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Evaluation of the color vision acuity pattern of undergraduates of health courses in a Brazilian university

Avaliação do padrão de acuidade visual para cores de acadêmicos da área de saúde em Universidade brasileira

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ABSTRACT

Objective: *The goal of the study is to analyze the color vision acuity pattern in undergraduates of health courses and to discuss the impact of these diseases in this population. Color deficiencies interfere significantly in the daily routine of professionals in the health area who need to discern different color hues in several situations of their everyday practice.* ***Methods:*** *Sixty-four volunteers, undergraduates of health courses of the Federal University of Alfenas (UNIFAL-MG), participated in the study. One man was excluded because he did not fit the inclusion criteria. Two groups were analyzed according to sex with the Farnsworth Munsell 100-Hue test.* ***Results:*** *There were no significant differences between the eyes and between the groups analyzed. The color vision acuity pattern is between 35 and 40, according to the Total Error Score. The gender issue does not influence the general pattern of the color vision acuity of the health courses undergraduates when those with color vision disorders are removed.* ***Conclusion:*** *Screenings and guidance should be given to undergraduates of health courses so that, aware of their condition of presenting some type of color disorder, they shall make the appropriate decision on which career to follow so that such limitation does not interfere with the quality of their daily life.*

Keywords: *Color vision; Color vision defects; Color perception; Color perception tests*

RESUMO

Objetivo: O objetivo do estudo é analisar a acuidade visual média para cores de estudantes da área de saúde e discutir o impacto das doenças que a afetam nessa população. Deficiências cromáticas interferem de forma significativa no dia a dia de profissionais da área da saúde que necessitam de discernir diferentes matizes em diversas situações de sua prática profissional. **Métodos:** Participaram da pesquisa 64 voluntários, estudantes de cursos da área de saúde da Universidade Federal de Alfenas, sendo que 1 homem foi excluído por não se adequar aos critérios de inclusão. Dois grupos foram analisados, de acordo com o sexo, com o teste de Farnsworth Munsell 100-Hue. **Resultados:** Não houve diferenças significativas entre os olhos e entre os grupos analisados. O padrão de visão de cores encontra-se entre 35 e 40, de acordo com a Pontuação do Erro Total. A questão de gênero não influencia no padrão geral da qualidade de visão de cores de estudantes da área de saúde, quando retirados aqueles que apresentam distúrbios da visão cromática. **Conclusão:** Devem ser realizadas triagens e orientação para estudantes de cursos da área de saúde para que, cientes da sua condição de apresentar algum tipo de distúrbio cromático, possam tomar a decisão adequada sobre qual carreira seguir para que tal limitação não interfira na qualidade de sua vida diária.

Descritores: Visão de cores; Defeitos da visão cromática; Percepção de cores; Testes de percepção de cores

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Introduction

Health professionals shall have a precise color vision for adequate evaluation and selection of clinical, laboratory and imaging exams in their routine. Therefore, those who present some type of color deficiency have difficulties in the diary exercising of their profession.

One of the few studies in the scope, shows severe difficulties for physicians to adequately measure skin color in relation to pallor, cyanosis, erythema, cutaneous rashes and jaundice, and difficulty in performing ophthalmoscopy and otoscopy, exemplifying only a few practical and vital situations whose impact from low color visual acuity hinders the professional exercise of those affected.

The largest cohort one on the subject, performed in the United Kingdom, evaluated the impact of congenital color deficiencies on the occupational trajectory of about 430 subjects after screening about 12,000 people using the Ishihara test. Some professional areas were considered as highly dependent on color vision, such as the Armed Forces, Medicine, Pharmacy, Civil Aviation, Electrical Engineering, among others, in order to evaluate the presence of people with color deficiencies among them. The study showed that there is no professional orientation to assist such persons in the occupational choice, so that there is no great difference between the jobs occupied by color-blind and non-color-blind people, even in cases where a precise color vision is relevant.

In Iran, a study involving professionals from a large hospital in the capital, Tehran, showed that 2.4% of the staff had color vision deficiencies, a condition that interfered directly in the performance of their duties. Therefore, it was proposed to screen for such a problem, which is neglected, but directly impacts on the quality of services performed by them. Papers even advocate screening for medical students before graduation, in order to guide them about the difficulties faced in the course related to the constant need of using color vision, a fact endorsed by the literature reviewed who concluded that early screening helps the student to deal with the difficulties of his pathological condition in relation to his profession. Quality of life questionnaires were developed for patients suffering from color vision deficiency in order to assess and verify the impact of this condition on their quality of daily life.

