

Some Factors Related to Refractive Errors in Students Aged 8–10 in Four Primary Schools in Hai Phong City, 2024

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ABSTRACT

Objective: To describe factors related to refractive errors in students aged 8–10 in four primary schools in Hai Phong City, 2024. **Methods:** A cross-sectional descriptive study was conducted. **Results:** The prevalence of refractive errors among students was 49.9%. Gender: Female students (OR: 1.3; 95% CI: 1.1–1.5, $p < 0.05$). Geography: Urban students (OR: 2.9; 95% CI: 2.5–3.4). Behavior: Students using computers (OR: 1.4; 95% CI: 1.2–1.7), screen time >1 hour/session (OR: 3.1; 95% CI: 2.2–4.5); TV viewing >1 hour/session (OR: 2.3; 95% CI: 1.9–2.8); electronic gaming (OR: 1.2; 95% CI: 1.01–2.4), gaming duration >1 hour/session (OR: 1.5; 95% CI: 1.2–2.0); reading >1 hour/session (OR: 1.5; 95% CI: 1.1–1.9). Family history: Students with a family history of refractive errors (OR: 1.8; 95% CI: 1.5–2.1). Parental knowledge: Parents with good knowledge about refractive errors (OR: 1.5; 95% CI: 1.2–1.9).

Keywords: Refractive errors, primary school students.

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INTRODUCTION

Refractive errors are a significant concern due to their impact on public health. Severe refractive errors can lead to complications such as vitreous opacity, cataracts, glaucoma, and amblyopia, which may result in blindness [5]. Additionally, the costs associated with treating refractive errors place a burden on families and society. Therefore, the World Health Organization (WHO) included refractive errors among the top five priorities in its "Vision 2020" global initiative to prevent blindness [6].

Primary school students are at a critical stage of early education when visual organs are still developing. Early detection of visual impairments, including refractive errors, is crucial for preserving visual function. Many domestic and international studies have explored the refractive errors and their risk factors in school-aged

children[1],[4],[7]. However, research on refractive errors in primary school students, particularly comparisons between urban and rural areas, remains limited. With the rapid expansion of information technology and the increased use of digital devices during the COVID-19 pandemic, questions arise about which the related factors to refractive errors among primary school students? This study, titled "Some Factors Related to Refractive Errors in Students Aged 8–10 in Four Primary Schools in Hai Phong City, 2024," aims to describe factors associated with refractive errors in this population.

METHODS

Research Design

A cross-sectional descriptive study design was conducted on 3113 primary students in two urban and two rural primary schools in Hai Phong City from October 2023 to October 2024.

The sample size was calculated using the formula to estimate the prevalence of a condition in a population:

$$n = Z_{1-\alpha/2}^2 \frac{p(1-p)}{d^2} \times DE$$

Target Population: Primary school students aged 8–10 years, corresponding to Grades 3, 4, and 5. **Inclusion Criteria:** Students enrolled in selected classes. **Exclusion Criteria:** Students with congenital eye abnormalities. Students absent during the eye examination and data collection.

Research variables

The study utilized the following tools: **Vision Examination Form:** Capturing personal information of students and their refractive conditions (myopia, hyperopia, astigmatism). **Parent Interview Form:** Recording demographic information (age, gender) and assessing parental knowledge about refractive errors, including symptoms, causes, bad habits, and treatment methods. It also collected information on the child's behaviors and lifestyle, such as independent study at home, TV watching, electronic gaming, reading, outdoor activities, and near-vision tasks.

Datacollection method

The study population comprised primary schools in Hai Phong City, categorized into two geographic areas: urban and rural. According to the educational statistics for the 2023–2024 school year, Hai Phong City had a total of 230 primary schools, with 88 in urban districts and 142 in rural districts. **Step 1: Selecting Districts:** Two districts were purposefully selected: Le Chan District, located in the city center, and Kien Thuy District, situated in the southeast of the city. **Step 2: Selecting Schools:** A list of

primary schools in the urban area of Le Chan District (22 schools) and the rural area of Kien Thuy District (14 schools) was compiled. Four schools were randomly selected: two urban schools (Le Van Tam and Vo Thi Sau) and two rural schools (Nui Doi and Tu Son). **Step 3: Selecting Classes:** At each school, all students from Grades 3, 4, and 5 were included in the study. **Step 4: Selecting Student-Parent Pairs:** All students from Grades 3, 4, and 5 who met the inclusion criteria and were present during the examination were included. The study ultimately involved 3,113 student-parent pairs.

