

## **Association between Time Spent on Near Work and Myopia in Children in Calabar, Nigeria: A Case control Study.**

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### **Abstract**

**Background:** Myopia is a refractive error of the eyes that causes blurred distance vision. Child myopia has received global attention with near work, genetics and environmental factors implicated as risk factors. This study sought to determine the association between time spent on near work activities and myopia in Children in Calabar, Nigeria.

**Methods:** A case-control study was conducted among children, 5-17 years old, matched by age and sex. Cases were children diagnosed with myopia and those without myopia were the controls. Eye examination was conducted to confirm refractive status and myopia was defined as a spherical equivalent of  $-0.50D$ . A structured questionnaire was used to collect data on near work activity. Data was analysed using SPSS version 22 and presented as odds ratios, independent t-test and Pearson's correlation.  $P < 0.05$  was considered statistically significant.

**Results:** Cases spent significantly more time on near work than controls (mean = 5.93 vs 5.00 hours daily,  $p = 0.001$ ). Increased time spent on near work was associated with more than twice the risk of developing myopia (Odds Ratio: 2.75; 95% CI; 1.040 - 7.292,  $p=0.037$ ). There was a positive correlation between time spent on near work and myopia. This was statistically significant ( $r = 0.440$ ,  $p = 0.001$ ).

**Conclusion:** This study identified long time spent on near work by children as a risk factor for myopia. Giving the growing educational pressure on children in Nigeria and use of digital devices, there is need to regulate the time children spend on near work activities.

**Keywords:** Association, children, myopia, near work, time spent

## Introduction

Myopia is a refractive error of the eyes that causes blurred distance vision or difficulty seeing clearly at a distance. It may be accompanied by eye strain and headaches. In recent times it has received global attention as a health problem owing to its association with vision impairment that can eventually lead to blindness.<sup>1</sup> Myopia impacts negatively on quality of life, with social, educational and economic ramifications, thereby becoming a disorder of public health importance.<sup>2</sup> Worldwide, about 1.2 million children between five and fifteen years battle with visual impairment from refractive errors such as myopia.<sup>3</sup> It was estimated in 2010 that 1.45 billion people, 27% of the world's population, were myopic,<sup>4</sup> and this number is predicted to increase to almost 5 billion (about 50% of the world population) by 2050.<sup>5,6,7</sup>

The prevalence of myopia varies across countries, ages and ethnicity. Nevertheless, it remains the major cause of visual impairment in low, medium and high-income countries.<sup>2</sup> The prevalence values reported are higher in Asia but lower in Africa. It is as high as 79.5 % in China, 73.0% in South Korea,<sup>8</sup> 62% in Singapore, 56.0% in Taiwan, 20% in United States, 19.2% in Vietnam, 10.9% in Australia, and 9.7% in urban India.<sup>9</sup> In Africa it is as low as 0.5% in Burkina Faso, 22.6% in Ghana,<sup>8</sup> 2.6% in Ethiopia, 4.4% in Uganda and 4.0% in South Africa. In Nigeria, the prevalence hovers between 2.7% in Abia State,<sup>9</sup> 13.8% in Bayelsa State<sup>10</sup> and 4.8%<sup>11</sup> in Cross River State where myopia was identified as the major refractive cause of blindness.<sup>12</sup>

Regrettably, myopia has a tendency to develop in childhood and thus can potentially plunge a child into a lifetime of visual impairment.<sup>13</sup> Such visual impairment can deny a child the physical, intellectual and psychosocial development the child needs. Currently and unfortunately, no preventive intervention is effective against onset of myopia.<sup>14</sup> Even if properly corrected, child myopia sometimes progresses to sight-threatening complications, ending ultimately in blindness.<sup>4</sup>

Certain risk factors have been implicated in the swift increase in myopia across the world. These include body mass index, intensive education, genetics, diet and some environmental factors (outdoor activities and increasing near work activities).<sup>15</sup> Given the implications of child

myopia, the scarcity of data on myopia studies in children in Nigeria leaves a gap that this case-control study seeks to fill by determining the association between time spent on near work and myopia in children in Nigeria. The results will complement existing data from other climes and encourage a holistic approach to prevention and clinical management of myopia. This study will also enable practitioners appreciate the magnitude of the problem and its major risk factor in our environment.

