0.001***
Visual stress	0.919	2.377	1.534	12.744	.002**
Sleeping hour	1.072	1.341	0.645	19.483	<0.001***
Family member suffer from myopia	2.731	1.710	4.359	18.095	<0.001***
Diabetes	4.101	0.838	20.017	3.528	.060
Smoke	1.145	0.561	2.339	.321	.571
Allergy	1.327	2.091	0.842	.763	.382
Glaucoma	2.076	4.296	1.003	10.092	0.046*

*CI=Confidence Interval *OR=Odd Ratios, *p<0.05, **p<0.01, ***p<0.001.

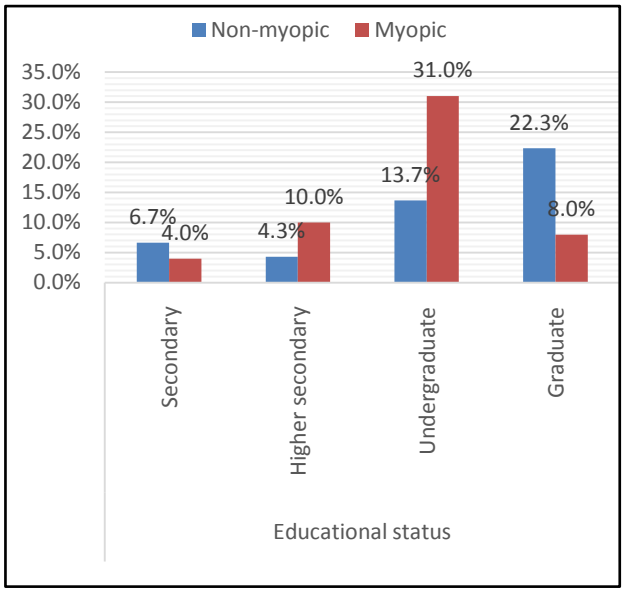

Figure 2. Graphical representation of the link between myopia and educational level

3.3.4. Prevalence of the Myopia Development in Students based on Age of Onset

Among all myopic students, Figure 3 reveals that 27%, 21%, 39% and 13% of the myopias developed at the age of 10-15 years, 16-18 years, 19-25 and the age of above 25 respectively.

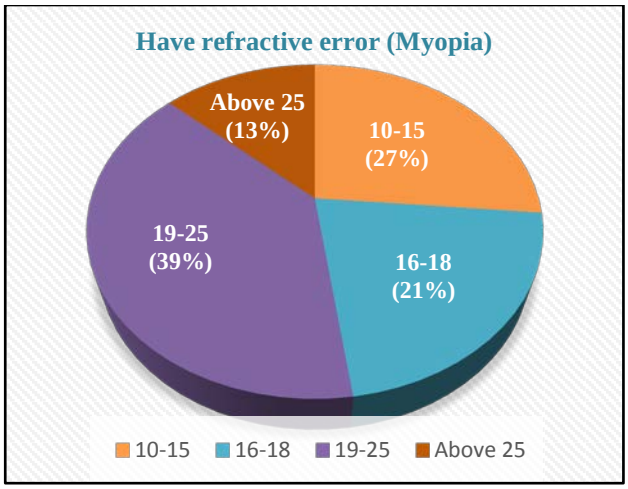

Figure 3. Development of myopia according to age onset

3.3.5. Relationship between Myopia and Sleeping Hours

Myopia was significantly associated with sleeping hours (Figure 4). If the sleeping period below 6 hours the myopia prevalence were very high (Chi square value 19.483 and p <0.001) and this factor was statistically significant.

