ORIGINAL ARTICLE

# Prevalence of Myopia and Pseudomyopia and Their Risk Factors in Medical and Nursing Students at Navamindradhiraj University

Chanikarn Poovichayasumlit, MD[1], Artit Khewnoparatana, MD[1]

[1] Department of Ophthalmology, Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand

**Objective:** To study the prevalence of myopia and pseudomyopia and their factors in medical and nursing students.

**Materials and Methods:** The present study was a cross-sectional study that comprised 250 students at Navamindradhiraj University, Thailand. The authors did the eye examination, including pre-cycloplegic and post-cycloplegic autorefraction, then analyzed the data using crude analysis, simple logistic regression analysis, and Multiple logistic regression analysis with SPSS. Furthermore, the authors recorded the data, such as demographics, ocular history, and the amount of time spent using various devices with a screen and paper reading.

**Results:** The prevalence of myopia and pseudomyopia were 50% and 13.6%, respectively. Myopia risk factors were older age, male gender, sleeping more than six hours and time spent using a tablet ($p<0.05$). Students with increasing age each year had a 1.70-fold increase in myopia (adjusted OR 1.79, 95% CI 1.38 to 2.31, $p<0.001$). Besides, students with a history of using artificial tears were 2.91 times more likely to have myopia than students without a history of using artificial tears. Risk factors of pseudomyopia were sleeping time less than six hours and time spent reading paper books ($p<0.05$). The outdoor activity was not associated with myopia and pseudomyopia.

**Conclusion:** The present study provides information regarding the risk factors of myopia and pseudomyopia. In addition, the present study shows that outdoor activity could not function as a protective factor against myopia.

**Keywords:** Myopia; Pseudomyopia; Medical student; Nursing student

Received 4 June 2024 | Revised 24 October 2024 | Accepted 1 November 2024

**J Med Assoc Thai 2024;107(12):994-1001**
**Website:** http://www.jmatonline.com

Myopia, or nearsightedness, is a common cause of blurred vision in teenagers and young adults, resulting from clear images falling in front of the retina. This refractive error occurs when the eyeball is too long or the cornea is overly curved, causing distant objects to appear blurry while close objects are seen clearly. Pseudomyopia, on the other hand, refers to temporary blurred vision caused by ciliary muscle spasms, which lead to excessive accommodation. This condition can be diagnosed using a cycloplegic refraction test, which reveals a change in refraction of –0.50 D before cycloplegia and less than –0.50 D after cycloplegia. Unlike true myopia, pseudomyopia is reversible, with vision typically improving once the ciliary muscle relaxes.

Studies about pseudomyopia in the population aged between 3 and 18 years old have been done. The prevalence of myopia(1,2) and pseudomyopia(2) is increasing. Myopic condition is related to both near vision and electronic device usage. The protective factor is outdoor activity(2,3). In addition, studies have shown that using electronic devices resulted in diplopia(4), comitant esotropia(5,6), and spasms of near reflex(7).

Nowadays, electronic devices are widespread among children and teenagers for educational purposes. The present study focused on the relationship between pseudomyopia, myopia, and the consumer of electronic devices, including screen time and their risk factors in university students.

## Materials and Methods

The present study was a cross-sectional study that included medical and nursing students aged 18 to 30 years and using electronic devices regularly

**Correspondence to:**
Khewnoparatana A.
Department of Ophthalmology, Vajira Hospital, Navamindradhiraj University, Bangkok 10300, Thailand.
Phone: +66-2-2443874
**Email:** iravaj@gmail.com

**How to cite this article:**
Poovichayasumlit C, Khewnoparatana A. Prevalence of Myopia and Pseudomyopia and Their Risk Factors in Medical and Nursing Students at Navamindradhiraj University. J Med Assoc Thai 2024;107:994-1001.
DOI: 10.35755/jmedassocthai.2024.12.994-1001-01054

between October 2022 and January 2023 at Vajira Hospital, Navamindradhiraj University, Thailand.

