MYOPIA PREVALENCE AMONG

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MYOPIA PREVALENCE AMONG STUDENTS DURING COVID-19 PANDEMIC. A SYSTEMATIC REVIEW AND META-ANALYSIS

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ABSTRACT

The lockdown policy was implemented during the *Covid-19 pandemic to stop its spread. Indonesia modified the lockdown into PSBB (*Pembatasan Sosial Berskala Besar*). During PSBB school activities were replaced with online learning methods. This increased screen time and near-sighted activities and reduced time outdoors, were the risk factors for myopia. The objective of this study was to determine the myopia prevalence among students during the pandemic. This study used a systematic review method with meta-analysis. Data collection was taken from PubMed, Mendeley, and Google Scholar databases published in 2020-2021. The inclusion criterion was research on myopia prevalence among students during the pandemic of Covid-19. Data retrieval used the PICO method and journal adjustments were selected using the PRISMA algorithm. Data analysis was performed using a random-effects model. Out of 971 studies found, only six studies met the criterion. The results of the study based on the forest plot showed high heterogeneity and significant differences in the results. This was probably due to the inclusion criterion being too broad. In the funnel plot, there was a possible publication bias because the data obtained was only available and accessible. Overall, the journals studied stated that increased screen time and lack of outdoor activity increased myopia prevalence. Other risk factors that consistently cause an increase in myopia prevalence are education level, paternal and maternal myopia, and too-close reading distance. Otherwise, age, gender, BMI, eye exercise, eating habits, posture, and lighting while reading showed so many differences in the results that conclusions cannot be made.*

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INTRODUCTION

Covid-19 was first detected in Wuhan on December 31, 2019, until an epidemic occurred. After four months from the beginning of the emergence of Covid-19, there was a rapid spread throughout the world, until finally on March 11, 2020, WHO declared it a pandemic. WHO states that steps to prevent transmission of the Covid-19 virus are to quarantine with activity restrictions or separate individuals who are healthy but exposed to infectious agents by monitoring symptoms and early detection of cases.[1] On April 3, 2020, the Minister of Health of the Republic of Indonesia issued a regulation regarding large-scale social constraints (*Pembatasan Sosial Berskala Besar* /PSBB) to speed up

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the Covid-19 response. School is one of the activities included in the PSBB so school activities were replaced with teaching and learning processes at home with online methods. School closures, home quarantines, and the development of online learning were increasing screen time and close-up activities while reducing time for outdoor activities in school children which could lead to the risk of myopia.[2,3]

Myopia is by far the most common eye disease in the world. Between 1972 and 2004, the rate of incidence of myopia in the United States grew from 25% to 44%. In Asia, myopia affects more than 80% of the population. Other eye problems such as cataracts, glaucoma, retinal detachment, and myopic maculopathy are linked to myopia. Myopia is also one of the most common causes of blindness in the world.[4] According to (Wang et al., 2020), the prevalence of myopia will increase 1.4 to 3 times in 2020 compared to the preceding 5 years. This study also showed that during the learning process carried out at home, there was an increase in the myopia of -0.3 diopters in the 6-8 years age group. A study in India showed that in March and April 2019, 80% of cases in eye outpatient clinics were cases of myopia and myopic astigmatism.[5] With an increasing number of cases, this study was compiled to determine the prevalence of myopia in students during the Covid-19 pandemic.

MATERIALS AND METHODS

This research used a systematic review method with meta-analysis. Data collection was taken from the PubMed, Mendeley, and Google Scholar databases published in 2020-2021, with the inclusion criterion of the prevalence of myopia in students during online learning throughout the covid-19 pandemic. The keywords used in the PubMed database were: ((student OR children OR school[Title]) AND (online learning OR education OR home-learning OR home-schooling OR lockdown OR covid OR screen time OR sars-cov OR coronavirus OR pandemic OR outbreak OR quarantine[Title]) AND (myopia OR blurry vision OR eyesight[Title])). In the Mendeley database we entered the keywords "myopia" and "covid" while in Google Scholar the keywords were ((student OR children OR school) AND (online learning OR education OR home-learning OR home-schooling OR lockdown OR covid OR screen time OR sars -cov OR coronavirus OR pandemic OR outbreak OR quarantine OR confinement) AND (myopia OR blurry vision OR eyesight)). The data were retrieved using the PICO method and journal adjustments were selected using the PRISMA algorithm. The result of the question formulation using the PICO method was how the prevalence rate of myopia during online learning during the Covid-19 pandemic among students is (Table 1). The quality assessment tool for quantitative studies from the MetaXL add-in was used to assess the quality of the literature with six general assessment aspects, namely: selection, diagnostic criteria, study design, data collection method, catchment area, and prevalence measure. Data analysis was performed using a random-effects model to account for heterogeneity using the MetaXL add-in (www.epigear.com) for Microsoft Excel. The pool prevalence was calculated with 95% CI.

