

## FREQUENCY OF COLOR VISION DEFICIENCY AND IT'S TYPES IN STUDENTS OF REHMAN COLLEGE OF ALLIED HEALTH SCIENCES, RMI, PESHAWAR

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### Abstract

*Background: (Color vision deficiency, CVD), where the person has difficulty in distinguishing certain colors from one another. Aim of the Study: To identify the prevalence among students of Rehman College of Allied Health Sciences as color discrimination is essential for most clinical and laboratory settings and to provide them of information related to their career. Methods: A Cross-sectional study was conducted anonymously on 85 students of Rehman College of Allied Health Sciences. A structured close-ended questionnaire was distributed for data collection and checking awareness concerning Color vision deficiencies amongst all. Volunteering participants underwent Color vision test including PV-16 test and the data were analyzed to determine the prevalence and distribution of different types of CVD, including Protanopia, deuteranopia and tritanopia. Results: The study found that Deuteranopia is the common color vision defect, affecting 3 students (3.5%) out of 85 students in department. The total frequency of color vision among 85 students is only 3 (3.5%) having deuteranopia. The frequency of protanopia and tritanopia is 0. Deuteranopia is more common affecting males (3 students 3.5% out of 55) more than females (0 out of 30 students 35.2%). Conclusions: Our findings highlight the prevalence of color vision deficiency, particularly Deuteranopia, among students of RMI. Color vision deficiency tests and early intervention are essential to address these conditions and improve students' academic and daily life experiences. Further studies with larger sample sizes are recommended to explore risk factors and trends in Color vision defects.*

## INTRODUCTION:

Color vision deficiency (CVD), commonly known as color blindness, is a congenital or acquired visual disorder characterized by the inability to distinguish certain colors due to abnormalities in retinal cone photoreceptors [1]. The condition primarily affects red-green color discrimination, although blue-yellow deficiency and complete color blindness (achromatopsia) also occur. While CVD does not reduce visual acuity, it can adversely affect academic performance, daily activities, and career opportunities, particularly in professions requiring accurate color discrimination such as medicine, engineering, aviation, and laboratory sciences. Because most inherited forms are X-linked recessive, CVD is considerably more common in males than females [2,3].

Globally, color vision deficiency remains an under-recognized public health concern despite its lifelong impact. Many individuals remain unaware of their condition until they encounter educational or occupational difficulties. Early detection through routine vision screening enables timely counseling, educational support, and informed career planning. However, limited epidemiological data are available regarding the prevalence and distribution of CVD among students in Pakistan, particularly in Peshawar, highlighting the need for locally generated evidence [4,5].

Several international studies have demonstrated that congenital CVD affects approximately 8% of males and 0.5% of females, with prevalence varying across different ethnic populations. Research conducted in China, India, Turkey, and other countries has consistently reported red-green deficiency as the predominant form of CVD. The Ishihara pseudoisochromatic plates remain the most widely used screening tool because of their high sensitivity and specificity, whereas the Farnsworth D-15 and Farnsworth-Munsell 100 Hue tests are useful for classifying the severity and type of color vision deficiency [6,7].

Previous studies have highlighted the educational and occupational implications of CVD. Students with undiagnosed color vision deficiency often experience difficulty interpreting color-coded educational materials, laboratory specimens, graphs, maps, and scientific illustrations. Furthermore,

healthcare professionals, laboratory personnel, and students pursuing careers requiring precise color discrimination may face diagnostic errors or occupational limitations if CVD remains undetected. Despite these challenges, evidence regarding CVD among Pakistani students remains scarce, emphasizing the importance of regional prevalence studies [8,9].

Determining the prevalence and pattern of color vision deficiency among students is essential for developing effective screening programs and educational support strategies. Early identification allows teachers and parents to adopt appropriate teaching methods, provide academic accommodations, and offer career guidance based on individual visual capabilities. The findings of this study may also assist healthcare professionals and policymakers in implementing routine color vision screening as part of school and university health programs [10,11].