Therefore, studies that define color vision normality patterns in different populations are important, as well as the measurement of the color vision acuity, due to its high impact on the lives of those affected. For this, several tests are used, such as the Ishihara test and the Farnworth Munsell 100-Hue test (FM 100-Hue), both performed in the present study. The literature indicates a relationship between the results of the FM 100-HUE test and the nonverbal IQ of the evaluated ones, observing that those with higher IQ scores present better results in relation to the lower IQ groups, both in children and adults. Several studies using FM 100-Hue are performed in specific populations, such as systemic lupus erythematosus patients, young smokers and Bantu people.

In Brazil, studies with FM 100-Hue were performed in groups of workers affected by mercury, alcoholics, type II diabetes, Leber's optic neuropathy, and with individuals with congenital color deficiencies. But no papers were found involving the university population of health courses in Brazil, being it the focus of the present study.

In Turkey, a paper dealing with researches done in medical students was performed, evaluating the color vision acuity, using the Ishihara test and the FM 100-Hue. This similar study evaluated the color vision acuity of undergraduates of health courses, showing the importance of carrying out the same screening research on subjects in Brazil. The study evaluated the ocular dominance for color vision and its acuity, being the only one in the literature found with similar population selected. The present article evaluates the color vision acuity pattern through Ishihara and FM 100-Hue tests in undergraduates of health courses, with the intention of becoming a reference for further studies and screenings involving the same tests in other universities.

Methods

The volunteers were submitted to the following tests: 15-plate Ishihara and Farnsworth Munsell 100-Hue in the N614 room of the Federal University of Alfenas (UNIFAL-MG), under the same lighting conditions. The undergraduates performed the tests on both eyes, first occluding the left one with a buffer and, after performing the test on the right eye, the same test was carried out on the left one, with the right eye being occluded. For the screening of normal subjects, the 15-plate Ishihara test was used: if the threshold of normality (more than 10 correct hits) was reached, the Farnsworth Munsell 100-Hue test was then used to measure the normality pattern of F group and M groups. Because of such a triage, one male volunteer did not reach the normal screening standard and, as being found to have color blindness, was dispensed and referred for specialized ophthalmologic treatment in a secondary outpatient clinic.

The results of the Ishihara and Farnsworth Munsell 100-Hue tests with 64 volunteer undergraduates from the Federal University of Alfenas (UNIFAL-MG) of health courses (medical, nursing and physiotherapy) were analyzed, being all subjects divided into a 28 men group (M group) and a 38 women group (F group), respecting the epidemiological differences in the prevalence of color deficiency on both genders, after the participants have signed the informed consent form and approval of the Research Ethics Committee of the university.

The results were analyzed using the Farnsworth Munsell 100-Hue test software, by the Total Error Score tool or TES, which evaluates the participants according to the color vision acuity as scoring possible errors in the correct sequence of color arrangement in the test. The lower the TES, the greater the color visual acuity. The volunteer with TES under 20 has the color vision acuity above the population's mean in the analyzed eye; between 20 and 100, the color vision acuity equal to the population's mean; and above 100, a low color vision acuity in relation to the population's mean analyzed in the test. We also analyzed the mean of the color vision acuity for all participants in each group for both eyes.

Analysis of Variance (ANOVA) and Tukey's test were used for comparison between male and female groups and for comparison between right and left eyes within the same group, considering a significance level of 5%.

Results

The F group, with 36 volunteers, corresponds to 56.25% of the study participants, while the M group, with 28 volunteers, 43.75% of those that were analyzed. One participant in M group

was not included because he did not reach the minimum inclusion criterion after 15-plate Ishihara test screening.

In the M group, 7 participants with the color vision acuity higher than average (TES < 20), 18 with the color vision acuity within the mean recommended for the test (20 < TES < 100) and 2 with the color vision acuity less than average (TES > 100) were found concerning the right eye. For the left one, there were 9 participants with the color vision acuity above average, 16 with the color vision acuity within the mean and 2 with the color vision acuity below it.

In the F group, 11 participants with the color vision acuity higher than average (TES < 20), 23 with the color vision acuity within the mean recommended for the test (20 < TES < 100) and 2 with the color vision acuity less than average (TES > 100) were found concerning the right eye. For the left one, there were 14 participants with the color vision acuity above average, 20 with the color vision acuity within the mean and 2 with the color vision acuity below it.