Refractive Errors: Divided into two groups: those with refractive errors and those without. Diagnosis of refractive errors is based on the vision criteria of students: Vision is measured at a distance of 5 meters using a Landolt C chart under lighting conditions of 100-300 lux. Eyes with a vision of less than 10/10, which improve after using a pinhole test, are diagnosed with refractive errors. **Classification of refractive errors:** Includes three types: myopia, hyperopia, and astigmatism. **Myopia** [9], [10]: The eye is considered myopic when the refractive measurement (SE) is -0.50D or higher. The severity is classified as: Mild myopia: < -3.00D. Moderate myopia: -3.00D to -6.00D. High myopia: > -6.00D. **Hyperopia:** The eye is considered hyperopic when the refractive measurement after cycloplegia (SE) is +0.50D or higher. The severity is classified as: Mild hyperopia: ≤ +2.00D. Moderate hyperopia: +2.25D to +5.00D. High hyperopia: > +5.00D. **Astigmatism:** The eye is considered astigmatic when the refractive measurement has a cylinder of 0.75D or higher. The severity is classified as: Mild astigmatism: < 1.00D. Moderate

astigmatism: 1.00D to 2.00D. High astigmatism: 2.25D to 3.00D, very high astigmatism: > 3.00D.

Data were entered using Epidata 3.0 software and subsequently cleaned, managed, and analyzed using SPSS 22.0.

Statistical Analysis

RESULTS

The prevalence of refractive errors among primary school students is 49.9%.

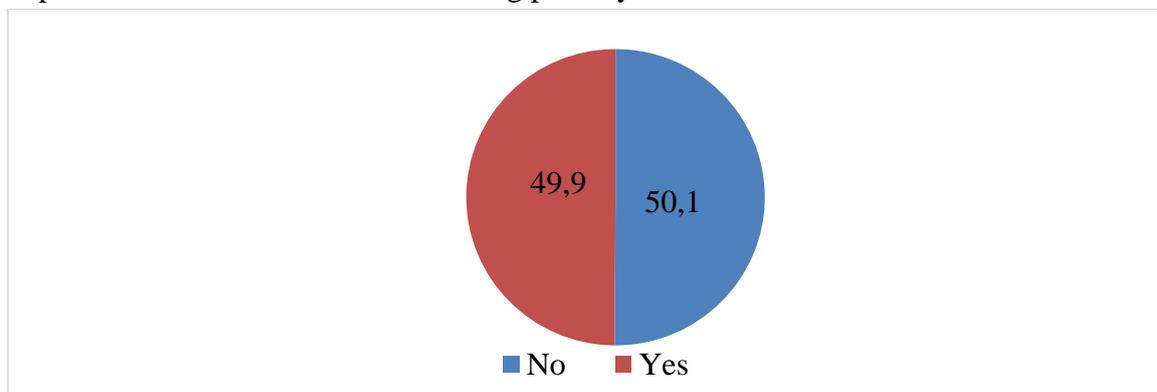


Figure 1. Prevalence of Refractive Errors Among Primary School Students (n = 3,113)

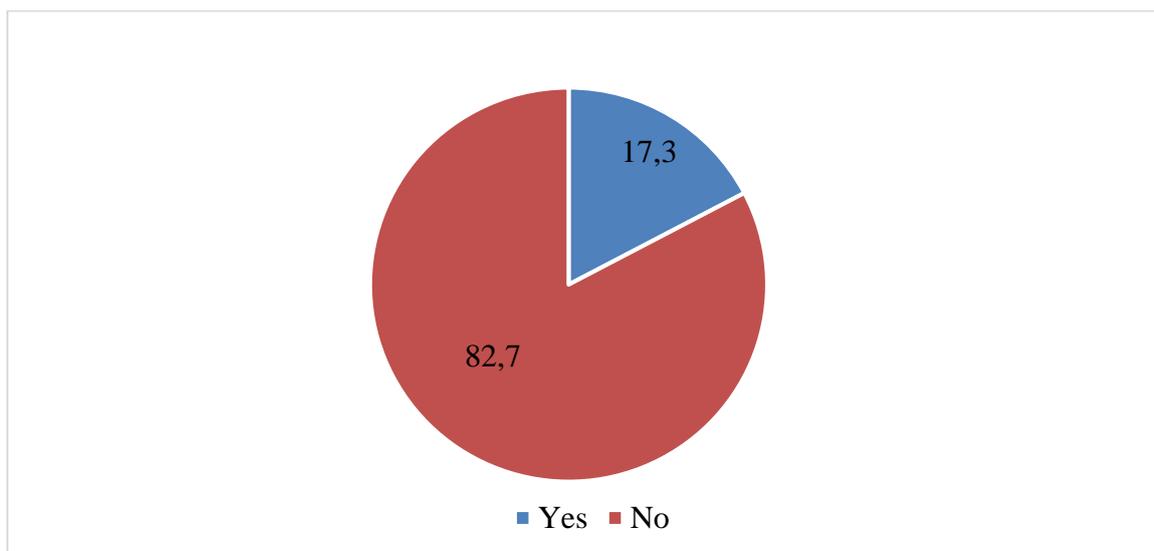


Figure 2. Parental Knowledge About Refractive Errors (n = 3,113)

Only 17.3% of parents have knowledge about refractive errors.

