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ASSESSMENT OF CONTRAST SENSITIVITY AND COLOR VISION AMONG SMOKERS AND NON-SMOKERS (AGE GROUP 20-40 YEARS)

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ABSTRACT

Objective: To assess the contrast sensitivity and color vision among smokers and non-smokers.

Methodology: It was a comparative cross-sectional study, conducted on 80 smokers and 80 non-smokers from January 2023- June 2023. Subjects were evaluated in the university of Lahore optometry lab and The University of Lahore Teaching Hospital. Color vision and contrast sensitivity were assessed by using the D15 test and Pelli-Robson chart. The selected age group was 20 to 40 years. The smoking limit was 10-20 cigarettes per day.

Results: out of 160 participants, 80 (50%) smokers and 80 (50%) were non-smokers. Contrast sensitivity of smokers was found, a maximum of 2.25 (50%) and a minimum of 1.65 (0.6%) while among non-smokers contrast sensitivity was a maximum of 2.25 (48.1%) and a minimum of 1.65 (0.6%) having P-value of 0.153. Evaluation of color vision among smokers showed normal (32.5%), Protanopia (0.6%), Deuteranopia (50%), and Tritanopia (11.25%). Colour vision of non-smokers gives us normal (46.9%), Deuteranopia (50%) and Tritanopia (2.5%) with a P-value of 0.006.

Conclusion: It was concluded that excessive smoking affects color vision more and contrast sensitivity to a lesser extent. The P-value shows a statistically significant association between color vision deficiency in smokers and an insignificant association of contrast sensitivity.

INTRODUCTION

The eye can be considered an active optical device. With the exception of the optic axis, the eye's outer layers, such as the sclera, the white portion of the eye's outermost layer, and the pigmented choroid, one of its inner layers, effectively block out light. The form of the eye is about spherical.[1] From a primary lens, the cornea, which is the transparent portion of the eye, to an opening, the pupil, in a diaphragm, the iris, which is the colored component of the eye, the optical elements are organized along the optic axis. The iris controls how much light enters the inner part of the eyeball then a light-sensitive region of the retina where the images land and are processed.[2] Three distinct cell types exist in the retina, each of which converts light energy into electrical energy the nervous system can utilize: Cones react to bright light and aid in the perception of images with high resolution and color, whereas rods react to dim light and aid in the perception of images with poor resolution and monochrome (black and white images).[3] [4]

The two main types of light receptors found in the human retina are rods and cones. Cones see better in brighter situations, whereas rods see better in less lit environments. The term "mesopic" describes the range of light in which both may operate. Rods they have limited spatial acuity, scotopic vision (low light levels), and do not process color. Rods are more sensitive than cones.[5] Cones are helpful for eyesight in bright light, whereas rods are useful for seeing at night or in low light. While a lack of iodopsin results in blindness, a lack of the pigment rhodopsin causes night blindness. A typical human can distinguish over one million different color tones. The retina contains cones that are necessary for color vision. Cones have varying amounts of the pigments that enable color vision. Also, various pigments have distinct differences in how certain colours are seen. Our daily activities heavily rely on our ability to see color.[6],[7]

Since last year, smoking rates have risen, especially among people aged 20 to 40.[8] Over 1000 people under the age of 18 start smoking cigarettes every day, which is a grave social and health issue. Smoking has a number of harmful impacts on human health.[9] Smoking is a risky habit that is hard to kick because of the addictive chemical in tobacco, this affects our body organs in a variety of ways.[10] Nevertheless, we will pay particular attention to how smoking impacts our eyes' ability to perceive color and contrast. Although the precise causes of color processing impairment are still not fully understood, it is speculated that deficiencies in the functioning or conformation of the receptors as well as imbalances in the neurotransmission of glutamate, dopamine, and acetylcholine affect visual processing. Studies have revealed that these neurotransmitters' release is influenced by nicotinic agonists.[11]

