Determinants of Refractive Errors on School-going Children Attending Ophthalmic Clinic of AlMoosa Hospital in Saudi Arabia

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Abstract:
Objective: The risk factors for vision problems in youngsters are relatively unknown in Saudi Arabia. The purpose of this study was to examine the determinants of refractive errors among school-going children attending the ophthalmic clinic of AlMoosa Hospital in Saudi Arabia.

Methodology: A sample of 161 school-going children were recruited voluntarily to complete a set of measures examining the determinants of refractive errors. The binary logistic regression model was applied to determine the relationship between independent and dependent variables.

Results: Refractive errors were common among Saudi school-going children, with myopia being the most common type of refractive error. About 96 (59.6%) samples had myopia, 28 (17.4%) children had hyperopia and 27 (16.8%) children did not have any refractive error. Genetic traits and machine dependence were found to be significant predictors of refractive error.

Conclusion: The preschool eye test and routine vision investigation should be performed on children to detect refractive errors early.

Keywords: Refractive error, Myopia, Genetic traits, Machine dependence, Ophthalmic clinic, Visual impairment.

1. INTRODUCTION
Refractive error is the major cause of visual impairment, and it has also been one of the main responsibilities of global leaders to prevent blindness [1, 2]. The World Health Organization estimates that at least 2.2 billion people worldwide suffer from visual impairment and approximately 19 million children below 15 years of age were visually impaired. Approximately 43% of this population is visually impaired due to refractive errors, which are the leading cause of visual inability in youngsters [3]. In refractive error, the eye fails to focus parallel beams of light on the retina due to an imbalance in the eye's axial length and refractive power [4]. Refractive error includes hyperopia, myopia, and astigmatism [5]. In Saudi Arabia, the prevalence of refractive error among school-aged children is alarming and ranges from 10.7% to 23% [6 - 8].

The most common cause of vision impairment in children aged 5 to 15 is untreated refractive errors [9]. Visual impairment caused by uncorrected refractive errors in children can have serious repercussions, including low academic achievements and work possibilities. Additionally, this may lead to lower economic growth and reduced life quality for people, families, and societies [10]. Globally, 153 million people are visually impaired as a result of uncorrected refractive defects. This number includes 12.8 million children aged 5 to 15, resulting in a worldwide prevalence of 1%.

The prevalence of refractive errors is influenced by genetic and environmental factors. Previous researchers have suggested that genetic factor is significantly associated with refractive error [11 - 14], which contributes to the high...
prevalence of visual impairment. Other factors that contribute to refractive error in school-age children include food, lifestyle, visual exposure, and urbanization [15]. Children's eating habits influence the development of refractive error. Studies have shown that myopes consume much less fresh vegetables, fruits, whole grains, and other foods in their regular diet [16]. Other findings reported that myopic children consumed less food high in protein, fat, vitamins, and minerals and more food high in carbohydrates, starches, or sugars [17]. To stop the onset of refractive error or any other health issues in children, a nutritious diet must be established. Another factor that may contribute to the progression of myopia in school-aged children is a hectic academic schedule. Traumatic educational schedules such as homework (worksheet and assignments) in initial years of schooling and tuition classes in primary schools were found to be positively and significantly related to myopia [18]. Hours of sleep are also associated with myopia and its progression becomes a risk factor for myopia in children [19].

Regarding visual experience, previous research suggested that positive attitudes, practices, and self-confidence could help people overcome their fear of spectacles. Literature has revealed that young kids are spending more time watching television, and playing video games and computer games resulting in visual impairments [20]. These children suffer from a wide range of ocular symptoms, including eyestrain, tiredness, irritation, redness, blurred vision, and double vision.

As previously stated, the prevalence of refractive error is increasing dramatically in Saudi Arabia, which requires immediate action; however, school-aged children have received the least attention. To our knowledge, there are few researches on the prevalence of refractive error among children in Saudi Arabia, and no research has been conducted specifically on the determinant factors of refractive error among school-aged children. As a result, this study aimed to investigate the determinants of refractive error in order to alleviate this invisible problem.