## Methodology

**Study setting and population:** This study was carried out in Calabar, the capital of Cross River State, located in the South-south geopolitical zone of Nigeria. Calabar lies in the Southern Senatorial District of the State and has a projected population of 631,000 as at 2022 by the UN World Population Prospects. Due to the district-based approach used by the State Ministry of Health in its eye care programme, the Cross River State Eye Care programme (domiciled in the College of Health Technology, Calabar) renders eye care to the Southern Senatorial District. In 2018, this Eye Care project partnered with Brian Holden Vision Institute to launch the Children Unit. Thus, the Cross River State Eye Care project served as a good study setting for this research work, providing the study population of 3005, comprising of children aged 5-17 years who attended the Children Unit from 2018 to 2020.

The sample size for this hospital-based case-control study, including a 15% non-response rate, was 60 x 2 (that is, 60 cases and 60 controls), derived from the formula illustrated below.<sup>16</sup>

$$n = \frac{2(Z_{\alpha} + Z_{(1-\beta)})^2 \cdot p(1-p)}{(p_0 - p_1)^2}$$

$$Z_{\beta} = 80\% (0.842); Z_{\alpha} = 1.96, p_0 = 64.1\% (0.641); p_1 = 35.9\% (0.359); p = 0.5.^2$$

### **Sampling procedure**

Cases and controls were selected for inclusion from the register of the Children Unit of the Cross River State Eye Care Programme, (CRSECP) Calabar. These had previously undergone comprehensive eye examination covering ocular history, visual acuity testing using Snellen charts, ocular motility tests, indirect ophthalmoscopy, auto refraction, cycloplegic refraction (using tropicamide and cyclopentolate) and subjective refraction for best vision correction.

### **Case definition:**

Myopia was defined as a refractive error  $-0.50D$  in either eye. Hence a case was a child diagnosed to have myopia within the study period.

### **Control definition:**

A control was a child without myopia.

### **Inclusion criteria:**

Children between five and seventeen years of age.

### **Exclusion Criteria:**

Children with significant ocular pathology (such as corneal opacities, lens opacities, and retinal disorders), children whose parents declined participation in the study, children without both parents available for an eye examination and children whose parent(s) had myopia. This was so designed to control for parental myopia as a confounding factor.

### **Selection process**

From the CRSECP register, based on the case and control definitions, 306 children were eligible for enrolment, of which 92 were eligible as cases while 214 were eligible as controls. A Table of Random Numbers was used to select 60 cases and 60 controls while being concurrently matched by age and sex. Parents of selected children were contacted and invited to the study. After written informed consent was obtained from the parents and assent given for their children to participate, the parents assisted the children in filling a questionnaire eliciting information on estimates of daily hours spent on study, use of smartphones, and computers in the last 12 months. The questionnaire was pretested with 10% of the sample size selected from

an eye clinic in Calabar.

### **Data analysis**

The Statistical Product and Services Solution software (IBM SPSS Statistics version 22) was deployed for statistical analyses. Results were presented in tables and graphs. Group means of cases and controls were compared using independent samples t-test and association was tested using Pearson's correlation taking P value  $< 0.05$  as statistically significant. To calculate the odds ratio (OR), an estimate of the relative risk of developing myopia, time spent on near work activities was categorized into 1–4 hours (non-exposed) and 5–10 hours (exposed).

### **Ethical considerations**

Informed consent was sought from parents and assent given for their children to participate in the study. The study was approved by the Cross River State Health Research Ethics Committee in State Ministry of Health with Reference No. CRS/MPH/HREC/020/Vol.V1/200, and conducted in accordance with the Helsinki Declaration of 1975, as revised in 2000.