Therefore, the present study aimed to determine the frequency and types of color vision deficiency among students in Peshawar. The findings are expected to provide baseline epidemiological data, increase awareness of color vision deficiency, promote early diagnosis, and support evidence-based educational and occupational policies that improve the academic performance and future career planning of affected students [12].

## Materials and Methods

A descriptive cross-sectional study was conducted at Rehman College of Allied Health Sciences over a period of three months to determine the frequency and types of color vision deficiency among students. A non-probability convenience sampling technique was employed, and the sample size of 88 participants was calculated using RaoSoft software with a 5% margin of error, a 99% confidence level, and a 50% response distribution. Registered students of Rehman College of Allied Health Sciences who were willing to participate were included in the study, whereas students with previously diagnosed ocular diseases affecting color vision (such as glaucoma or optic neuritis), moderate to severe visual impairment, or a history of ocular surgery were excluded. Ethical approval was obtained from the Research Ethics Committee of Rehman Medical Institute (RMI) before data

collection. Participants were recruited through classroom announcements, and written informed consent was obtained prior to enrollment. Visual acuity was assessed using the LogMAR visual acuity chart, followed by color vision assessment using the PV-16 color vision test under standardized lighting conditions. Relevant demographic and clinical information were collected using a structured

## RESULTS

**Table 1: Age**

|       | Frequency | Percent |
|-------|-----------|---------|
| 18.00 | 1         | 1.2     |
| 19.00 | 12        | 14.1    |
| 20.00 | 17        | 20.0    |
| 21.00 | 31        | 36.5    |
| 22.00 | 15        | 17.6    |
| 23.00 | 8         | 9.4     |
| 24.00 | 1         | 1.2     |
| Total | 85        | 100.0   |

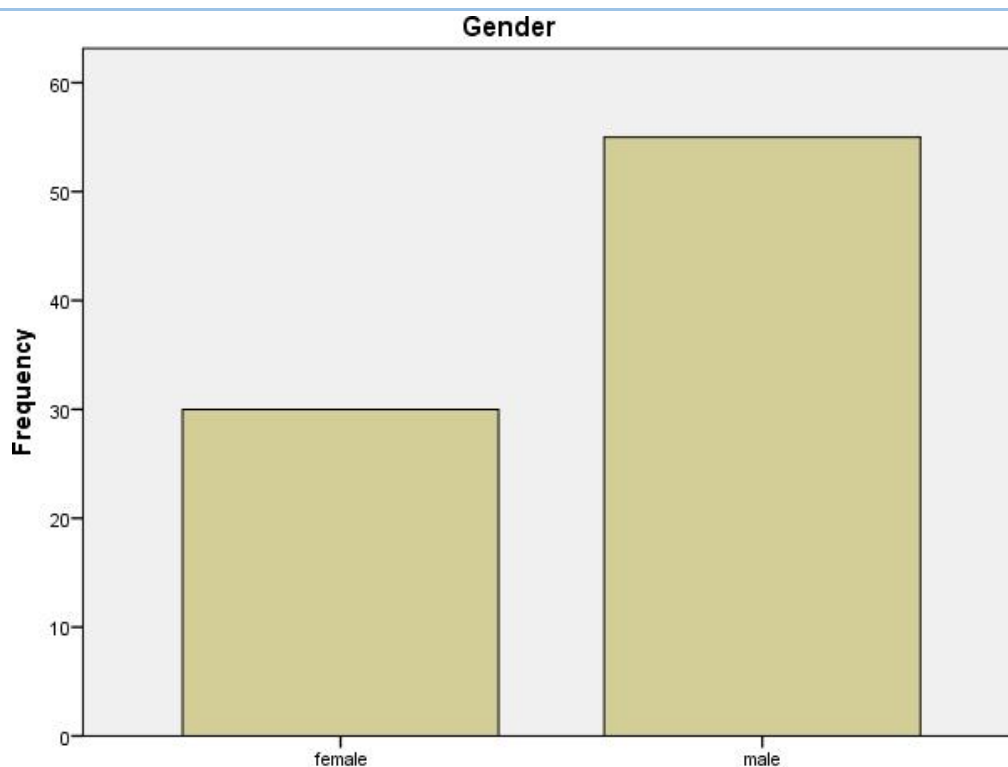
The table representing different group ages ranging from 18-24 years. Majority of age ranging from 20-