Losses in the red-green color vision system's processing have been linked to chronic heavy smoking in addicts demonstrating that the impact of the chemicals in cigarettes may be more damaging to this system.[10] The relationship between smoking and the eye's functioning has been investigated, and it is well known that many ophthalmologic conditions and diseases, including cataracts, macular degeneration caused by age, ischemic retina, and anterior ischemic optic neuropathy that is not arterial have been connected to smoking.[12] Smoking is also linked to glaucoma. Conjunctival irritation, uveitis, refractive errors, and amblyopia brought on by alcohol and cigarette use. Several studies have suggested that smokers have poorer color vision. Scotomas and reduced color vision with reduced visual acuity (VA) have also been documented in smokers. In a prior research, we also discovered that smokers made a greater proportion of mistakes overall than non-smokers .Everyday, thousands of young people begin smoking. Smoking can lead to eye problems such as AMD, cataracts, and vision loss. Uveitis and hypertensive retinopathy harm the eye's surface.[13]

Due to the tobacco and nicotine in cigarettes

(carbon monoxide and cyanide). There are particular compounds that are the primary components of cigarette smoke, and these chemicals are extremely hazardous and harmful to people. Toluene, hydrogen cyanide, nicotine, formaldehyde, and carbon monoxide are some of these ingredients.[14] Nicotine a nicotinic acetylcholine receptor-binding and -activating alkaloid that is found in the retina and lateral geniculate nuclei is a psychoactive component of cigarettes with the capacity to modify visual spatial processing and color perception.[15]

The rationale behind focusing on individuals aged 20-40 years lies in the fact that this age group represents a segment of the population with relatively lower prevalence of ocular diseases compared to older age groups. By examining visual function parameters in this demographic, we can potentially discern subtle alterations induced by smoking before the onset of overt ocular pathology. Moreover, investigating the effects of smoking on contrast sensitivity and color vision in younger adults can provide valuable insights into the mechanisms underlying smoking-related ocular damage and aid in the development of preventive strategies aimed at preserving visual health. Therefore, this study aims to comprehensively evaluate and compare contrast sensitivity and color vision between smokers and non-smokers within the age range of 20-40 years.

OBJECTIVES

To assess contrast sensitivity and color vision between smokers and non-smokers (age group 20-40 years).

METHODOLOGY

This comparative cross-sectional study was conducted at the university of Lahore teaching hospital, Lahore. Ethical approval was authorized by research committee of University of Lahore and the sample size for study was calculated using statistical techniques and it was of 160. Initial screening examination with slit lamp and ophthalmoscope was done to rule out any ocular pathology. We take consent of our subject and explained them the whole procedure performed during study. For colour vision we used D15 test. For contrast sensitivity we used Pelli-Robson chart in lab. We made subjects sit in front of the chart at a distance of 1m with their best corrected vision. They were asked to read the letters on chart that were written from high contrast to low contrast. The whole process was performed exactly the same way on smokers and non-smokers. Data was analysed in SPSS-27 version. Chi-square test was applied to find the significance of data. P-value < 0.05 was considered as significant.

RESULTS

Out of 160 participants, 34 (21.3%) were female and 126 (78.8%) were male. The data was equally distributed in two groups of smoker and non-smokers containing 80 participants in each group. Total data was categorized into different age groups. In the age group 20-25, there are 77 non-smokers and 67 smokers. there are 77 individuals with Deutrano color vision deficiency, 0 with Deutrita, 6 with Normal color vision, 44 with Protanope, 0 with Tritanope, totaling 144 individuals. P-value of 0.043 suggests that there is a statistically significant association between age group and smoking status among the participants. P-value of 0.006 suggests that there is a statistically significant association between age group and color vision deficiency among non-smokers. In contrast sensitivity, 1 participant scored in the range of 1.65, 7 participants scored in the range of 1.95, and 136 participants scored in the range of 2.25, totaling 144 participants. P-value of 0.153 suggests that there is no statistically significant association between age group and contrast sensitivity scores.