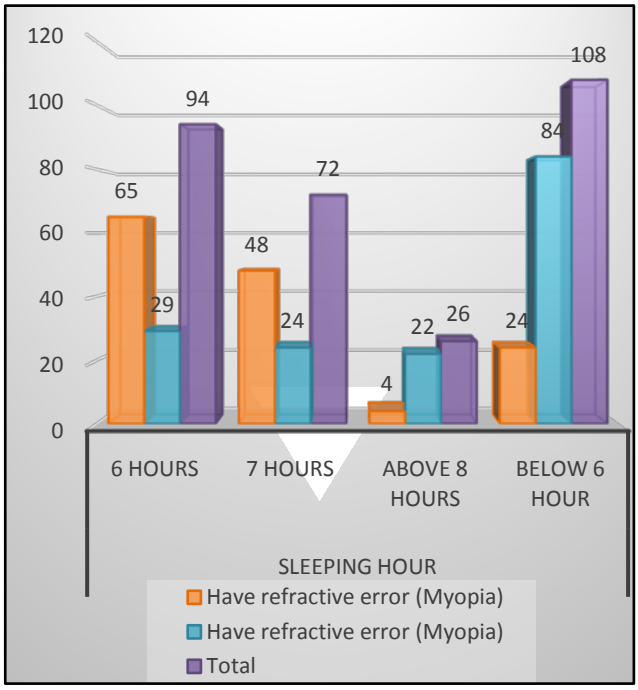

Figure 4. Graphical representation of relationship between myopia and sleeping hours

Table 4. Knowledge and attitude towards myopia

Variables		N	Marginal Percentage (%)
Have you heard about Myopia?	Yes	61	23.9
	No	194	76.1
Are you concerned about the long term effect of myopia?	May be	49	19.2
	No	60	23.5
	Yes	146	57.3
Permanently wearing spectacles	Yes	86	33.7
	No	169	66.3
Outside, wear sunglasses	Yes	73	28.6
	No	182	71.4

Table 5. Daily life activities towards myopia development

Characteristics		N	Marginal Percentage (%)
Sleeping hours	6 hours	94	31.3
	7 hours	72	24.0
	Above 8 hours	26	8.7
	Below 6 hours	108	36.0
Low light work	Yes	97	32.3
	No	203	67.7
Take certain steroid medication	Yes	64	21.3
	No	236	78.7
Insufficient time spent on outdoor activities	Yes	129	43.0
	No	171	57.0
Spending too much time on electronic devices	May be	43	14.3
	Yes	186	62.0
	No	71	23.7

Table 4 shows the participants' knowledge and attitudes about myopia. Table 5 summarizes daily living activities that contribute to myopia development (sleeping hours, outdoor activities, amount of time spent with electronic devices, and so on).

3.4. Association of Myopia with Other Significant Factors

The genetic factor was found in 33.3% of myopics (Figure 5) (P <0.05). In myopics, the average amount of near work was significantly higher than in non-myopics. In terms of water intake, 42.3% of myopics were drink less amount of water.

The difference between daily time spent on screen (devices like, phone, computer, television) activity, low light work, wearing sunglasses by myopics and non-myopics were significant (p <0.001).

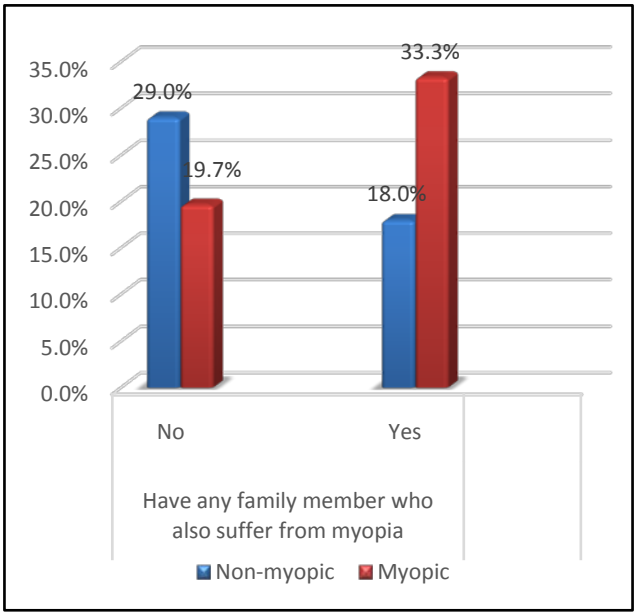

Figure 5. Graphical representation of relationship between myopia and heredity

Diabetes, steroidal drugs, smoking, food consumption, and allergy problems had no statistically significant connection (p =0.060, 0.268, 0.710, 0.223, 0.073, and 0.223 respectively) (Table 6).

Table 6. Relationship of Myopia with other significant factors

Variables	OR	95% CI		Chi-Square	Sig. (P value)
		Lower bound	Upper Bound		
High BP	0.857	0.364	2.021	0.124	0.725
Medication (steroidal)	1.366	0.785	1.5	1.225	0.268
Dietary Intake	1.072	1.341	0.645	6.968	0.073
Insufficient time spent on Outdoor Activities	2.731	1.710	4.359	27.960	<0.001***
Screen light exposure	4.101	0.838	20.017	18.220	0.01***
Low light work	0.123	0.067	0.226	53.551	<0.001***

Out of 53% myopic, 27.0% did works at low light whereas 26.0% did not work at low light (Figure 6). Similarly, out of 53% myopic, 38.3% had much time spending on devices whereas 7.0% had low time spending on devices (Figure 7) and shows significant relationship.