**Table 4.2: Gender**

|        | Frequency | Percent |
|--------|-----------|---------|
| female | 33        | 37.5    |
| Male   | 55        | 62.5    |
| Total  | 88        | 100.0   |

The second table is representing total number of students 88 out of which females are 33 and males are 55.

questionnaire. Students identified with color vision deficiency were counseled regarding their condition and future career implications. The collected data were entered and analyzed using the Statistical Package for the Social Sciences (SPSS), and the results were summarized using descriptive statistics and presented in tables and graphs [13,14].

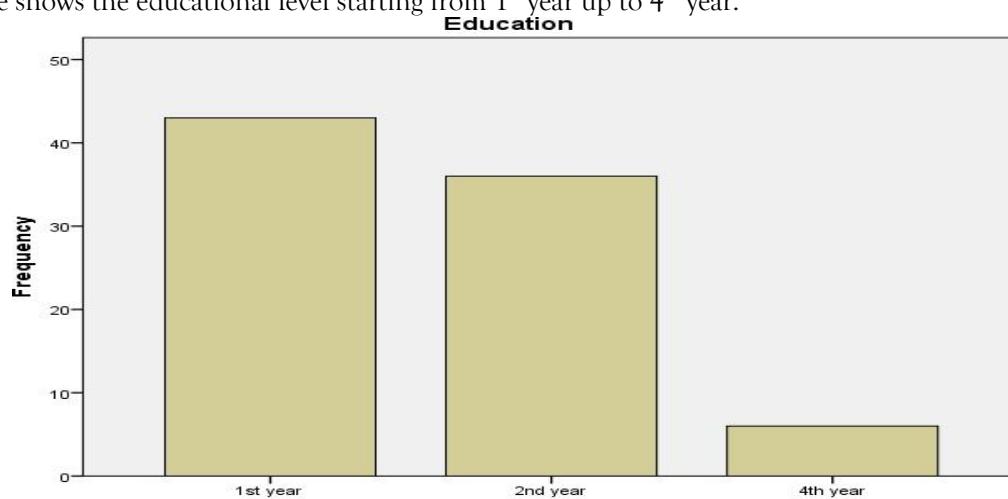


**Gender**  
*Figure 1: Gender*

**Table 3:**      *Education*

|          | Frequency | Percent |
|----------|-----------|---------|
| 1st year | 43        | 50.6    |
| 2nd year | 39        | 44.4    |
| 4th year | 6         | 7.1     |
| Total    | 88        | 100.0   |

This table shows the educational level starting from 1<sup>st</sup> year up to 4<sup>th</sup> year.



**Education**  
*Figure 2: Education*

**Ocular Problem:**

**Table 4:** *Any ocular problem that can affect color vision?*

|       | Frequency | Percent |
|-------|-----------|---------|
| Yes   | 3         | 3.5     |
| No    | 85        | 96.4    |
| Total | 88        | 100.0   |

In this table only 3 (3.5%) out of 85 students has been diagnosed with color vision deficiency.