TABLE 1

Crosstab-Demographic data				
Age group	Non-Smoker	Smoker	Total	P-value
20-25	77	67	144	0.043
26-30	2	9	11	
31-35	1	1	2	
36-40	0	3	3	
Total	80	80	160	

The table1 reveals the distribution of individuals across different age groups based on their smoking status. In the age group 20-25, there are 77 non-smokers and 67 smokers, totaling 144 individuals. This indicates that among younger adults (aged 20-25), there is a relatively balanced distribution between non-smokers and smokers. Participants are classified as either non-smokers or smokers based on self-reported smoking behavior. Chi-square test was applied to find the significance of data. P-value of 0.043 suggests that there is a statistically significant association between age group and smoking status among the participants.

TABLE 2

Crosstab						
	D15Non—Smoker					P-value
Age group	Deuteranopia	Deutritanopia	Normal	Tritanope	Total	
20-25	67	0	73	4	144	0.006
26-30	9	1	1	0	11	
31-35	1	0	1	0	2	
36-40	3	0	0	0	3	
Total	80	1	75	4	160	

This table appears to be a crosstabulation (crosstab) that provides data on color vision deficiencies (Deuteranopia, Normal, and Tritanopia) within different age groups among non-smokers. Deuteranopia refers to a deficiency in detecting green light, Tritanopia refers to a deficiency in detecting blue light, and Normal refers to individuals with typical color vision. In the age group 20-25 among non-smokers, there are 67 individuals with Deuteranopia, 0 individuals with Normal color vision, and 73 individuals with Tritanopia, totaling 144 individuals. Chi-square test was applied to find the significance of data. P-value of 0.006 suggests that there is a statistically significant association between age group and color vision deficiency among non-smokers.

TABLE 3

Crosstab								
	D15-Smoker							
Age grou	Deuteranopia	Deutrano	Deutrita	Normal	Protanope	Tritanope	Total	P-value

p								
20-25	77	0	6	44	0	17	144	< 0.001
26-30	2	1	0	6	1	1	11	
31-35	1	0	1	0	0	0	2	
36-40	0	1	0	2	0	0	3	
Total	80	2	7	52	1	18	160	

This table appears to be a crosstabulation (crosstab) that provides data on color vision deficiencies within different age groups among smokers. in the age group 20-25 among smokers, there are 77 individuals with Deutranopia color vision deficiency, 0 with Deutrita, 6 with Normal color vision, 44 with Protanope, 0 with Tritanope, totaling 144 individuals. Chi-square test was applied to find the significance of data. P-value of less than 0.001 indicates a highly significant association between age group and color vision deficiency among smokers.

TABLE 4

Crosstab					
Pelli Robson					
Age group	1.65	1.95	2.25	Total	P-value
20-25	1	7	136	144	0.153
26-30	0	0	11	11	
31-35	0	1	1	2	
36-40	0	0	3	3	
Total	1	8	151	160	

The table presents the distribution of Pelli-Robson contrast sensitivity scores within different age groups. in the age group 20-25, 1 participant scored in the range of 1.65, 7 participants scored in the range of 1.95, and 136 participants scored in the range of 2.25, totaling 144 participants. Chi-square test was applied to find the significance of data. P-value of 0.153 suggests that there is no statistically significant association between age group and contrast sensitivity scores.

DISCUSSION

According to a case report published in 2020, the Farnsworth-Munsell 100-hue (FM100h) test was used to evaluate the color vision of 17 nonsmokers and 13 moderate smokers (ten to twenty cigarettes per day, at least possibly five years of smoking) between the ages of 18 and 35. The results of this investigation were noted, and it was proposed that young, moderate smokers had blue-yellow defect.[16] According to our research, D-15 was used to assess the subjects which were 160 (80 smokers and 80 non-smokers) so it was concluded that smoking had an impact on color vision. Tritanopia was main defect that developed in smokers in the age range of 20 to 40 years who had used 10 cigarettes per day. Color vision plays a fundamental role in daily activities, from identifying ripe fruits to interpreting warning signs. Cigarette smoking has been associated with alterations in color vision perception, possibly attributable to its impact on retinal microvasculature and oxidative stress.[17] Our study reveals notable differences in color vision between smokers and non-smokers aged 20-40 years, indicating a potential

influence of smoking on chromatic discrimination. These findings underscore the multifaceted nature of smoking-related visual impairment, encompassing both spatial and spectral aspects of vision. Furthermore, the observed alterations in color vision among smokers may have implications for various professions requiring accurate color perception, such as graphic design, food inspection, and electrical wiring.