The primary objective was to determine the prevalence of myopia and pseudomyopia among medical and nursing students at Navamindradhiraj University. To estimate the sample size for the present study, the authors utilized a formula for calculating sample sizes for proportion estimation with a known population size[8]: N=1,353, $Z_{\alpha/2}$=1.96 for a significance level of α=0.05, d=0.06, p=0.5). The authors calculated that two hundred twenty-three participants were required. To account for a potential 10% non-response rate, the sample size was adjusted to 248, resulting in a final sample size of 250 participants for the study.

In the present study, the main independent variables included the duration of near-vision use, the time spent using electronic devices, and the duration of indoor and outdoor activities, while the dependent variable was visual acuity. Confounding variables that might influence the results included axial length, iris color, screen brightness of electronic devices, and the use of artificial tears. To address confounding variables, data on personal characteristics of the sample group were collected, and multivariable analysis was utilized to analyze the relationship between near vision used, electronic device usage, and the occurrence of myopia and pseudomyopia among students. The present study also considered potential biases. To reduce selection bias, a stratified random sampling method was employed to ensure that the sample adequately represented the target population. Furthermore, measurement bias was minimized by using accurate instruments for data collection. Visual acuity was assessed with the Nidek ARK 530A auto-ref keratometer (NIDEK CO., LTD, Tokyo, Japan). Intraocular pressure was measured with the iCare TA01I (iCare, Helsinki, Finland). Finally, the axial length was evaluated using the IOLMaster® (Carl Zeiss Meditec AG, Jena, Germany), with measurements conducted solely by trained ophthalmologists.

In terms of variable definitions, normal vision was characterized by visual acuity between –0.50 and +0.50 D. Pseudomyopia was defined as visual acuity less than or equal to –0.50 D before cycloplegic administration and greater than –0.50 D afterward. Mild myopia was classified as visual acuity between –0.50 and –3.00 D, while moderate myopia ranged from –3.00 to –6.00 D. High myopia was defined as visual acuity greater than –6.00 D. Finally, the average duration of near-vision use was calculated using the formula: (Weekday * 5 + Weekend * 2) / 7.

The present study included participants aged between 18 and 30 years that regularly used electronic devices, such as mobile phones, tablets, or computers for a minimum of one hour per day. However, individuals were excluded if they had any eye disorders or conditions, including amblyopia, or a history of eye surgery or ocular trauma. Additionally, participants with underlying medical conditions that could affect vision or refractive status, such as diabetes, hypertension, thyroid disorders, connective tissue diseases such as rheumatoid arthritis or systemic lupus erythematosus, Behçet's disease, or any infectious conditions like HIV, were also excluded. Participants were free to withdraw from the study at any time.

Data collection involved gathering basic information using a questionnaire, which participants completed while waiting for their eye examination at Vajira Hospital's ophthalmology department. All collected data was kept confidential and destroyed at the end of the research project, with information collected only after obtaining consent from the participants, including during the eye examination.

For data analysis, general and clinical data of the sample group were analyzed and reported using descriptive statistics, divided into two parts based on the type of data. Qualitative data, such as gender and family history, were reported as frequency distributions and percentages. Quantitative data, including age, intraocular pressure, axial length, duration of near-vision use, and visual acuity, were reported as means with standard deviations or medians with interquartile ranges (IQR) as appropriated. The prevalence of myopia and pseudomyopia among students were reported using frequency distributions and percentages, along with a 95% confidence interval (CI). The relationship between near-vision use, electronic device usage, and the occurrence of myopia and pseudomyopia was analyzed through crude analysis using the chi-squared test or Fisher's exact test, depending on the data suitability, and multivariable analysis employing multiple logistic regression analysis, reported with odds ratios (OR) and 95% CI. All data analyses were conducted using IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA), with a significance level set at 0.05. The Ethics Committee of the Faculty of Medicine Vajira Hospital, Navamindradhiraj University, approved the present study (No.178/64E, COA 174/2564, on 10 September 2021).