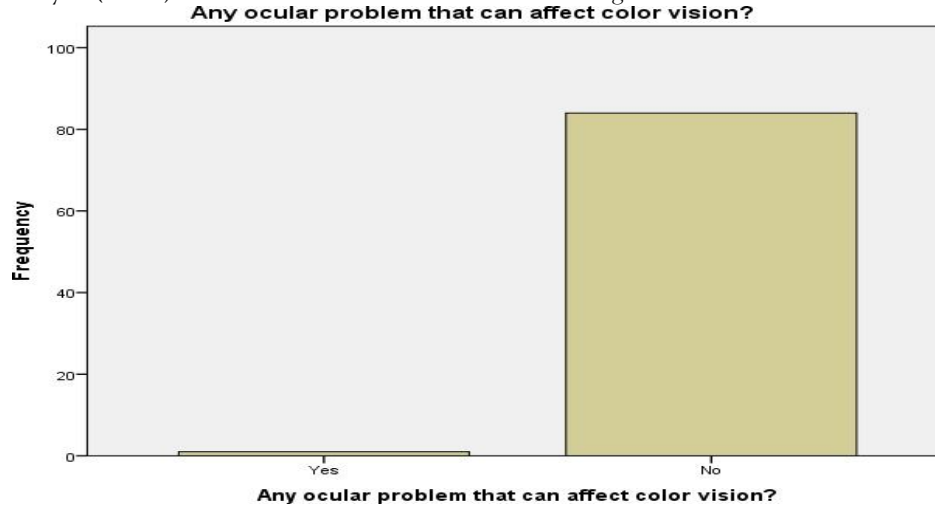


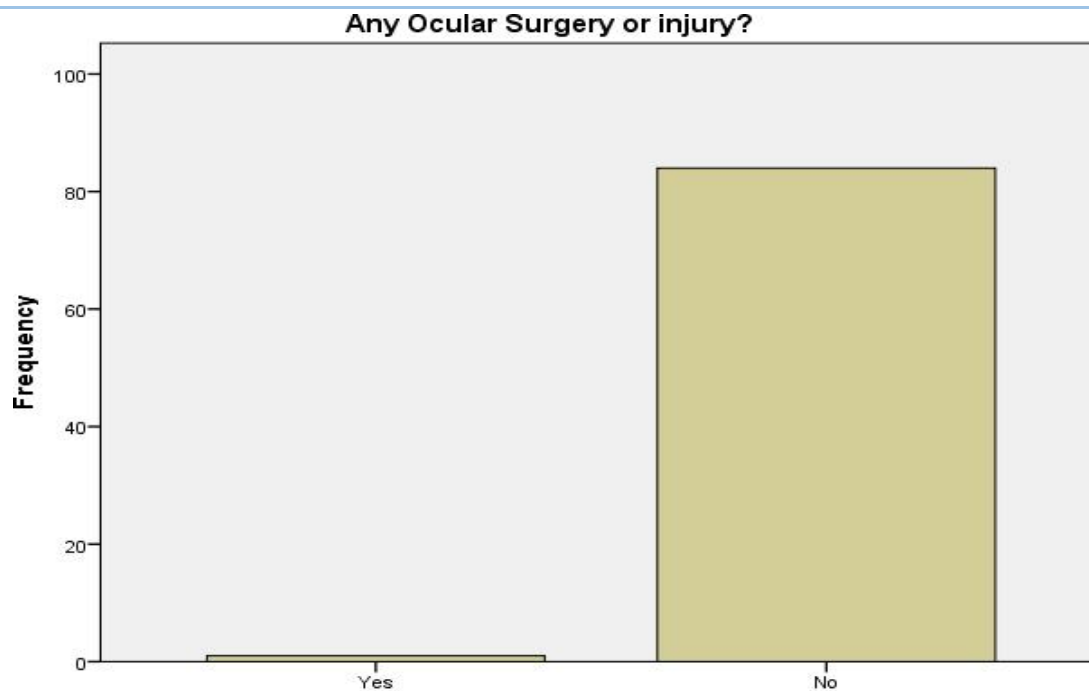
**Figure 3:** *Any ocular problem that can affect color vision?*

**Ocular Surgery**

**Table 5:** *Any Ocular surgery or injury?*

|       | Frequency | Percent |
|-------|-----------|---------|
| Yes   | 0         | 0       |
| No    | 88        | 100     |
| Total | 88        | 100.0   |

No history of ocular injury or surgery has been detected.