Table 1. Factors Related to Refractive Errors

RE Variables	Yes n (%)	No n (%)	OR (95%CI)	P
Gender				
Female	770 (53,4)	672 (46,6)	1,3(1,1 – 1,5)	0,02
Male	783 (46,9)	888 (53,1)		
Grade level				

Grade 3	504 (47,5)	556 (52,5)	1	
Grade 4	465 (48,9)	485 (51,1)	0,9(0,8 – 1,2)	0,7
Grade 5	584 (52,9)	519 (50,1)	1,0(0,8 – 1,2)	0,8
Geographical Factors				
Urban	1238 (58,7)	871 (41,3)	3,0(2,5 – 3,6)	< 0,01
Rural	315 (31,4)	689 (68,6)		
Self study at home				
Yes	923 (51,7)	861 (48,3)	1,2(0,8 – 1,6)	0,2
No	630 (47,4)	699 (52,6)		
Computer use				
Yes	592 (53,3)	592 (53,3)	1,4(1,2 – 1,7)	< 0,01
No	961 (48,0)	961 (48,0)		
Computer use duration > 1 hour/session				
Yes	284 (80,2)	70 (19,8)	3,1 (2,2 – 4,5)	< 0,01
No	1269 (46,0)	1490 (54,0)		
TV viewing >1 hour/session				
Yes	786 (65,5)	414 (34,5)	2,3(1,9 – 2,8)	< 0,01
No	767 (40,1)	1146 (59,9)		
Video game				
Yes	752 (52,0)	695 (48,0)	1,2	0,03
No	801 (48,1)	865 (51,9)	(1,01 – 1,4)	
Video game duration >1 hour/session				
Yes	350 (67,7)	167 (32,3)	1,5(1,2 – 2,0)	< 0,01
No	1203 (46,3)	1393 (53,7)		
Reading (n = 3113)				
Yes	957 (51,4)	906 (48,6)	1,0(0,8 – 1,2)	0,7
No	596 (47,7)	654 (52,3)		
Reading duration >1 hour/session				
Yes	244 (61,6)	152 (38,4)	1,5(1,1 – 1,9)	< 0,01
No	1309 (48,2)	1408 (51,8)		
Family history				

No errors	Refractive	684 (43,2)	901 (56,8)	1	
Unknow		149 (45,4)	179 (54,6)	1,1(0,8 – 1,4)	0,2
Refractive errors		720 (60,0)	480 (40,0)	1,7(1,4 – 1,9)	< 0,01
<i>Parental knowledge of refractive errors</i>					
Yes		319 (59,2)	220 (40,8)	1,2(1,02 – 1,5)	< 0,03
No		1234 (47,9)	1340 (52,1)		

The multivariate regression analysis identified several factors associated with refractive errors, including female gender (OR: 1.3; 95% CI: 1.1–1.5), urban residence (OR: 2.9; 95% CI: 2.4–3.4), computer use (OR: 1.4; 95% CI: 1.2–1.7), computer use duration >1 hour/session (OR: 3.1; 95% CI: 2.2–4.5), TV viewing >1 hour/session (OR: 2.3; 95% CI: 1.9–2.8), playing video games (OR: 1.2; 95% CI: 1.01–2.4), video game duration >1 hour/session (OR: 1.5; 95% CI: 1.2–2.0), reading duration >1 hour/session (OR: 1.5; 95% CI: 1.1–1.9), family history (OR: 1.7; 95% CI: 1.4–1.9), and parental knowledge of refractive errors (OR: 1.2; 95% CI: 1.02–1.5), all with statistically significant differences.

DISCUSSION

In today's society, increasing development and globalization place greater demands on individuals, leading to intensified workloads. Students face academic pressures and parental expectations for their future, resulting in high study intensity and frequent near-work activities. Prolonged visual accommodation over many hours a day has contributed to a growing prevalence of refractive errors among students. Additionally, the lack of sports playgrounds and outdoor activity spaces forces students to remain indoors. Recreational activities, such as watching TV, reading, and playing video games, further strain their eyes with near-vision tasks. The risk factors for refractive errors among students have been extensively studied by various authors and remain a topic of ongoing discussion. This study focuses on students' unfavorable habits at home, parental knowledge of refractive errors, and common student characteristics.