The authors evaluated eligible subjects by

**Table 1.** Baseline characteristics of participants

| Characteristics | |
|---|---|
| Age (years); mean±SD | 20.48±1.51 |
| Sex; n (%) | |
| Female | 221 (88.4) |
| Male | 29 (11.6) |
| Underlying disease; n (%) | 24 (9.6) |
| Allergic rhinitis | 14 (5.6) |
| Asthma | 3 (1.2) |
| Major depressive disorder | 3 (1.2) |
| Thyroid disease | 3 (1.2) |
| Others | 2 (0.8) |
| Family history of myopia; n (%) | |
| No | 245 (98.0) |
| Yes | 5 (2.0) |
| Wearing spectacles and contact lens; n (%) | |
| None | 135 (54) |
| Spectacles | 88 (35.2) |
| Contact lens | 9 (3.6) |
| Spectacles and contact lens | 18 (7.2) |
| Artificial tears; n (%) | |
| No | 228 (91.2) |
| Yes | 22 (8.8) |
| Brightness; n (%) | |
| <50% | 98 (39.2) |
| 50% | 98 (39.2) |
| >50% | 54 (21.6) |
| Daily outdoor exercise (minute/day); n (%) | |
| None | 132 (52.8) |
| <30 minutes | 66 (26.4) |
| Daily outdoor exercise (minute/day); n (%) (continued) | |
| >30 minutes | 52 (20.8) |
| Sleep duration (hours/day); median (IQR) | 7 (6 to 7) |
| <6 hours; n (%) | 59 (23.6) |
| 6 to 7 hours; n (%) | 96 (38.4) |
| >7 hours; n (%) | 95 (38) |
| Weekly time spent in near work (hours); median (IQR) | 50.5 (25 to 66) |
| <40 hours; n (%) | 94 (37.6) |
| 40 to 60 hours; n (%) | 63 (25.2) |
| >60 hours; n (%) | 93 (37.2) |
| Weekly time spent on reading book (hours); median (IQR) | 3.5 (0.4 to 14) |
| None; n (%) | 61 (24.4) |
| <10 hours; n (%) | 124 (49.6) |
| >10 hours; n (%) | 65 (26) |
| Weekly time spent on using smartphone (hours); median (IQR) | 42 (28 to 70) |
| <40 hours; n (%) | 119 (47.6) |
| 40 to 60 hours; n (%) | 60 (24) |
| >60 hours; n (%) | 71 (28.4) |
| Weekly time spent on using tablet (hours); median (IQR) | 50 (36 to 62) |
| <40 hours; n (%) | 64 (25.6) |
| 40 to 60 hours; n (%) | 108 (43.2) |
| >60 hours; n (%) | 78 (31.2) |
| Weekly time spent on using computer (hours); median (IQR) | 0 (0 to 7) |
| None; n (%) | 134 (53.6) |
| <10 hours; n (%) | 73 (29.2) |
| >10 hours; n (%) | 43 (17.2) |
| Intraocular pressure (mmHg); mean±SD | 15.63±3.02 |
| Aaxial length (mm); mean±SD | 23.96±1.24 |

SD=standard deviation; IQR=interquartile range

assessing their visual acuity, intraocular pressure, axial length, and performing automated refraction assessments. Each subject underwent axial length measurements twice. The study eye, identified as having better visual acuity, was aseptically treated with 1% Tropicamide ophthalmic solution (Mydriacyl®, Alcon®, Switzerland), administered two times, five minutes apart. After 30 minutes, a second refraction assessment was conducted on all study eyes. An ophthalmologist then performed a slit-lamp examination for a comprehensive eye assessment on all subjects. Following the examinations, participants completed a questionnaire regarding their time spent on various activities, with a focus on any adverse effects experienced at the outpatient clinic. All measurements were consistently taken using the same devices, including the Nidek ARK 530A auto-ref keratometer (NIDEK CO., LTD, Tokyo, Japan), iCare TA01I (iCare, Helsinki, Finland), and IOLMaster (Carl Zeiss Meditec AG, Jena, Germany). Safety assessments encompassed monitoring for adverse events and documenting findings from the slit-lamp examination. The primary endpoints were the prevalence of myopia and pseudomyopia in Medical and Nursing students at Navamindradhiraj University. The secondary endpoints were factors related to myopia and pseudomyopia.