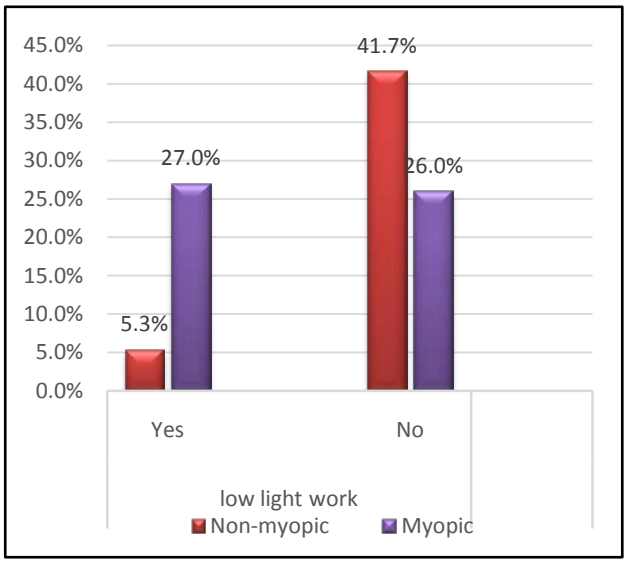

Figure 6. Graphical association between myopia and low light work

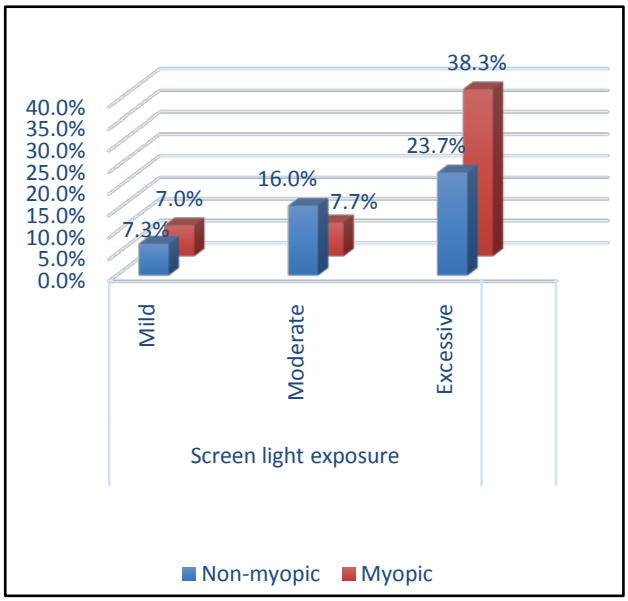

Figure 7. Graphical representation of association between myopia and screen (blue) light exposure

Similarly, the difference between myopic and non-myopic daily time spent on outdoor activities (Figure 8) was significant (p <0.001).

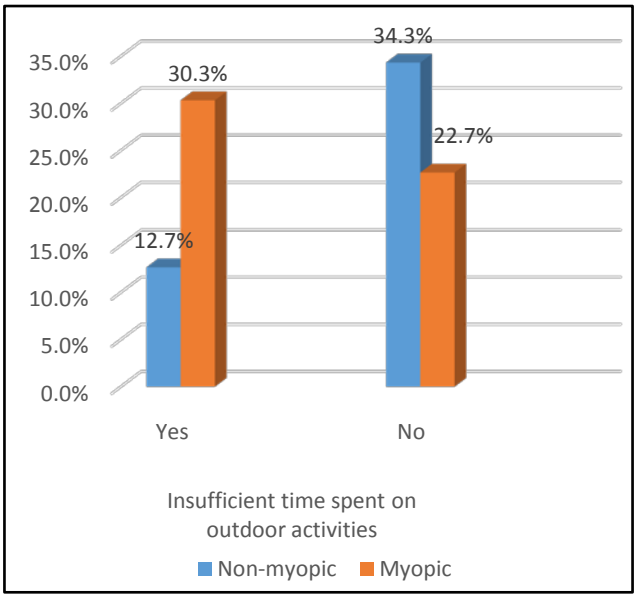

Figure 8. Graphical relationship between myopia and outdoor activities

There was a link between parental myopia and the development of myopia in children. The P value is less than 0.05 (P <0.001), indicating a meaningful association.