**Any Ocular Surgery or injury?**  
*Figure 4: Any Ocular surgery or injury?*

History of glasses:

**Table 6:** *Any history of glasses/Contact lenses?*

|       | Frequency | Percent |
|-------|-----------|---------|
| Yes   | 5         | 5.8     |
| No    | 83        | 94.3    |
| Total | 88        | 100.0   |

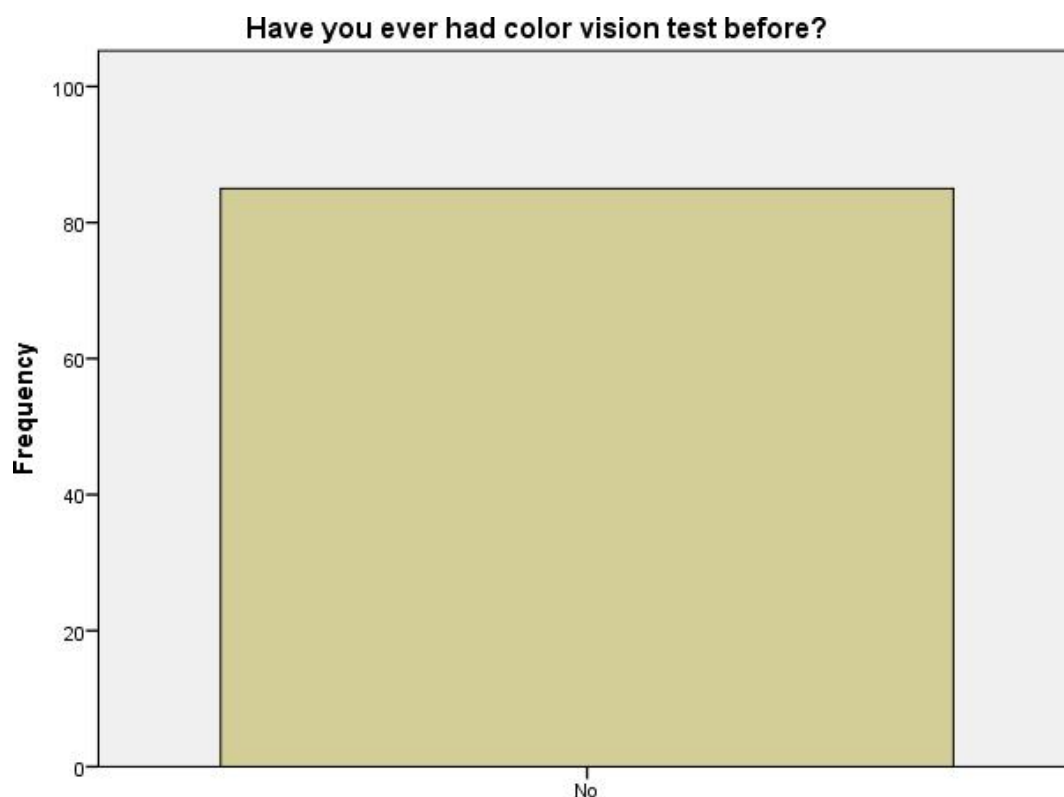
This graph shows the total number of students out of 88 students. having history or usage of glasses which is 5 cases

**Any color vision test before?**

**Table 7:** *Have you ever had color vision test before?*

|    | Frequency | Percent |
|----|-----------|---------|
| No | 88        | 100.0   |

This graph shows that no student has been undergone any type of color vision test before.



**Have you ever had color vision test before?**  
*Figure 5: Have you ever had color vision test before?*

**Table 8: Test Outcome:**

|                     | Frequency | Percent |
|---------------------|-----------|---------|
| Normal color vision | 85        | 96.6    |
| Abnormal            | 3         | 3.4     |
| Total               | 88        | 100.0   |

The table shows the total number of students having color vision defect which is (3, 3.5%) while normal color vision students are (85, 96.6%).

**Type of color vision defect:**

**Table 9: Type of color vision deficiency (if detected):**

|              | Frequency | Percent |
|--------------|-----------|---------|
| Deuteranopia | 3         | 3.4     |
| Normal       | 85        | 96.5    |
| Total        | 88        | 100.0   |

This table represents that only Deuteranopia has been detected in (3) out of 88 students.