Gender

Female students are 1.3 times more likely to develop refractive errors than male students, with statistically significant differences ($p < 0.05$). Multivariate regression analysis found female gender to be a significant factor (OR: 1.3; 95% CI: 1.1–1.5). A study by Bersabeh Besufikad in South Wollo, Ethiopia, found women were nearly four times more affected than men (aOR: 3.9; $p = 0.001$), with this pattern observed across all age groups [6]. Similarly, Hassan Hashemi's research indicated that myopia increased by 20% annually in girls, while no significant change was observed in boys. The study also highlighted a significant interaction between outdoor activities and gender concerning hyperopia prevalence. Increased outdoor activities reduced hyperopia risk in girls but showed no correlation in boys [7].

Grade Level

Fifth-grade students were 1.2 times more likely to have refractive errors than third-grade students, though the difference was not statistically significant ($p < 0.05$). Our findings align with other studies domestically and internationally. For instance, Trinh

Quang Trí's research found that the prevalence of refractive errors among Khmer ethnic primary students increased with grade level ($p < 0.001$) [8]. Similarly, Trần Tất Thắng et al. (2022) in three primary schools in District 1, Ho Chi Minh City, reported higher myopia rates in grades 4 and 5 [9]. Ainagul Mukazhanova's research, through adjusted multivariate regression analysis, identified higher grade levels as significant predictors of myopia: grade 5 (OR 1.78; 95% CI 1.26–2.52) and grade 9 (OR 3.34; 95% CI 2.31–4.82) [10].

Geographical Factors

Our study reveals that urban students are 3.1 times more likely to develop refractive errors than rural students, a statistically significant difference with $p < 0.05$. Multivariate regression analysis shows a geographical odds ratio (OR) of 2.9 (95% CI: 2.5–3.4). These results align with previous studies, which also indicate a higher prevalence of refractive errors in urban areas than in rural areas. According to Hoàng Hữu Khôi, the higher prevalence of refractive errors among urban students suggests that environmental and behavioral factors play a significant role. Urban students often face intense academic pressure, higher parental expectations, and extended periods of near work, such as studying at school, attending extra classes, and engaging in activities like gaming, internet use, and reading. In contrast, rural students experience less academic pressure and participate more in outdoor activities, which relax the eyes and reduce strain, thereby lowering the risk of refractive errors [11].

Behavioral Factors

Our study identified behavioral risk factors among students, such as computer use, which increased the likelihood of refractive errors by 1.2 times compared to those who did not

use computers. The difference is statistically significant ($p < 0.05$). Students who played video games were 1.1 times more likely to develop refractive errors than non-gamers, and students who read books were 1.2 times more likely to develop refractive errors than those who did not read books ($p < 0.05$). Several studies have highlighted the relationship between near-work activities and myopia. For example, in Australia, Jenny M. and colleagues studied the link between near-work activities and myopia in 12-year-old students, finding that children who read for over 30 minutes daily were at a higher risk of myopia. Similarly, Ainagul Mukazhanova's study found that myopic children spent significantly more time on screens than non-myopic children (OR: 2.29; 95% CI: 1.54–3.42) [10]. Hoàng Hữu Khôi's research revealed that 43.4% of students with refractive errors exhibited poor behavioral habits, while only 26.8% of those with refractive errors had good behavioral habits, a statistically significant difference with $p < 0.001$ [11]. Bùi Thanh Quyên's study identified several behavioral risk factors, such as TV watching and gaming, which led to a refractive error prevalence of 25.3% among students compared to 18.0% among those who did not engage in these activities (OR: 1.5; 95% CI: 1.2–1.8; $p < 0.001$). Students who frequently played video games had a refractive error rate of 27.2%, significantly higher than the 11.8% rate among non-gamers. Video gamers were 2.7 times more likely to develop refractive errors than non-gamers (OR: 2.7; 95% CI: 2.3–3.4; $p < 0.001$) [12]. According to James Loughman, frequent and prolonged exposure to digital devices is one of the causes of the increasing prevalence of myopia [13]. Excessive near-work activities, such as studying, working, entertainment, gaming,