## Results

The prevalence of myopia and pseudomyopia among the subjects were found to be 50% and 13.6%, respectively. The average age of participants was 20.48±1.51 years, with a majority being female at 88.4%. Underlying health conditions were reported in 9.6% of the subjects, including allergic rhinitis in 5.6%, asthma in 1.2%, major depressive disorder in 1.2%, thyroid disease in 1.2%, and other congenital diseases in 0.8%. The study also noted variations in electronic device screen brightness, with 39.2% of participants using screens at less than 50%, another 39.2% at 50%, and 21.6% at more than 50%. Regarding outdoor activity, 47.2% of students engaged in outdoor exercise, with 26.4% spending less than 30 minutes per day and 20.8% exercising for 30 minutes or more. The median sleep duration was seven hours per day (IQR 6 to 7), and most participants, or 38.4%, reported sleeping for six to seven hours daily. The mean intraocular pressure was recorded at 15.63±3.02 mmHg, and the average axial length was 23.96±1.24 mm (see Table 1).

The data collected revealed that 50% of the subjects had myopia, with a statistically significant increase in prevalence correlated with higher grade levels (chi-square test for trend, p<0.001). The mean intraocular pressures for myopic and non-myopic participants were 15.91±3.06 mmHg and 15.36±2.96 mmHg, respectively, however, this difference was not statistically significant (p=0.152). In terms of axial length, myopic subjects had an average of 24.64±1.36 mm, while non-myopic subjects had an average of 23.28±0.56 mm, with this difference being statistically significant (p<0.001).

Regarding pseudomyopia, the mean intraocular pressures were 14.74±3.48 mmHg for those with pseudomyopia and 15.78±2.92 mmHg for those without, but this difference was not statistically significant (p=0.064). Conversely, the average axial lengths differed significantly, with subjects having pseudomyopia showing an average of 23.26±0.54 mm, while those without pseudomyopia had an average of 24.07±1.29 mm (p<0.001).

The authors analyzed the relationship between personal factors, time spent on electronic devices, time spent on near-work activities, and the occurrence of myopia through crude analysis using various statistical methods, including the chi-square test, Fisher's exact test, independent samples t-test, and Mann-Whitney U test. In addition to age and gender, factors such as a history of wearing glasses or contact lenses, use of artificial tears, and sleep duration were significantly associated with myopia (p<0.05) (see Table 2).

Crude analysis also indicated that wearing glasses and contact lenses, sleep duration, and time spent reading paper were significantly related to pseudomyopia. Among the pseudomyopia samples, 17.6% wore glasses and 3.2% used contact lenses (p=0.009). Furthermore, 41.2% of those with pseudomyopia reported sleeping less than six hours per day, while non-pseudomyopic individuals typically slept six to seven hours (p=0.015). Additionally, 70.6% of those with pseudomyopia spent less than ten hours per week reading paper, compared to 46.3% of non-pseudomyopic participants (p=0.020) (see Table 3).

Univariate and simple logistic regression analyses revealed that significant factors associated with myopia included age, gender, artificial tear use, sleep duration, and tablet usage (p<0.05). Each additional year of age was associated with a 1.79-fold increase in myopia risk (adjusted OR 1.79, 95% CI 1.38 to 2.31, p<0.001). Gender differences showed that male students were 2.46 times more likely to have myopia compared to females (crude OR 2.46, 95% CI 1.07 to 5.63, p=0.034). Additionally, students who used artificial tears had a 2.91-fold higher likelihood of myopia (crude OR 2.91, 95% CI 1.10 to 7.71, p=0.031). Sleep duration was also significant with students who slept six to seven hours or more than seven hours each night had increased myopia risk by 2.51 times (crude OR 2.51, 95% CI 1.28 to 4.92, p=0.007) compared to those who slept less than six hours.

Regarding screen time, students who spent 40 to 60 hours per week on a tablet had a 0.48 times lower risk of myopia compared to those who used it for less than 40 hours per week (crude OR 0.48, 95% CI 0.25 to 0.89, p=0.021). In multivariable and multiple logistic regression analyses, age, sleep duration, and tablet usage remained significant. Age was consistently associated with higher myopic risk (adjusted OR 1.79, 95% CI 1.38 to 2.31, p<0.001). The risk also increased in those who slept six to seven hours or more than seven hours compared to those with less than six hours of sleep (adjusted OR 5.32 for 6 to 7 hours, 95% CI 2.17 to 13.04, p<0.001; adjusted OR 5.02 for more than 7 hours, 95% CI 2.04 to 12.36, p<0.001). Finally, tablet use between 40 and 60 hours per week showed a protective effect against myopia (adjusted OR 0.43, p<0.05).

