



Prevalence of Color Blindness among Students of Secondary Schools in Shahrekord

Ezzat Allah Memarzadeh¹, Forouzan Ganji^{2*}

¹Assistant Professor, Shahrekord University of Medical Sciences, Shahrekord, Iran

²Shahrekord University of Medical Sciences, Shahrekord, Iran

Abstract

Background and aims: Color blindness is a disease that remains undiagnosed in some cases. The diagnosis of the disease during schooling is necessary to take the required measures for the future life of adolescents. Therefore, the aim of this study was to determine the prevalence of color blindness among the students of secondary schools in Shahrekord.

Methods: In this descriptive study, 4074 students of secondary schools across Shahrekord were included by the cluster sampling method. Ishihara color blindness test plate was used to diagnose color blindness. Data were analyzed using descriptive statistics (mean and percentage) by SPSS 18.

Results: In general, 362 (88.8%) patients had color blindness. Out of 2052 male students and 2022 female ones, 343 (16.71%) and 19 (0.93%) cases were diagnosed with color blindness, respectively. In both genders, most students had deuteranopia or deuteranomalialia, while other types of color blindness, including tritanomalialia, were not detected in the students.

Conclusion: The results of this study showed that the number of color blind people in the studied region was higher compared to the results of studies in the other regions of Iran. Moreover, the prevalence of color blindness was more in males compared to females. In addition, the prevalence of other kinds of color blindness mainly belonged to deuteranopia or deuteranomalialia.

Keywords: Vision deficiencies, Color blindness, Secondary school

*Corresponding Author:

Forouzan Ganji, Shahrekord University of Medical Sciences, Shahrekord, Iran.
Email: foruzan2000@yahoo.co.in

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Introduction

Color blindness is considered a disease in which a person has little or no ability to distinguish and recognize the colors in normal light.¹ This disease can be divided into acquired and hereditary or genetic types, in which the type of genetics is more prevalent than the acquired type.² The jobs as the acquired type create color blindness in the people. In addition, color blindness can be considered as an acquired type due to welding.³ Hereditary color blindness can appear as monochromacy or dichromacy.² The prevalence of color blindness was studied in different cities of Iran. In a study in Tehran, out of 500 studied students, 26 (2.5%) male cases had color blindness, of whom 18 had partial color vision deficiencies and 8 had color blindness.⁴

In terms of the impacts on the lives of individuals, color blindness can lead to disturbances in the occupation of such persons as firefighters, pilots, computer users, drivers, as well as bank clerks who handle the cash and even students.^{5,6} In some cases, people are not able to recognize the bleeding from their bodies and may confuse the blood with other liquids.⁷

Various studies have focused on the prevalence of this disease in different parts of the world and Iran. Statistically, significant differences are reported in this regard, which can be due to differences in races, instruments of examination, and researchers' interpretations of the disease.^{8,9}

The diagnosis of this disease during schooling is essential for taking the necessary actions for the future life of adolescents. In this respect, interventions can be performed to improve the living conditions and even the type of occupation of these patients so as to be able to prevent some health and financial damage and behavioral abnormalities and ultimately promote the health of the patients and the community.^{10,11} The prevalence of the disease appears to be higher in Chaharmahal and Bakhtiari province due to the relatively high prevalence of family marriages and genetic dependence compared to many other provinces. Therefore, implementing this project in Chaharmahal and Bakhtiari province is necessary. On-time diagnosis of this disease and the prevention of some casualties and financial damages are considered necessary as well. Accordingly, the current study aimed to investigate the prevalence of color blindness among the students of

secondary schools in Shahrekord.

Materials and Methods

The population of this descriptive study consisted of 4074 students who were selected from secondary schools in Shahrekord by the cluster sampling technique from two sections (1,2) of the city, and then 60 schools entered the study. Forty-two clusters were chosen in this study and each school was considered as one cluster. Further, the clusters were selected based on accessibility and their distance for sampling, and the students in one cluster were chosen based on their parents' satisfaction.

Sampling was computed based on the following formula:

$$ss = Z^2 * (p) * (1-p) / d^2$$

Z = Z value (e.g., 1.65 for a 90% confidence level)

$$P = 0.15$$

$$d = 0.015$$

$$N = 4000$$

The sample size was determined as 4000 according to the sample size formula and 4079 students were enrolled by considering the dropouts. Students were included in the study based on their willingness for participation, and their unwillingness to cooperate with the study and inaccessibility were considered as the exclusion criteria.

Color vision deficiencies including deuteranopia, deuteranomalia, protanopia, protanomalia, and color blindness were evaluated in this study. Both study groups were considered to have color blindness due to the lack of the diagnosis of blue-yellow color blindness and the lack of differentiation between mixed anomalous trichromats and monochromates.

All students' information was collected, including demographic characteristics, (the lack of) color blindness, the type of color blindness, the students, parents, or the teachers' awareness of the disease, and the way of the students, the parents, or the teachers' becoming aware of the disease.

Meanwhile, the students with color blindness were asked to provide their address and telephone number to be able to enroll them in the study if their parents provided consent to their participation in subsequent studies. Ishihara color blindness test plate was used to test color blindness. This test is a global and reliable test for this disease.⁹

The light conditions of the test should be similar to the daylight, and therefore the MacBeth light bulb can be used, which is about 100-650 LUX. Alternatives such as a fluorescent bulb of more than 5000 k or Kodak Watten 78aa number with a 100-watt bulb can be utilized because this light bulb is very expensive. Thus, a Kodak Watten 78 along with a 100-watt bulb was applied in this study.¹¹

The test was done with one eye open at a distance of 63 cm, and the examinee underwent the test with his/her best possible correctable vision. Color vision tests were not performed immediately after ophthalmoscopy or retinoscopy because the light is flashed into the eyes in such

tests. The employed plates and beads were curved, swollen, or blurred and optical conditions and test methods were the same for all students.