### **Results**

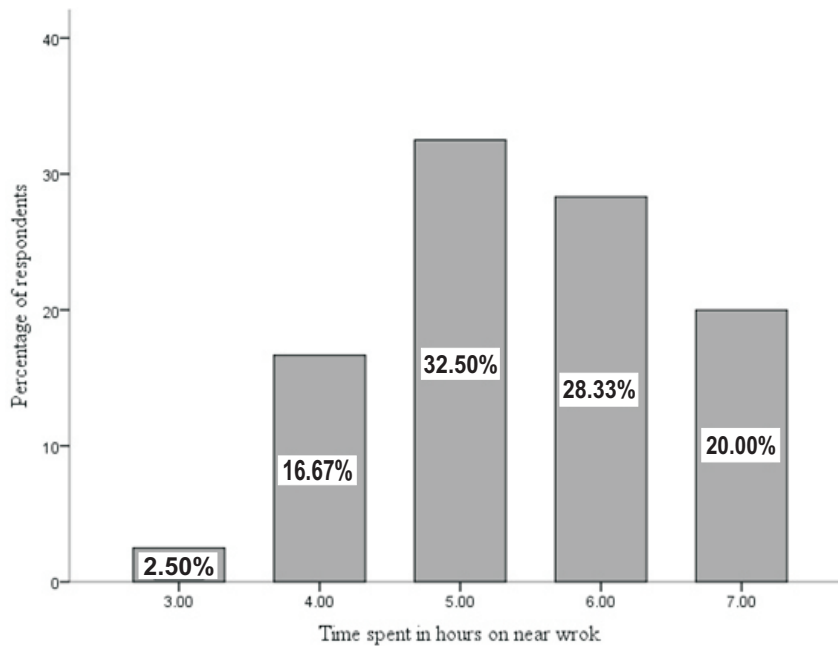
There was an equal number of males (60) and females (60) in the study. The respondents' ages ranged from five to seventeen years with 78 (65.0%) being between 12 to 17 years (Table 1). Ninety seven respondents (81.0%) spent 5 hours and above daily on near work activities, while 23 (19.0%) spent less than 5 hours daily (Figure 1).

Cases were found to have spent on average more time (mean =  $5.93 \pm 1.02$  hours vs  $5.00 \pm 0.90$  hours) on near work activities than controls and the difference in time spent was statistically significant ( $t = 5.301$ , 95% CI; 0.59 - 1.28,  $p = 0.001$ ). (Table 2).

Also, a statistically significant, moderate positive correlation was found between time spent on near work activities and myopia ( $r = 0.440$ ,  $p = 0.001$ ) as assessed by Pearson's product-moment correlation (Table 3). As such, as the time spent on near work activities increases, myopia increases (Figure 2). This study found an odds ratio of 2.75 (95% CI = 1.04 – 7.29,  $p = 0.037$ ). (Table 4).

**Table 1: Socio-demographic characteristics of respondents**

Characteristics	Cases 60	Controls 60	Total 120	Percent
<b>Sex</b>				
Male	30	30	60	50.0
Female	30	30	60	50.0
<b>Age (years)</b>				
5 – 11	21	21	42	35.0
12 – 17	39	39	78	65.0



**Figure 1: Daily time in hours spent on near work activities by respondents**

**Table 2: Time spent on near work activities between cases and controls**

		Independent -samples t-test			Test for Equality of Variance and Means		
		N	Mean	SD	F	t	p value
Time spent on	Cases	60	5.933	1.023			
Near work	Controls	60	5.000	0.902	2.881	5.301	$p= 0.001^*$

\* Significant at  $P < 0.05$  at 95% confidence interval (2-tailed).

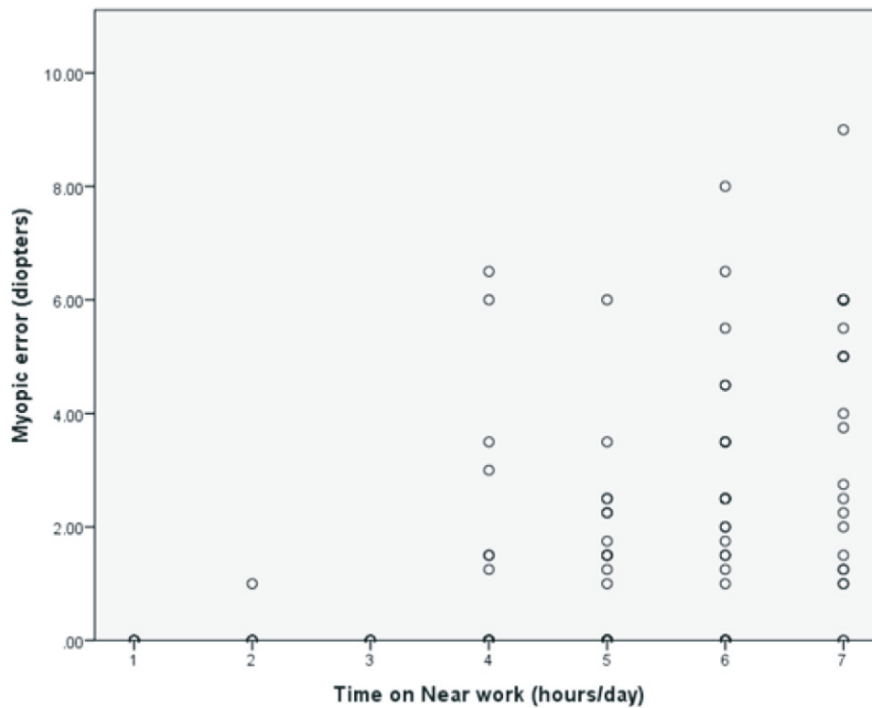
† F: F-statistic

‡ t: t-statistic

**Table 3: Association between time spent on near work activities and myopic error.**

Variable	Number	1	2	P-value
1. Time spent on Near work	120	—		
2. Myopic error	120	0.440*	—	$p = 0.001$