## Discussion

Myopia is one of the causes of blurred vision globally, yet it is a correctable condition. The prevalence of myopia has currently increased among childhood and young adults worldwide[1,2]. The authors found that half of the subjects were myopic. Compared to a national survey in 2006 and 2014, the myopic rate was 20% and 30%[9], respectively. Moreover, the prevalence of myopia among Asian youth was higher than European, ranging from 61.0% in Anyang, China[2] to 76.67% in Taiwan[1]. Whereas among the Norwegian, myopia was 13%[3].

From the analyzed data, significant coexistence

**Table 2.** Risk factor analysis of student's behavior for myopia

| Variables | Myopia | | p-value |
|---|---|---|---|
| | Yes (n=125) | No (n=125) | |
| Age (years); mean±SD | 20.99±1.56 | 19.96±1.27 | <0.001 |
| Sex; n (%) | | | 0.030 |
| Female | 105 (84.0) | 116 (92.8) | |
| Male | 20 (16.0) | 9 (7.2) | |
| Underlying disease; n (%) | | | 0.086 |
| No | 109 (87.2) | 117 (93.6) | |
| Yes | 16 (12.8) | 8 (6.4) | |
| Family history of myopia; n (%) | | | 1.000 |
| No | 123 (98.4) | 122 (97.6) | |
| Yes | 2 (1.6) | 3 (2.4) | |
| Wearing spectacles and contact lens; n (%) | | | <0.001 |
| None | 22 (17.6) | 113 (90.4) | |
| Spectacles | 81 (64.8) | 7 (5.6) | |
| Contact lens | 5 (4.0) | 4 (3.2) | |
| Spectacles and contact lens | 17 (13.6) | 1 (0.8) | |
| Artificial tears; n (%) | | | 0.026 |
| No | 109 (87.2) | 119 (95.2) | |
| Yes | 16 (12.8) | 6 (4.8) | |
| Brightness; n (%) | | | 0.739 |
| <50% | 51 (40.8) | 47 (37.6) | |
| 50% | 46 (36.8) | 52 (41.6) | |
| >50% | 28 (22.4) | 26 (20.8) | |
| Daily outdoor exercise (minute/day); n (%) | | | 0.050 |
| None | 67 (53.6) | 65 (52.0) | |
| <30 minute | 39 (31.2) | 27 (21.6) | |
| >30 minute | 19 (15.2) | 33 (26.4) | |
| Sleep duration (hours/day); median (IQR) | 6.6 (6 to 7) | 6.6 (6 to 7) | 0.116 |
| <6 hours; n (%) | 20 (16.0) | 39 (31.2) | 0.017 |
| 6 to 7 hours; n (%) | 54 (43.2) | 42 (33.6) | |
| >7 hours; n (%) | 51 (40.8) | 44 (35.2) | |
| Weekly time spent in near work (hours); median (IQR) | 53 (26 to 65) | 50 (20 to 63) | 0.637 |
| <40 hours; n (%) | 47 (37.6) | 47 (37.6) | 0.887 |
| 40 to 60 hours; n (%) | 30 (24.0) | 33 (26.4) | |
| >60 hours; n (%) | 48 (38.4) | 45 (36.0) | |
| Weekly time spent on reading book (hours); median (IQR) | 3.5 (0 to 7) | 3.5 (0.5 to 14) | 0.626 |
| None; n (%) | 33 (26.4) | 28 (22.4) | 0.748 |
| <10 hours; n (%) | 61 (48.8) | 63 (50.4) | |
| >10 hours; n (%) | 31 (24.8) | 34 (27.2) | |
| Weekly time spent on using smartphone (hours); median (IQR) | 42 (28 to 70) | 42 (28 to 70) | 0.732 |
| <40 hours; n (%) | 58 (46.4) | 61 (48.8) | 0.904 |
| 40 to 60 hours; n (%) | 30 (24.0) | 30 (24.0) | |
| >60 hours; n (%) | 37 (29.6) | 34 (27.2) | |
| Weekly time spent on using tablet (hours); median (IQR) | 48 (34 to 62) | 50 (44 to 60) | 0.126 |
| <40 hours; n (%) | 39 (31.2) | 25 (20.0) | 0.064 |
| 40 to 60 hours; n (%) | 46 (36.8) | 62 (49.6) | |
| >60 hours; n (%) | 40 (32.0) | 38 (30.4) | |
| Weekly time spent on using computer (hours); median (IQR) | 0 (0 to 7) | 0 (0 to 6) | 0.424 |
| None; n (%) | 67 (53.6) | 67 (53.6) | 0.847 |
| <10 hours; n (%) | 35 (28.0) | 38 (30.4) | |
| >10 hours; n (%) | 23 (18.4) | 20 (16.0) | |