2. MATERIALS AND METHODS

2.1. Study Design

This institutional based cross sectional study was carried out at the ophthalmic clinic of AlMoosa hospital AlHassa, Saudi Arabia. This hospital is well-known for giving eye care to the residents living within its catchment area. The present study was carried out from November 2022 to January 2023. Children with both corrected and uncorrected refractive errors who visited the clinic during the data collection time were included in the study. This study was conducted in accordance with the Helsinki Declaration and after the ethical approval from the Deanship of Scientific Research, King Faisal University, Alhasa Saudi Arabia (KFU-REC-2022-JAN-ETHICSS12). Informal verbal consent was taken from all the parents or guardians prior to participation in the study and their confidentiality was ensured.

2.2. Study Sample

The sample size of this study was estimated according to sample size calculations for cross-sectional studies. According to the previously published studies, the prevalence of refractive error was 13.7% among school-going children in a local study [6]. After obtaining informal consent, 185 volunteer school going children were recruited to participate in this research and 161 children (Males = 87; Females = 74) aged between 4 and 12 years ($M = 8.89; SD = 2.74$) finally completed the survey. The other 24 study participants were excluded because of missing answers to the study items.

2.3. Measures

The questionnaire measuring the determinants of refractive errors was adapted from a previous study [21]. The questionnaire was initially written in English, and then translated into Arabic language. A panel of expert researchers evaluated the scale's content and face validity. The face validity of the Arabic version was examined by an Arabic speaker research expert. Prior to data collection, a pilot study was carried out on fifteen randomly selected children. Based on the pilot study, participants understood and answered all of the questionnaire items.

The questionnaire was containing 2 parts, the first part of the questionnaire consists of demographic information and the second part includes questions related to determinants of refractive error. A team of 5 members including two nurses, one optometrist, one ophthalmologist and a medical student were involved in data collection after receiving proper training by the principal investigator.

Demographic data including age, gender and other information related to visual impairment such as visual problem, duration of weaning eyeglass, history and type of refractive error, etc. was collected by the nurse through personal interviews.

Regarding questions of determinants to refractive error, the questionnaire consisted of 19 items covering five dimensions, namely, eating habits genetic traits, lifestyle, personal achievements and machine dependence. Responses are obtained on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Jayaraman K, et al. [21], obtained a reliability coefficient of all the dimensions ranging from 0.62 to 0.79. For the present study, the Cronbach’s alpha was between 0.67 to 0.77.

The refractive error was measured by the ophthalmic nurse using spherical power (right or left) and cylinder power (right or left). A refractometer was used to examine the non-cycloplegic autorefraction of both eyes. After that cycloplegic 1% was used three times in 10 minutes’ interval, after 30 minutes from the last drop a retinoscopy was used to evaluate the refractive error. The spherical equivalent (SE) of the refractive error was calculated as $SE = (spherical\ power) + (cylinder\ power)/2$. A professional eye care doctor performed and recorded all of the eye measurements.

2.4. Statistical Analysis

After checking for the quality and consistency of the data, the data was coded and put into EPI data version 3.1 and after that, it was exported to SPSS (version, 25) for analysis. At first, frequency distribution and descriptive statistics with mean and
standard deviation were computed. Binary logistic regression analyses in enter method were utilized to examine the role of independent variables on refractive error. A $P$ value of $< 0.05$ was considered statistically significant.

3. RESULTS

3.1. Initial Analysis

Participants of the present study (Table 1) were 161 children (87 males and 74 females) living in Hofuf city of Alhasa Region of Saudi Arabia. The age of these participants ranged from 3 to 12 years ($\text{Mean} = 8.89; \text{SD} = 2.74$). About 96 (59.6%) samples with myopia, 28 (17.4%) children with hyperopia and 27 (16.8%) children without any refractive error. It is surprising that the prevalence of refractive errors was high among the school-going Saudi children. Male participants (52.38%) complained of more refractive errors in comparison to their counterpart female participants (47.61%).