Table 1. PICO and search keywords

PICO	Search keywords
Population	Student
Intervention	Online learning during the covid-19 pandemic
Context	Prevalence
Outcome	Myopia

RESULTS

A total of 971 studies were obtained by searching the Pubmed, Google Scholar, and Mendeley databases. After filtering articles and duplicate articles, 964 studies were found. After re-screening by reading the title and abstract of the study, there were 952 studies with irrelevant titles/abstracts, so the remaining studies were 19 studies. Of the 19 studies, 11 studies were obtained with the type of research; systematic review, narrative review, meta-analysis, letter to the editor, pre-proof, non-peer-reviewed, opinion, and commentary. Then, as many as eight studies with full article texts were assessed for feasibility and found that two studies did not meet the inclusion criteria, namely one study with digital eye strain outcomes and one study with eye fatigue outcomes. In addition, for the quantitative study, a total of six studies that matched the inclusion criteria were included and assessed in Tables 2 and 3. The study assessment was carried out based on the meta-analysis assessment points of the prevalence study on MetaXL as shown in Table 3. Furthermore, from the six studies that were assessed, the data were then extracted in Table 5 to identify the quality index of each study to be used in data analysis. Based on the forest plot graph, several findings can be seen as follows: 1) The value of I2 = 100% indicates high heterogeneity. Therefore, a random effect model was chosen for meta-analysis 2) The horizontal line indicating 95% CI in each study did not cross-vertical line "line of no effect", thus indicating a significant difference in results between the studies used in this study. 3) Pooled prevalence was 59% (95% CI: 0.53 - 0.65) with high heterogeneity (I2 = 100%). This high heterogeneity could be caused by the inclusion criterion with a broad population studied varied from elementary to high school students. Meanwhile, the funnel plot analysis in Figure 3 shows that there is a publication bias because it is possible that the data obtained were not the whole data, but only the data that were available and accessed.

Table 2. Qualitative Assessment

No	Authors	Title	Place	Method	Time	Participants	Population	Case	Outcome
1	Pingjun Chang, et. al	Comparison of the myopic progression before, during, and after Covid-19 lockdown	Hangzhou China	Cohort	2019-2020	29.713	Students in 46 elementary-middle schools in Hangzhou, China	Unilateral myopia was defined as an SER≤-0.5 diopter, and high myopia was defined as an SER≤-6.0 diopter.	Online learning was carried out in period 2 with the proportion of myopia was 53.2%