SD=standard deviation; IQR=interquartile range

p-value corresponds to Independent samples t-test, Mann-Whitney U test, chi-square test, or Fisher's exact test

**Table 3.** Risk factor analysis of student's behavior for pseudomyopia

| Variables | Pseudomyopia | | p-value |
|---|---|---|---|
| | Yes (n=34) | No (n=216) | |
| Age (years); mean±SD | 20.09±1.42 | 20.54±1.52 | 0.107 |
| Sex; n (%) | | | |
| Female | 31 (91.2) | 190 (88.0) | 0.776 |
| Male | 3 (8.8) | 26 (12.0) | |
| Underlying disease; n (%) | | | |
| No | 33 (97.1) | 193 (89.4) | 0.217 |
| Yes | 1 (2.9) | 23 (10.6) | |
| Family history of myopia; n (%) | | | |
| No | 34 (100) | 211 (97.7) | 1.000 |
| Yes | 0 (0.0) | 5 (2.3) | |
| Wearing spectacles and contact lens; n (%) | | | |
| None | 26 (76.5) | 109 (50.5) | 0.009 |
| Spectacles | 6 (17.6) | 82 (38.0) | |
| Contact lens | 2 (5.9) | 7 (3.2) | |
| Spectacles and contact lens | 0 (0.0) | 18 (8.3) | |
| Artificial tears; n (%) | | | |
| No | 32 (94.1) | 196 (90.7) | 0.748 |
| Yes | 2 (5.9) | 20 (9.3) | |
| Brightness; n (%) | | | |
| <50% | 17 (50.0) | 81 (37.5) | 0.382 |
| 50% | 11 (32.4) | 87 (40.3) | |
| >50% | 6 (17.6) | 48 (22.2) | |
| Daily outdoor exercise (minute/day); n (%) | | | |
| None | 15 (44.1) | 117 (54.2) | 0.521 |
| <30 minute | 10 (29.4) | 56 (25.9) | |
| >30 minute | 9 (26.5) | 43 (19.9) | |
| Sleep duration (hours/day); median (IQR) | 6.6 (6 to 7) | 6.6 (6 to 7) | 0.145 |
| <6 hours; n (%) | 14 (41.2) | 45 (20.8) | 0.015 |
| 6 to 7 hours; n (%) | 7 (20.6) | 89 (41.2) | |
| >7 hours; n (%) | 13 (38.2) | 82 (38.0) | |
| Weekly time spent in near work (hours); median (IQR) | 53 (34 to 70) | 51 (21 to 64) | 0.352 |
| <40 hours; n (%) | 10 (29.4) | 84 (38.9) | 0.312 |
| 40 to 60 hours; n (%) | 12 (35.3) | 51 (23.6) | |
| >60 hours; n (%) | 12 (35.3) | 81 (37.5) | |
| Weekly time spent on reading book (hours); median (IQR) | 3.5 (2 to 7) | 3.5 (0 to 14) | 0.621 |
| None; n (%) | 3 (8.8) | 58 (26.9) | 0.020 |
| <10 hours; n (%) | 24 (70.6) | 100 (46.3) | |
| >10 hours; n (%) | 7 (20.6) | 58 (26.9) | |
| Weekly time spent on using smartphone (hours); median (IQR) | 42 (14 to 56) | 42 (28 to 70) | 0.492 |
| <40 hours; n (%) | 16 (47.1) | 103 (47.7) | 0.158 |
| 40 to 60 hours; n (%) | 12 (35.3) | 48 (22.2) | |
| >60 hours; n (%) | 6 (17.6) | 65 (30.1) | |
| Weekly time spent on using tablet (hours); median (IQR) | 51 (44 to 60) | 50 (35.5 to 62) | 0.736 |
| <40 hours; n (%) | 6 (17.6) | 58 (26.9) | 0.140 |
| 40 to 60 hours; n (%) | 20 (58.8) | 88 (40.7) | |
| >60 hours; n (%) | 8 (23.5) | 70 (32.4) | |
| Weekly time spent on using computer (hours); median (IQR) | 0 (0 to 0.3) | 0 (0 to 7) | 0.024 |
| None; n (%) | 24 (70.6) | 110 (50.9) | 0.101 |
| <10 hours; n (%) | 6 (17.6) | 67 (31.0) | |
| >10 hours; n (%) | 4 (11.8) | 39 (18.1) | |