\*Correlation is significant at the 0.05 level (2-tailed)



**Table 4: Association between near work and myopia**

Variable	Disease Status		Odds Ratio (95% CI)
	Cases	Controls	
<b>Near work</b>			
Exposed	53 (54.6%)	44 (45.4%)	2.753 (1.040 -7.292)
Non-Exposed	7 (30.4%)	16 (69.6%)	$\chi^2 (4.357) p=0.037$
Total	60 (100%)	60 (100%)	

## Discussion

This study found that majority of the respondents spent 5 hours and above daily on near work activities. This could be attributed to the pressure on educational activities by both parents and the school system. After an average of 6 hours at school, all the respondents had to undergo an extra lesson class that lasted an average of 2 hours. In this study, cases (myopes) spent on average more time on near work activities than controls. The result from this study was similar to those from some school-based studies.<sup>17,18,19</sup> However, some studies reported seeing no difference in the time spent at near tasks between children who had myopia and those who did not.<sup>20</sup> It is likely that this disagreement may not be unrelated to the difference in the age range of the children, with theirs being 8–9 years while this study used 5-18 years.

This study found that children who spend five to ten hours per day on near work or tasks were almost three times more likely to be myopic than those who spend less than five hours per day. This implies that time spent on near tasks is a risk factor for myopia. Interestingly, a Pearson's product-moment correlation found a statistically significant, moderate, positive correlation between myopic error and time spent on near tasks. This agrees with the findings in India where a positive association was reported in children who studied/read beyond 5 hours per day, watched television beyond 2 hours per day, and played video games beyond two hours as well.<sup>21</sup> A cohort study reported that the odds of developing myopia increases when a child reads beyond 3 hours/day.<sup>22</sup> The result of this cohort study aligns with a review of 27 other studies spanning Asia, North America, Australia, Europe and the Middle East which found that the odds of developing myopia rose by 2% with every addition of 1 hour of near work.<sup>23</sup>

The odds of exposure as found in this study was similar to the findings of some studies.<sup>24, 25</sup> but in contrast with studies that found the odds of developing myopia from near work was lower than 1.0.<sup>26, 27</sup> It is worthy of note that these later studies adopted a narrower age bracket (7-9 and 7-11 years respectively) while this study adopted 5 - 17 years as the age bracket and this might explain the

variation between their results and those of this study.

When much near work is done overtime, it could result in retinal defocus which is a suspected probable cause of the increase in length of the eye ball that eventually leads to myopia.<sup>28</sup> When one superimposes the high demand of near work on the eyes on the predisposition of the eyes to develop myopia during the years of schooling, the picture becomes clearer why increased time spent on reading and other near work is suspected to be a potential myopia determinant.<sup>23</sup> In fact, the mounting educational pressure on children could be responsible for the epidemic of myopia the world is experiencing, as such high degree of near work over time could precipitate retinal defocus, facilitating elongation of the eyeball, thereby bringing about myopia.<sup>29</sup> While contending with near work activities such as studying, the increase in the use of digital devices has compounded the situation, with children being the fastest growing population of users of smart phones and digital devices both at home and in school.<sup>7</sup> Increased screen time on digital devices will mean staying indoors more, having less interest in sports and other outdoor activities, factors that would favor onset of myopia.<sup>30</sup> This association between near work and myopia implies that either near work predisposes one to myopia or that myopia predisposes a person to preference for closer reading distance.<sup>31</sup> Therefore, it is highly expedient to regulate the weight of near work on children as this may help to prevent myopia.<sup>23</sup> There were limitations to this study which include recall and observer bias and the covid-19 pandemic and total lock down that restricted movements during this period.

## Conclusion

There is need for eye care practitioners to sensitize parents, guardians, care-givers, teachers and school authorities on the risk associated with long time spent on near work activities. However, more cause-and-effect prospective cohort studies with larger sample sizes are needed in Nigeria and Africa

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### Data Availability

The data set used for this study is available on reasonable request.

### Conflict of Interest

We have no potential conflict of interest to disclose.

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