#### **DISCUSSION:**

In our study we determined the prevalence of Color Vision deficiency among RMI students, with a total sample size of 88 participants. Our findings indicate that total frequency of color vision deficiency is (3 cases, 3.5%), Deuteranopia is the most common (3 cases, 3.5%). These results are

consistent with global trends showing a rising prevalence of Deuteranopia particularly [15,16].

The gender-wise distribution revealed that prevalence of deuteranopia among males is greater rather than females. This suggests that males are more vulnerable of developing this defect [17]. This is consistent with the known genetics of CVD, which is an X-linked recessive trait [18]. Because males only possess one X, any defective gene causes

CVD. Females on the other hand, inherit two X chromosomes, and a healthy gene on one chromosome can compensate with a faulty gene on the other, resulting in lesser prevalence in female. Among the affected students, the most prevalent type of CVD was Deuteronopia with (3 cases, 3.5%) falling into this category. The frequency of CVD varied across different academic programs, with some disciplines having a higher proportion of students affected [19,20].

The findings of our study align with previous research on color vision deficiency among university students [21]. A study by Tsai et al. (2019) in a hospital setting revealed that color vision deficiencies were present in about 5-10% of laboratory staff. This percentage aligns with findings from other studies in healthcare professions, which report a range of 2-10% prevalence depending on the population studied. While these rates are not extraordinarily high, they raise concerns when considering the critical role color vision plays in laboratory work [22,23].

Our findings also correlate with a study conducted in A study by George et al. (2017) emphasized that even subtle color vision deficiencies among laboratory professionals could result in diagnostic mistakes, such as misidentifying abnormal cell colors or misinterpreting test results. This is particularly concerning in tertiary care hospitals where precision and accuracy are crucial. While some researchers argue that technicians may adapt over time and develop compensatory strategies, the risk of undetected errors remains a significant concern [24,25].

#### CONCLUSION:

Color Vision Deficiency is a common yet often overlooked condition that can significantly impact an individual's academic performance, career choices and daily life. This study is aimed to determine the frequency of color vision deficiency among students of RMI, providing valuable insight into its prevalence. The findings indicate that (3.5%) percentage of students exhibit deuteranopia reinforcing the need for early detection and interventions. Early screening for color vision deficiency is essential, as many individuals remain unaware of their condition until they encounter challenges in tasks in which accurate color

discrimination is required. The lack of awareness and routine testing can lead to difficulties in fields where color discrimination is critical, such as medicine, engineering and design. Furthermore, this study highlights the importance of incorporating color vision screening into routine medical examinations, especially for those students who are pursuing professions related to color perception. Educational institutions and healthcare providers should collaborate to raise awareness, provide necessary accommodations, ensuring that the students with color vision defects get the support they need for their chosen fields. By addressing this issue at an institutional level, we can help individuals with color vision deficiency navigate their academic and professional journeys more effectively.

#### REFERENCES:

1. Williams KM, Hysi PG, Nag A, Yonova-Doing E, Venturini C, Hammond CJ. Age of myopia onset in a British population-based twin cohort. *Ophthalmic Physiol Opt.* 2013;33:339-345.
2. Borchert MS, Varma R, Cotter SA, Tarczy-Hornoch K, McKean-Cowdin R, Lin JH, et al. Risk factors for hyperopia and myopia in preschool children the multi-ethnic pediatric eye disease and Baltimore pediatric eye disease studies. *Ophthalmology.* 2011;118:1966-1973.
3. 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;49:2903-2910.
4. Niyazmand H, Ostadi Moghaddam H, Sedaghat MR, Ahmadi Hosseini SM, Abolbashari F. Anterior segment changes following short-term reading and its correlation with corneal biomechanical characteristics. *Ophthalmic Physiol Opt.* 2013;33:592-596.
5. Dirani M, Tong L, Gazzard G, Zhang X, Chia A, Young TL, et al. Outdoor activity and myopia in Singapore teenage children. *Br J Ophthalmol.* 2009;93:997-1000.
6. Waaler GH. Über die Erbliehkeitsverhältnisse der verschiedenen Arten von angeborener Rotgrünblindheit. *Acta Ophthalmol.*