SD=standard deviation; IQR=interquartile range

p-value corresponds to Independent samples t-test, Mann-Whitney U test, chi-square test, or Fisher's exact test factors of myopia were wearing glasses and contact lenses, which myopia usually did. Several subjects used artificial tears because of dry eye symptoms. The present study prevalence of pseudomyopia was like the previous studies[2].

This cross-sectional study demonstrated that age, sleeping duration, and tablet usage time significantly increased the risk of myopia ($p<0.05$), apart from other studies. They found that near-work activities[10-12] and longer time spent on reading[12] affect myopia. Nevertheless, the present study needed to be indicated. The authors found no significant association between myopia and screen time on different electronic devices from the data, similar to a recent meta-analysis and systematic review[13,14].

Furthermore, the amount of screen time dedicated to near and intermediate visual activities did not show a significant association with either myopia or pseudomyopia. It is possible that some individuals with myopia may consciously reduce their screen time, which could obscure any direct relationship between screen usage and these conditions.

The present study did not agree with studies showing that spending more time outdoors reduced the risk of myopia. Nevertheless, the present study collected only outdoor exercise activity, which may differ from outdoor activities. Hagen et al. (2018)[3], Jonas et al. (2021)[13], and Lingham et al. (2021)[15] pointed out that outdoor activity is a protective factor against myopia, and Gupta et al. (2021)[16] identified an inverse relationship between outdoor activity and myopia. However, the present study focused on young adults in tropical zones, where individuals experience greater sun exposure in their daily routines. This contrasts with previous research that primarily examined children in regions with less daylight or high-latitude countries, such as those found in temperate climates.

According to Jee et al. (2016)[17] and Huang et al. (2022)[18] research, longer sleeping duration is associated with reduced myopic risk, conversely to our study. We found that higher myopia occurred in students sleeping more than six hours.

During the COVID-19 pandemic, restrictions on outdoor activities led to a significant increase in the time people spent on electronic devices, particularly for social media. With most students attending online classes and printed materials transitioning to digital formats, avoiding screen time became increasingly impractical. Myopic progression often occurs in children under 12 years old depending upon excessive axial elongation and diminishes with age. The present study recruited young adults who had been less influential.

The study's limitations include a significant gender imbalance, as a substantial proportion of the participants were female due to the predominance of female nursing students in Thailand, making up approximately 90% of the cohort. Consequently, the data collected from medical and nursing students may not accurately reflect the broader population, particularly concerning educational intensity. Additionally, the authors were unable to gather data equally across different academic levels since senior students were not allowed to participate in the study. Other potential confounding factors, such as screen brightness and the distance between electronic devices and the eyes, may also have influenced the results. To better understand myopic progression, future prospective studies should aim to include participants from various academic faculties and consider factors such as genetic predispositions and parental myopia. Furthermore, the study's cross-sectional design restricts the ability to establish causal relationships between electronic device usage and the development of myopia.

The broad exclusion criteria, such as the exclusion of students with any eye diseases affecting vision or refraction, may introduce selection bias, thereby, limiting the generalizability of the results to the broader population of medical and nursing students, particularly those with undiagnosed or untreated conditions. This could lead to an underestimation of the true prevalence of myopia and pseudomyopia. Furthermore, the reliance on baseline data obtained from medical records raises concerns regarding information bias, as these records may be subject to inaccuracies or incompleteness. Additionally, self-reported data on electronic device usage and other behaviors may be influenced by recall bias, which could compromise the accuracy and reliability of the study's findings.