Table 2 presents mean scores and SDs of determinant variable including eating habits, genetic traits, lifestyle, personal achievement and machine dependence that affects the vision of the 161 school-going children. The result showed that children have disagreed about unhealthy eating habits ($\text{M} = 2.15$). Regarding the genetic trait ($\text{M} = 3.24$) of the children, the mean score indicates that more than 50% children’s parents had a refractive error. In addition, the children disagreed that they had poor lifestyles ($\text{M} = 2.62$). Moreover, the mean score of personal achievement ($\text{M} = 3.36$) showed that children had good personal achievements in their academic records. Lastly, the machine dependency mean score ($\text{M} = 3.75$) indicates that children consume more time using electronic gadgets results in high machine dependency.

3.2. Binary Logistic Regression

In the present study, it was hypothesized that independent variables including eating habits, genetic traits, lifestyle, personal achievement, and machine dependence had a direct impact on refractive errors. Binary logistic regression analyses were utilized to examine the role of independent variables in these relationships. Refractive error yes/no was considered the dichotomous outcome variable. Results of logistic regression analysis (Table 3) revealed all variables influenced refractive error with Nagelkerke’s $R^2$ of .61, $p < .05$, and the total probability of correct classification was 0.78. Results show that genetic traits and machine dependence were found to be statistically significant. The positive relationship of genetic traits with refractive error indicated that heritable factors play a significant role in the development of refractive errors. Moreover, machine dependence was also found positively and significantly related to refractive error. This shows that with the increasing use of smartphones, tablets and computers refractive errors increase significantly.

Table 1. Demographic and personal characteristics of participants.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Male</td>
<td>87</td>
<td>54.00</td>
</tr>
<tr>
<td>Female</td>
<td>74</td>
<td>46.00</td>
</tr>
<tr>
<td>Age</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>&lt;5 years</td>
<td>20</td>
<td>12.40</td>
</tr>
<tr>
<td>6 – 9 years</td>
<td>106</td>
<td>65.80</td>
</tr>
<tr>
<td>&gt;10 years</td>
<td>35</td>
<td>21.70</td>
</tr>
<tr>
<td>Refractive Error</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Yes</td>
<td>126</td>
<td>78.30</td>
</tr>
<tr>
<td>No</td>
<td>35</td>
<td>21.70</td>
</tr>
<tr>
<td>Type of Refractive Error</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>No refractive error</td>
<td>35</td>
<td>21.73</td>
</tr>
<tr>
<td>Myopia</td>
<td>96</td>
<td>59.63</td>
</tr>
<tr>
<td>Hyperopia</td>
<td>20</td>
<td>12.42</td>
</tr>
<tr>
<td>Astigmatism</td>
<td>10</td>
<td>6.22</td>
</tr>
<tr>
<td>Refractive Error by Gender</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Male</td>
<td>66</td>
<td>52.38</td>
</tr>
<tr>
<td>Female</td>
<td>60</td>
<td>47.62</td>
</tr>
<tr>
<td>Refractive Error by Age</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>&lt;5 years</td>
<td>18</td>
<td>14.28</td>
</tr>
<tr>
<td>6 – 9 years</td>
<td>85</td>
<td>67.46</td>
</tr>
<tr>
<td>&gt;10 years</td>
<td>23</td>
<td>18.25</td>
</tr>
<tr>
<td>Onset of Wearing Spectacles (in years)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>&lt;5 years</td>
<td>64</td>
<td>39.8</td>
</tr>
<tr>
<td>6 – 7 years</td>
<td>48</td>
<td>29.8</td>
</tr>
<tr>
<td>8 – 9 years</td>
<td>28</td>
<td>17.4</td>
</tr>
<tr>
<td>10 – 11 years</td>
<td>19</td>
<td>11.8</td>
</tr>
<tr>
<td>&gt;12 years</td>
<td>2</td>
<td>1.2</td>
</tr>
</tbody>
</table>
The present study demonstrated that the prevalence of teaching and learning are being conducted online, which requires lengthy hours of close work, using small display screens and engaging in longer screen viewing time may contribute to screen dependency in children. Another reason for Saudi children's excessive use of electronic devices may be to maintain daily contact with their mother/father or guardian and to contact someone in an emergency or when their parents are away from home. These factors have a significant impact on these children's vision. Research has shown that using electronic devices for more than 2 h per day presents an independent risk factor for myopia, and heavy use of electronic products is one of the important risk factors for ametropia in both boys and girls [29, 45]. According to a review article, watching television and playing computer/video/mobile games for more than 2 hours per day increased the risk of developing myopia in youngsters [46].