The data were entered into SPSS, version 23 after encoding and then analyzed by descriptive statistics (frequency/percentage).

Results

In general, 4074 out of 4079 students were investigated in the present study. Among them, three male and two female students were excluded from the study for reasons including the lack of parents' cooperation with determining the type of blindness.

Further, 343 male and 19 female students were diagnosed with color blindness. A total of 362 (88.8%) cases were suffering from various types of color blindness (Table 1). Of 343 boys with color blindness, 32 students were aware of their illness, and 33 parents were aware of their child's disease. On the other hand, 6 out of 19 affected girls were aware of their illness, and 7 parents of the girls were aware of their child's illness, but no school teachers had knowledge of students' blindness. Other types of color blindness, including tritanomaly were not detected in this study.

Discussion

This study was conducted to investigate the prevalence of color blindness in secondary schools in Shahrekord. It was observed that a total of 362 (88.8%) students suffered from different types of color blindness. Out of 2052 male students, 343 (16.71%) cases had color blindness, which was more than girls. Furthermore, 19 (0.093%) out of 2022 female students were diagnosed with color blindness. The results of a study in Tehran showed that 2.2% of school children, with the most being boys, had color blindness.¹⁴ The results of another study by Ostadimoghaddam et al on 4400 students in Mashhad indicated that 136 boys and 24 girls suffered from the disease.¹²

Based on the findings of another study in Urmia, out of a total of 2000 students, 40 (2%) cases had color blindness, of whom 36 (3.6%) were males and 4 (0.4%) were females. The prevalence of different types of color blindness demonstrated that 25 students (1.25%) were color blind, 13 students (0.65%) had deuteranopia, and 2 students (0.1%) had protanopia.¹³

Table 1. The Frequency and Percentage of Color Blindness in Students

Color Blindness Type	Girl Students No. (%)	Boy Students No. (%)
Deuteranomalous	16 (79.0)	298 (52.14)
Deuteranopia	2 (09.0)	18 (87.0)
Protanomalous	1 (04.0)	15 (73.0)
Protanopia	0 (0.0)	12 (58.0)
Total	19 (93.0)	343 (71.16)

In another study in Tehran, out of the 500 students under investigation, 26 (2.5%) male students had color blindness, of whom 18 had partial color vision deficiencies and 8 had color blindness.

Moreover, Rezaieshokouh and Najafi found that of the students with partial color vision deficiencies, 12 had deuteranomalopia (2.4% of the total) and 6 had protanomalopia (1.2% of the total), and among the students with color blindness, 3 and 5 had deuteranopia (0.6% of total), and protanopia (1% total), respectively.⁴ The obtained results contradict the results of our study and the prevalence of protanopia color blindness is more than that of deuteranopia color blindness, which is probably due to the limited number of patients. However, more study is necessary to find its exact reasons.

In another study carried out in Bushehr, 48 (4.4%) out of 1,100 students suffered from color blindness. The prevalence rates of color blindness were 6.1% and 3.1% in males and females, respectively. The findings of this study are in line with our study where color blindness is more prevalent in males than in females. Finally, deuteranopia (2.2%) was the most common type of congenital color blindness.¹⁴

In another study in Qazvin, the results showed that 49.3% of all 10-25-year-old children had color blindness, of whom 93.9% were females and 56.2% were males.¹⁵ The results obtained from this study are not in agreement with those of our study, and the prevalence of color blindness in females was more than that in males.

Additionally, the results of studies in our country were compared with those of other countries. In the United Kingdom, the prevalence of this disease is reported by 6.6% in males and approximately 17% in females, and it is 4.2% in boys and 46% in girls in Basque, Spain, which is lower than that in the other European countries.¹⁶

In Ethiopia and Germany, the prevalence of the disease is 2.4% and 20%,¹⁷ as well as 75.7% and 36% (18%) in boys and girls, respectively. Interestingly, the prevalence of color blindness is very low among Eskimos.¹⁸

Various factors can affect color blindness prevalence, including genetic factors, which are considered among the most important determinants of the dispersion of the disease and its prevalence in the communities.¹⁷ Different instruments of examination and researchers' interpretations can also lead to inconsistent results.^{8,19} Contradictory results were obtained regarding the prevalence rate of color blindness. Therefore, it is suggested that future studies investigate this problem in the elementary period so that one can take necessary measures and plan better for these students' health status. In future studies, other eye problems (e.g., depth perception, contrast sensitivity, astigmatism, and the like) and their relation to color blindness should be considered as well. It is also advisable to examine the relationship between more demographic variables such as the relationship between genetic and racial factors so that

one can draw a more accurate epidemiologic and clinical picture of color blindness.

Conclusion

The prevalence of the disease in students of secondary education in Shahrekord was 88.8%, which indicated that the number of color-blind people in the region is higher compared to the other regions of the country. Moreover, the prevalence of color blindness was more in males compared to females. In addition, deuteranopia or deuteranomalopia was the other most prevalent kind of color blindness.

Despite the lack of effective treatment for this disease as well as the lack of accurate statistics on it, measures should be taken to educate provincial executive directors, parents, and teachers, along with patients and their relatives, about different dimensions of color blindness in order to reduce the consequences of the disease.

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Ethical Approval

NA.

Conflict of Interest Disclosures

None.

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