From this study, it shows significant association between myopia and the students who wear sunglasses regularly. Students who wear sunglasses are less likely to develop myopia (P <0.05).

4. Discussion

Several population-based surveys from different regions of the world have provided comparative data on the prevalence of myopia in young people during the last few decades. The frequency of myopia among high school students increased dramatically during the 15-year period, from 79.5 % in 2001 to 87.7 % in 2015 [20], potentially posing a severe public health hazard in the next decades.

This research was carried out on pupils who were more exposed to undertaking near activities. Myopia affected 159 (53%) of the 300 students. Differences in myopia prevalence rates among students in different nations could be due to ethnic differences and distinct genetic predispositions [21].

This study conducted on 300 different ages' students of Bangladesh, found a clear relationship between the onset of myopia and age. The age group of 18-24 years had the highest number of students with myopia 165 (55%) and the relationship was statistically significant (p < 0.001). As many as 15.3 % of myopic students who wear corrective lenses started wearing them when they were around 17 years old, showing that a high percentage of students developed myopia between the ages of 10-15 years. Myopia prevalence among 18-year-old children in Taiwan grew from 74% in 1983 to 84% in 2004 [11].

27% of myopia develops between the ages of 10-15 years, while 21% develops between the ages of 16-18 years, 39% develops between the ages of 19-25 years, and

only 13% develops after the age of 25 year. It indicates that myopia develops primarily during early adulthood, when children are still in school, and that the number of new myopia cases reported diminishes over time. That's why myopia has traditionally been thought to be a childhood problem.

There was a substantial relationship with study level between undergraduate and graduate students. Out of a total of 134 (44.7%) undergraduate students 31% being myopic. The percentage was statistically significant ($p < 0.001$), indicating that students who had just started their B.Sc. (Hons') students have a higher rate of myopia than students who started 4–5 years ago.

In comparison to their male counterparts, female students had a greater incidence rate of myopia. Myopia affected 27.8% of females and 24.3% of males in the current study. Although prevalence was higher among females than males in Bangladesh, but overall frequency of myopia in young males in Singapore grew from 79.2% in 1996–1997 to 81.6% in 2009–2010 [22]. A cross-sectional descriptive study of 2000 students in the Kathmandu valley's Bhaktapur and Lalitpur districts found that the prevalence of refractive error was 8.60%, with female students having a considerably greater frequency than male students [23].

Among 159 myopic students, 100 (62.9%) had positive family history (myopia among first blood relations), whereas 59 (37.1%) had no family history. It demonstrated a statistically significant relationship. Finally, genetic investigations have shown many loci associated with particular pathological myopia variations. As a result, the findings of this study point to a substantial familial propensity to myopia. Children with parents who wear spectacles are much more likely to have this problem, according to another study conducted in Dhaka city [23,24].

There were a strong significant relationship between refractive errors and sleeping hours, the amount of time spent doing outside activities, and the amount of time spent working in low light. There were also a substantial difference in daily time spent on electronic devices (such as- mobile, computer and television), screen activity, as well as wearing sunglasses by myopias and non-myopias was significant. No statistically significant relationship was found between refractive error and diabetes, steroidal drugs, blood pressure, smoking, food consumption, or allergy problems in this investigation. There was no link between myopia and diabetes because the whole study population consisted mostly of adult students, with only a few young students having diabetes. It can be an important factor in the development of myopia in a large population study.

5. Conclusions

Myopia is one of the most common ophthalmologic condition that is a serious public health concern around the world. The prevalence of myopia varies depending on ethnicity, region, and age group. Finally, the prevalence of myopia among young adults is significant. In Bangladesh, it is a major public health issue that permits the attention of policymakers, researchers, and practitioners. Age, higher education level, more near work, such as reading and computer use, less outdoor activity, and higher level of urbanization were all found to be independent predictors of myopia in young pupils. It is strongly recommended that children get effective interventions to prevent and control myopia. Parents and educational institutes should focus on myopia in children, especially those who have a family history. Furthermore, it is also required to raise awareness in families and educational institutions about the serious consequences of myopia.

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Competing Interest

The authors have no competing interest.

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