2	Liangde Xu, et al	Covid-19 Quarantine Reveals Grade Grade-specific Behavioral Modification of Myopia: OneOne-Million Chinese Schoolchildren Study.	China	Cohort	June 2019 - June 2020	768.492 pelajar SD-SMA	Students in 1.305 elementary-high schools	Myopia was defined as an uncorrected visual acuity of 20/25 or less and an eyeball equivalent refraction (SER) of -0.5 diopters (D) or less.	Covid-19 quarantine for 6 months is enough to increase the risk of developing myopia (OR: 1.36, 95% CI, 1.33 to 1.40) or high myopia (OR: 1.30, 95% CI, 1.22 to 1.39) in the Class I group.
3	Jiaxing Wang, et. al	Progression of Myopia in School-Aged Children After Covid-19 Home Confinement	China	Cross-sectional	2015-2019	123.535 school-aged students (6-13 years old)	Students from 10 elementary schools in Shandong, Feicheng, China	Myopia was defined as an SER of -0.50 D or less.	The prevalence of myopia will increase 1.4 to 3 times in 2020 compared to the previous 5 years.
4	Fangyuan Chen, et al.	Prevalence of Myopia and Associated Risk Factors Among Primary Students in the Period of Online Study During Covid-19: A Cross-Sectional Study in Guangzhou	Guangzhou China	Cross-sectional	2020	905	Elementary school students from grades 1 to 6 in Tianhe district, Guangzhou city, China	Myopia was defined as a UCVA (uncorrected visual acuity) < 1.0 or a refractive error of at least -0.50 diopters (D).	699 students were identified as having myopic refractive errors making the prevalence 77.2% ([95% (CI): 75.5% – 80.0%]
5	Yuanyuan Liang, Tsz-wing Leung, Jinxiao Tina Lian, Chea-su Kee,	Study at Home During Covid-19 Lockdown Is Associated with a Dramatic Increase in the Prevalence of Myopia in Hong Kong Children.	Hongkong	Cross-sectional	Juni 2020	179	Government-funded elementary school students located in downtown Hong Kong	Myopia is defined as SE≤-0.50 D	By 2020, 95 · 8% (95% CI 92 · 8-98 · 9%) of school children experienced farsightedness using lower criteria (SE ≤ -0.50 D)
6	Liu, J., Li, B., Chen, Q. and Dang, J.,	Student Health Implications of School Closures during the Covid-19 Pandemic: New Evidence on the Association of e-Learning, Outdoor Exercise, and Myopia.	China	Cross-sectional study.	12 to 18 May 2020	3405	Elementary, middle, and high school students in 29 provinces in China	Changes in symptoms in visual conditions with terminology such as "blurred vision when looking at objects in the distance"	Of the 3405 subjects who met the inclusion criteria, 1358 (39.9%) reported nearsightedness

Table 3. Study Assessment

No	Study	Outcome	Population	Case	Assessment Criteria							Score	Qi
					1	2	3	4	5	6	7		
1	(Chang et al., 2021) (China)	myopia & high myopia	29713	53,20%	yes	ICD	Community survey	Screening survey	*multi site*	6 months	Elementary-Middle school students	10	0,8
2	(Xu et al., 2020) (China)	myopia & high myopia	768492	59,35%	yes	ICD	Community survey	Validated online questionnaire	*multi site*	2019 - 2020	Elementary-High school students	9	0,9
3	(Wang et al., 2021) (China)	myopia	194904	48,58%	yes	ICD	Community survey	Validated online questionnaire, *photoscreening*	*multi site*	2015 - 2020	Students aged 6-13 years old	10	0,8
4	(Chen et al., 2020) (China)	myopia	905	699	yes	ICD	Community survey	UCVA, questionnaire	*multi site*	point	Elementary school students	11	1
5	(Liang et al., 2020) (Hongkong)	myopia	173	75,70%	yes	ICD	Community survey	UCVA, questionnaire	*one school*	2018 - 2020	Elementary school students (8-10 years old)	9	0,8
6	(Liu et al., 2021) (China)	myopia	3405	1358	yes	symptoms	Community survey	Validated online questionnaire	*multi site*	point	Students on Grade 1-12	9	0,8

Table 4. Pooled Prevalence Analysis

Method	Prevalence	LCI	HCI	Q
Fixed effects	0,5704	0,5694	0,5713	8072, 4151
Random effects	0,5859	0,5254	0,6452	8072, 4151
Quality effects	0,5768	0,4684	0,6816	8072, 4151
Fixed effects, heterogeneity	0,5704	0,4544	0,6845	8072, 4151

Table 5. Study Quality Index (Qi)

No	Study name	N	Cases	Qi
1	Chang et al 2021	29713	15807	0,8
2	Xu et al 2021	768492	456100	0,9
3	Wang et al 2021	194904	94689	0,8
4	Chen et al 2020	905	699	1
5	Liang et al 2020	173	130	0,8
6	Liu et al 2021	3405	1358	0,8