The parameter analyzed and used to stablish the pattern proposed in the present study was the Total Error Score (TES), which is the basic parameter taken by the Farnsworth Munsell 100-Hue test for it evaluates the number of changes and distortions in the correct color sequences of the test. It was observed that there were no statistically significant differences between M and F groups, on the right and left eyes. An important finding was that, for the right eye, the M group had an average of 37.7, while the F group had a mean of 39.3; therefore, its mean color vision acuity pattern was higher than that of the M group. This fact, however, from the statistical point of view, is not significant using $p = 0.05$. The standard error for the right eye was 6.22.

For the left eye, the M group showed a mean of 38.0, while the F group had an average of 35.2, reversing what was found above. The mean visual acuity pattern was higher in the F group than that in the M group, but not statistically significant at $p = 0.05$. The standard error for analysis of the left eye was 5.96.

Finally, the comparative analysis between right and left eyes for M and F groups was performed. We found, on average, a higher color vision acuity on the left eye in both groups, without statistical significance. In the M group, the left eye pattern was 37.9, while the right one pattern was 39.1. In turn, the pattern for the F group was 35.2 on the left eye and 39.3 on the right eye. The standard error for the analyzes was, respectively, 7.01 and 5.54.

Discussion

The results of the test make it possible to conclude that, on average, students presented between 35 and 40 points in TES, a number that is within the average of the general population. This implies that the majority of volunteers, regardless of gender, did not display any type of color deficiency or visual acuity below the pattern that would hampers their daily occupational activities.

It is also important to emphasize that there was no discrepancy in the color vision acuity between the groups included in the study. Therefore, the hypothesis that sex does not influence the color vision pattern is confirmed when patients with some type of color deficiency are removed from the evaluation. Another finding was a slight dominance of the left eye in relation to the right for color visual acuity, which corroborates the data of a study with 50 Turkish medical students.

Another point to be discussed is the screening performed for inclusion in the study, through the 15-plate Ishihara Test. Concerning the participants, 1.5% were excluded due to the positivity for a color vision deficiency, a number close to that found in a study which was 2.4%. The literature shows prevalence variations between 6% and 10% in general society. Therefore, in our sample, lower levels of prevalence were found in relation to the general population. This can be explained by the difficulty made explicit by studies for such people to deal with different needs of using color discrimination in their profession, thus choosing another type of area where it is not necessary routinely. A scientist physician reports his difficulties, as colorblind, to enter into the medical profession and into the student routine.

The creation of a Brazilian pattern for the color vision acuity in undergraduates /of health courses also makes it possible to carry out more detailed screening and studies on the subject, including for the guidance of students and professionals who present some kind of color deficiency, as defended by some authors. Some authors report that there is no support for people who are diagnosed with such disorder and who are enrolled in medicine, something that can be solved through screenings and further studies, both with trained professionals and with academics, as an example of lack of orientation of undergraduates about color deficiencies. In a Brazilian study, 13 students from the Federal University of São Carlos interviewed, from courses in the area of exact, human and health sciences, addressing the difficulties undergone by them in graduation, such as questions and prejudices of colleagues and problems with teaching materials and diagnoses, corroborating the importance of studying a pattern to evaluate the interference of such deficiencies in the lives of academics and to increase the interest and diffusion of studies in the area, as well as increasing the occupational orientation for people who have difficulties in certain tasks due to such disorders. A review advocates that "screening" should be adopted in order to guide potential carriers of these disorders for their professional career, reinforcing the importance of screening for the future of such individuals.

Conclusions

After completing the study that determines the color vision acuity pattern for undergraduates of health courses in Brazil, using the Farnsworth Munsell 100-Hue test, we could conclude that the average points in TES parameter (Total Error Score) was between 35 and 40, for both eyes and genders, when individuals with color deficiency are excluded. Based on this, we try to encourage studies about the importance of the color vision acuity in the occupational field, more specifically in health sciences, highly affected by such disorders.

The study, in agreement with the literature, suggests the screening of health professionals prior to or shortly after entering college, in order to clarify this population about the color vision deficiency and the difficulties they will face during their studies and in the profession. They should not be discouraged to work in this area, but rather be oriented so that they can face such difficulty with more discernment and information about the subject.

The present study was carried out with solid methodology and on a theme not previously explored deeply in Brazilian literature, which demonstrates its importance. The main deficiency of the study may be related to the number of participants, a fact, however, that does not invalidate it.

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