- 1927;5:309–345.
7. Feig K, Ropers HH. On the incidence of unilateral and bilateral colour blindness in heterozygous females. *Hum Genet.* 1978;41:313–323.
8. Kherumian R, Pickford RW. Paris: Vigot Frères; 1959. Hérédité et fréquence des Anomalies Congénitales du Sens Chromatique: (dyschromatopsies) pp. 63–67.
9. Crone RA. Incidence of known and unknown colour vision defects. A study of 6526 secondary school pupils in Amsterdam. *Ophthalmologica.* 1968;155:37–55.
10. Birch J. Worldwide prevalence of red-green color deficiency. *J Opt Soc Am A Opt Image Sci Vis.* 2012;29:313–320.
11. Chippa SA, Hashmi FK, Ali S, Kamal M, Ahmad K. Frequency of color blindness in pre-employment screening in a tertiary health care center in Pakistan. *Pak J Med Sci.* 2017; 33:430–2.
12. Shah A, Hussain R, Fareed M, Afzal M. Prevalence of Red-Green Colour Vision Defects among Muslim Males and Females of Manipur, India. *Iran J Public Health.* 2013; 42:16–24.
13. Melillo P, Riccio D, Di Perna L, Sanniti Di Baja G, De Nino M, Rossi S, et al. Wearable Improved Vision System for Color Vision Deficiency Correction. *IEEE J Transl Eng Health Med.* 2017; 5:3800107.
14. Neitz J, Neitz M. The genetics of normal and defective color vision. *Vision Res.* 2011; 51:633–51.
15. Merbs SL, Nathans J. Absorption spectra of the hybrid pigments responsible for anomalous color vision. *Science.* 1992; 258:464–6.
16. Abramov I, Hainline L, Turkel J, Lemerise E, Smith H, Gordon J, Petry S. Rocket-ship psychophysics. Assessing visual functioning in young children. *Investigative Ophthalmology and Visual Science.* 1984;25(11):1307–1315.
17. Atowa U, Wajuihian S, Hansraj R. A review of paediatric vision screening protocols and guidelines. *International Journal of Ophthalmology.* 2019;12(7):1194–1201.
18. Azizoğlu S, Crewther S, Şerefhan F, Barutçu A, Göker S, Junghans B. Evidence for the need for vision screening of school children in Turkey. *BMC Ophthalmology.* 2017;17(1):230.
19. Barbur J, Rodriguez-Carmona M. Color vision changes in normal aging. In: Elliott AJ, Fairchild MD, Franklin A, editors. *Handbook of Color Psychology* (pp. 180–196) Cambridge University Press; 2015.
20. Barry J, Mollan S, Burdon M, Jenkins M, Denniston A. Development and validation of a questionnaire assessing the quality-of-life impact of Colour Blindness (CBQoL) *BMC Ophthalmology.* 2017;17(1):1–7.
21. Achenbach TM: Integrative guide for the 1991 CBCL/4-18, YSR and TRF Profiles. 1st ed. Burlington, VT: Department of Psychiatry, University of Vermont.1991.
22. Achenbach TM, Bird HR, Canino G, et al.: Epidemiological comparisons of Puerto Rican and U.S. mainland children: parent, teacher, and self-reports. *J Am Acad Child Adolesc Psychiatry.* 1990;29(1):84–93.
23. Achenbach TM, Hensley VR, Phares V, et al.: Problems and competencies reported by parents of Australian and American children. *J Child Psychol Psychiatry.* 1990;31(2):265–286.
24. Achenbach TM, Rescorla LA: *Manual for the ASEBA School-Age Forms & Profiles.* Burlington, VT: Research Center for Pupil, Youth, & Families, University of Vermont,2001. Reference Source.