5. LIMITATIONS

There were some limitations to the current study. First, data of the present study was obtained from the AlHasa Governorate of Saudi Arabia. Data collected in this setting may thus be unique, and a replication of this study in other regions of the country may produce different outcomes. Second, this study was conducted in a hospital setting, the prevalence of refractive error may have been overestimated because most people go to the hospital for vision problems. Third, the questionnaire method was used in this study, which cannot demonstrate a causal relationship between the determinant factors and refractive error. Therefore, future research could further explore the link between the determinant factors and refractive error. Finally, the sample size of the present study was relatively small and homogeneous which also limits generalization.

CONCLUSION

The present study demonstrated that the prevalence of

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Table 2. Means and standard deviations of independent variables.

<table>
<thead>
<tr>
<th>Variables</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eating habits</td>
<td>2.15</td>
<td>.66</td>
</tr>
<tr>
<td>Genetic trait</td>
<td>3.24</td>
<td>1.16</td>
</tr>
<tr>
<td>Lifestyle</td>
<td>2.62</td>
<td>.77</td>
</tr>
<tr>
<td>Personal achievement</td>
<td>3.36</td>
<td>1.03</td>
</tr>
<tr>
<td>Machine dependence</td>
<td>3.75</td>
<td>.62</td>
</tr>
</tbody>
</table>

Table 3. Result of binary logistic regression analysis predicting refractive errors from independent variables.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Exp(β)</th>
<th>Wald</th>
<th>P value</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eating habits</td>
<td>2.21</td>
<td>2.61</td>
<td>.10</td>
<td>Not Supported</td>
</tr>
<tr>
<td>Genetic trait</td>
<td>2.29</td>
<td>8.15</td>
<td>.00</td>
<td>Supported</td>
</tr>
<tr>
<td>Lifestyle</td>
<td>.69</td>
<td>1.18</td>
<td>.27</td>
<td>Not Supported</td>
</tr>
<tr>
<td>Personal achievement</td>
<td>.69</td>
<td>1.38</td>
<td>.24</td>
<td>Not Supported</td>
</tr>
<tr>
<td>Machine dependency</td>
<td>.01</td>
<td>30.96</td>
<td>.00</td>
<td>Supported</td>
</tr>
<tr>
<td>Nagelkerke R Square</td>
<td>-</td>
<td>-</td>
<td>.61</td>
<td>-</td>
</tr>
</tbody>
</table>

Classification Results

Note: *p < .05. **p < .01.
refractive errors was high among the school-going Saudi children and myopia is the most frequent kind of refractive error. Genetic traits and machine dependence were found significant predictors of refractive error. Therefore, every child should be properly examined before enrolled in schools, and routine eye examinations should be performed during their stay in the schools in order to detect refractive errors early.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Deanship of Scientific Research, King Faisal University, Saudi Arabia (KFU-REC-2022-JAN-ETHICS512).

HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All procedures performed in studies involving human participants were in accordance with the ethical standards of institutional and/or research committee and with the 1975 Declaration of Helsinki, as revised in 2013.

CONSENT FOR PUBLICATION

Informed consent was obtained from all participants involved in the study.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The source of the data are patients visited to Ophthalmic Clinic at Almoosa Hospital, Alhsa Saudi Arabia. The material used for data collection was the questionnaire measured for data collection was the questionnaire measured determinants of refractive errors. The data that support our findings can be found through directly asking the corresponding author [A.L].

FUNDING

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CONFLICT OF INTEREST

The authors declare no conflict of interest financial or otherwise.

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Declared none.

REFERENCES