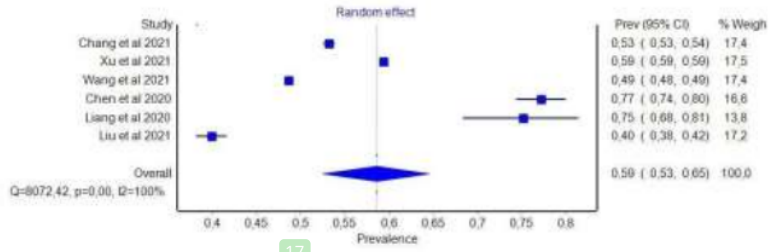

Figure 1. Forest Plot

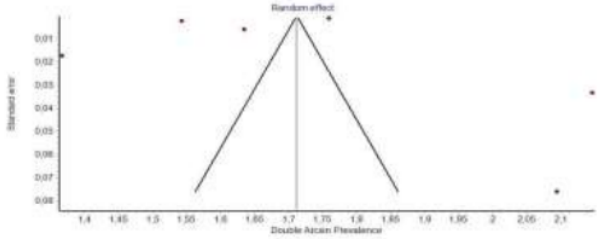

Figure 2. Funnel Plot

DISCUSSION

In this systematic review, we mainly discuss some risk factors that may affect the prevalence of myopia in school-age children during the Covid-19 pandemic. Some risk factors that are being identified are age, education, decreased outdoor activity, increased screen time, BMI, paternal and maternal myopia, eye exercise, reading while lying, reading distance, diet habits, lack of lighting, and sex (an estrogen hormone) which are elaborated as follows:

Age according to (Sun et al., 2018), there is an upsurge in the progression and prevalence of myopia as people get older. The younger the onset of myopia, the faster the progression of myopia.[6]

Education the prevalence of myopia in adolescents increases with grade level.[7] Research by (Hung et al., 2020) revealed that the increased prevalence of myopia was due to high learning activities. This was caused by the burden of studying with higher education.

Decreased outdoor activity and brighter light have the potential to reduce the development of myopia by various mechanisms.[8] This mechanism hypothesizes that the biochemical changes associated with increased physical activity help to prevent the onset of visual problems.[9]

Increased screen time and brighter light have the potential to reduce the development of myopia by various mechanisms.[8] This mechanism hypothesizes that the biochemical changes associated with increased physical activity inhibit the development of eye disorders.[9]

BMI in the study of (Kim et al., 2020) the higher the BMI, the higher the risk of experiencing myopia. However, in the study of (Lee et al., 2018) it was found that the lower the BMI, the higher the risk.

Paternal and maternal myopia is an association between paternal myopia[10] and maternal myopia and the prevalence of myopia. Risk factors for paternal myopia

and maternal myopia lead to an increased risk for myopia.[11]

Eye exercise several studies have stated that there is no relationship between eye exercise and the prevalence of myopia.[12] Whereas in a study,[13] students who receive high-quality eye workouts developed myopia at a slower pace.

Reading while lying the research of (Xie et al., 2020) stated that there was a significant correlation in reading/writing position with myopia, either sitting while reading position or lying down.[14]

Reading distances and longer near-sight activities cause myopia.[3] There is a higher prevalence of myopia in children who have a close reading habit.[16]

Diet habit (Berticat et al., 2020) found that there was an increase in the prevalence of myopia in a population that adopted a glucose-rich diet (western lifestyle).

Lack of lighting norton and Siegwart found that dim light causes myopia, whereas bright light slows myopia progression.[17] Increasing eye exposure to good lighting can prevent myopia progression.[18]

Sex (an estrogen hormone) Some researchers stated that there is a relation between refractive error and gender,[19,20] although there are conflicting data on which gender is more likely to have myopia.

The study's limitation was that the sample size was too large. Because the population ranged from elementary to high school students. This could lead to a lot of heterogeneity. Furthermore, there was a bias that could be produced by the fact that the data retrieved were simply those available and accessed, rather than the entire data set.

CONCLUSION

Several risk factors caused an increase in the prevalence of myopia in students during the Covid-19 pandemic. Overall, the journals studied stated that increased screen exposure and lack of outdoor activities increased the prevalence of myopia in students. In addition, other risk factors that consistently caused an increase in the prevalence of myopia in the studies studied after being compared with comparison journals were the level of education, paternal and maternal myopia, and too-close reading distance. Suggestions that can be submitted for future research include expanding the topic of visual impairment not only limited to myopia and involving research samples from other community groups, for example, office workers, freelancers, video editors, and so on.

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CONFLICT OF INTEREST

All Authors declare that they have no conflict of interest.

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AUTHOR CONTRIBUTION

All authors have contributed to all processes in this research, including preparation, data gathering, analysis,

drafting, and approval for publication of this manuscript.

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