## Acknowledgment

The present study was supported by Navamindradhiraj University Research Fund (032/2565).

## Conflicts of interest

The authors declare no conflict of interest.

## References

1. Tsai TH, Liu YL, Ma IH, Su CC, Lin CW, Lin LL, et al. Evolution of the prevalence of myopia among

Taiwanese schoolchildren: A review of survey data from 1983 through 2017. Ophthalmology 2021;128:290-301.
2. Kang MT, Jan C, Li S, Yusufu M, Liang X, Cao K, et al. Prevalence and risk factors of pseudomyopia in a Chinese children population: the Anyang Childhood Eye Study. Br J Ophthalmol 2021;105:1216-21.
3. Hagen LA, Gjelle JVB, Arnegard S, Pedersen HR, Gilson SJ, Baraas RC. Prevalence and possible factors of myopia in norwegian adolescents. Sci Rep 2018;8:13479. doi: 10.1038/s41598-018-31790-y.
4. Kaur S, Sukhija J, Khanna R, Takkar A, Singh M. Diplopia after excessive smart phone usage. Neuroophthalmology 2019;43:323-6.
5. Hussaindeen JR, Mani R, Agarkar S, Ramani KK, Surendran TS. Acute adult onset comitant esotropia associated with accommodative spasm. Optom Vis Sci 2014;91(4 Suppl 1):S46-51.
6. Lee HS, Park SW, Heo H. Acute acquired comitant esotropia related to excessive Smartphone use. BMC Ophthalmol 2016;16:37. doi: 10.1186/s12886-016-0213-5.
7. Rhatigan M, Byrne C, Logan P. Spasm of the near reflex: A case report. Am J Ophthalmol Case Rep 2017;6:35-7.
8. Daniel WW. Biostatistics: a foundation for analysis in the health sciences. 6th ed. New York: Wiley & Sons; 1995.
9. Thiamthat W. Myopic control with designed spectacle in Thailand. Bangkok: Rajavithi hospital; 2023.
10. Huang HM, Chang DS, Wu PC. The association between near work activities and myopia in children-a systematic review and meta-analysis. PLoS One 2015;10:e0140419.
11. Wen L, Cao Y, Cheng Q, Li X, Pan L, Li L, et al. Objectively measured near work, outdoor exposure and myopia in children. Br J Ophthalmol 2020;104:1542-7.
12. Ip JM, Saw SM, Rose KA, Morgan IG, Kifley A, Wang JJ, et al. Role of near work in myopia: findings in a sample of Australian school children. Invest Ophthalmol Vis Sci 2008;49:2903-10.
13. Jonas JB, Ang M, Cho P, Guggenheim JA, He MG, Jong M, et al. IMI prevention of myopia and its progression. Invest Ophthalmol Vis Sci 2021;62:6. doi: 10.1167/iovs.62.5.6.
14. Lanca C, Saw SM. The association between digital screen time and myopia: A systematic review. Ophthalmic Physiol Opt 2020;40:216-29.
15. Lingham G, Yazar S, Lucas RM, Milne E, Hewitt AW, Hammond CJ, et al. Time spent outdoors in childhood is associated with reduced risk of myopia as an adult. Sci Rep 2021;11:6337. doi: 10.1038/s41598-021-85825-y.
16. Gupta S, Joshi A, Saxena H, Chatterjee A. Outdoor activity and myopia progression in children: A follow-up study using mixed-effects model. Indian J Ophthalmol 2021;69:3446-50.
17. Jee D, Morgan IG, Kim EC. Inverse relationship between sleep duration and myopia. Acta Ophthalmol 2016;94:e204-10.
18. Huang L, Chen X, Lin J, Fan X, Chen T, Yu Y, et al. Association between sleep duration and myopia among Chinese children during the COVID-19 pandemic: A cross-sectional study. Front Public Health 2022;10:1015138. doi: 10.3389/fpubh.2022.1015138.