and TV watching, have significantly contributed to the rapid rise in refractive errors among students. Despite widespread awareness through media, teachers, and parents about the risks of these behaviors, the prevalence of risky behaviors among students remains high. Our research found a strong link between refractive errors and behaviors such as using computers, watching TV, reading books, and gaming for more than 1 hour at a time: Computer use > 1 hour/session: OR = 3.1 (95% CI: 2.2–4.5). TV watching > 1 hour/session: OR = 2.3 (95% CI: 1.9–2.8). Gaming > 1 hour/session: OR = 1.5 (95% CI: 1.2–2.0). Reading books > 1 hour/session: OR = 1.5 (95% CI: 1.1–1.9). These results align with numerous studies showing that continuous near-work activities, such as reading, watching TV, and gaming, contribute to eye strain and refractive errors. For instance, Trịnh Quang Trí's research showed a higher prevalence of refractive errors among students who engaged in continuous near-work activities for ≥ 1 hour/day: Reading: OR = 2.32; $p < 0.05$. TV watching: OR = 1.87; $p < 0.05$. Gaming: OR = 1.68; $p < 0.05$ [14]. Nguyễn Ngọc Trâm's study in Vĩnh Long (2022) reported a significantly higher prevalence of myopia among students who watched TV continuously for over 1 hour (OR = 7.75; $p < 0.001$), used smartphones/tablets continuously for over 1 hour (OR = 15.61; $p < 0.001$), and used computers continuously for over 1 hour (OR = 14.49; $p < 0.001$) [15]. Increased outdoor activities during school breaks or at home can reduce the prevalence of refractive errors. Trịnh Quang Trí's study highlighted a higher prevalence of refractive errors among students who did not participate in outdoor activities during school breaks (OR = 1.89; $p < 0.05$) or spent less than 2 hours/day on outdoor activities at home (OR

= 2.23; $p < 0.05$) [14]. Similarly, Bùi Thanh Quyền's research in Sóc Trăng (2020) found that students who did not engage in outdoor activities had a higher risk of refractive errors than those who did (OR = 2.0; $p < 0.001$) [12]. Hồ Đức Hùng's study in Nghệ An (2020) indicated that students with less than 14 hours/week (equivalent to 2 hours/day) of outdoor activities had a higher prevalence of myopia than those with ≥ 14 hours/week of outdoor activities (OR = 1.77; $p < 0.05$) [16]. Ainagul Mukazhanova's study in Kazakhstan (2022) also found a lower prevalence of myopia among students who participated in outdoor activities [10].

Family History

Over the years, numerous studies have established that refractive errors, especially myopia, are influenced by genetic factors in addition to environmental factors. Research shows that 33% to 60% of children with myopia have both parents with myopia, compared to 23% to 40% with one parent with myopia and only 6% to 15% with neither parent having myopia [17]. Our study also found a significant association between family history and refractive errors. Students with a family history of refractive errors were 1.7 times more likely to develop refractive errors than those without such a history ($p < 0.05$).

Parental Knowledge of Refractive Errors

Parents of children with refractive errors had 1.2 times higher knowledge levels about refractive errors than parents of children without refractive errors, a statistically significant difference ($p < 0.05$). Multivariate regression analysis also showed a significant association (OR = 1.5; 95% CI: 1.2–1.9). This may be explained by the fact that parents of children with refractive errors often receive advice and actively seek information about the condition.

CONCLUSIONS

The research highlights a notable issue regarding refractive errors among students, with a prevalence rate of 49.9%. The factors associated with the risk of refractive errors include: Gender: Research indicates that gender may influence the risk, often due to behavioral or physiological differences between males and females. Habits and behaviors related to electronic device usage: Prolonged use of devices such as computers, televisions, and smartphones can cause eye strain and increase the risk of refractive errors. Time spent reading books or stories: Extended periods of reading, especially under poor lighting conditions or at inappropriate distances, also contribute to the risk. Family history: Refractive errors have a genetic component, so individuals with a family history of such conditions are at a higher risk. To mitigate these risks, it is essential to promote healthy lifestyle habits, regulate the use of electronic devices, and conduct regular eye check-ups.

RECOMMENDATIONS

For Parents: Parents should strengthen their knowledge of refractive errors to understand the causes, risk factors, and early signs of refractive errors. They should also regularly monitor and manage their children's screen time and other habits that could affect their vision. **For Students:** Students should proactively seek information and participate in discussions to enhance their understanding of good eye care habits, such as: sitting properly, ensuring adequate lighting, maintaining proper reading distance, reducing screen time, watching TV, and increasing outdoor activities. **For managers:** Develop communication programs to raise awareness and understanding of refractive errors. Establish school eye care programs,

conduct regular screening to detect and provide counseling for refractive errors. Ensure that school hygiene conditions meet the required standards. Implement regulations regarding the use of electronic devices during lessons. Create plans and prioritize interventions in areas or among students who are at high risk for refractive errors.

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