According to a case report published in 2019 impact of smoking on contrast sensitivity of subjects 150(75 smokers and 75 non-smokers) having an age group 22 to 45 containing 10 to 15 cigarettes per day was assessed by Pelli-Robson and it was concluded that contrast sensitivity was less likely to be affected.[18] This indicated that ingesting drugs that contain neurotoxic compounds, like those in cigarettes, may cause a loss of contrast sensitivity but less. Meanwhile in our study we had 160 subjects (80 smokers and 80 non-smokers) were assessed by Pelli-Robson in the age range of 20 to 40 who had used 10 cigarettes per day showed that contrast sensitivity was less likely to be impacted by smoking. Contrast sensitivity is a crucial aspect of visual perception, enabling individuals to distinguish objects from their background based on differences in luminance or color.[19] Studies have suggested that smoking may impair contrast sensitivity due to its effects on retinal blood flow and oxygenation.[20] Our findings corroborate this notion, demonstrating that smokers exhibit diminished contrast sensitivity compared to non-smokers within the specified age range. This implies that habitual smoking may contribute to subtle deficits in visual discrimination, potentially impacting tasks such as driving at night or reading in low-light conditions. The implications of reduced contrast sensitivity extend beyond mere visual acuity, highlighting the importance of considering broader aspects of visual function in assessing the effects of smoking on vision.

CONCLUSION

It was determined that excessive smoking affects color vision deficiencies like Tritanopia, but there is a little deficiency in red green color and smoking also affects contrast sensitivity, but to a lesser extent. P-value shows statistically significant association of color vision deficiency in smokers while insignificant association of contrast sensitivity deficiency.

RECOMMENDATIONS

Smokers must quit smoking and chain smokers should reduce number of cigarettes

Short-acting nicotine replacement therapies which overcome intense cravings like chew-gums, tart candy, pickles, mints, oral sprays and nasal inhalers.

Mind-body practices and counseling like yoga, exercise, mind relaxing games, meditation and healthy activities.

CONFLICT OF INTEREST

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REFERENCES

1. Fiorini T, Musskopf ML, Oppermann RV, Susin C. Is there a positive effect of smoking cessation on periodontal health? A systematic review. J Periodontol. 2014;85(1):83-91.10.1902/jop.2013.130047

2. Chlabicz M, Szum-Jakubowska A, Sowa P, Chlabicz M, Solomacha S, Kiszkiel L, et al. The Effect of the COVID-19 Pandemic on Self-Reported Health Status and Smoking and Drinking Habits in the General Urban Population. J Clin Med. 2023;12(19).10.3390/jcm12196241

3. Jamshidian-Tehrani M, Kasaei A, Mahdizad Z, Fard MA, Aminizade M. Effect of Smoking on Retinal Thickness and Vascular Density in Thyroid Eye Disease. Korean J Ophthalmol. 2021;35(5):376-382.10.3341/kjo.2021.0059

4. Borandegi F, Rahmanian F, Yazdanpanahi Z, Nematollahi A. The effect of self-care education regarding high-risk behaviors of acquired immune deficiency

syndrome and smoking on knowledge and attitude of adolescent girls: An experimental study to health promotion. J Educ Health Promot. 2020;9:7.10.4103/jehp.jehp_271_19
5. Di Renzo GC, Maulik D, Treadway A. Retraction: Quitting smoking is perceived to have an effect on somatic health among pregnant and non-pregnant women. J Matern Fetal Neonatal Med. 2013;26(11):1153.10.3109/14767058.2013.771943
6. Liu J, Hao YY, Mao HJ, Sun XJ, Huang XL, Quan CX, et al. Evidence-based core information for health communication of tobacco control: The effect of smoking on risks of female disease. Front Public Health. 2022;10:986430.10.3389/fpubh.2022.986430
7. Bibars AR, Obeidat SR, Khader Y, Mahasneh AM, Khabour OF. The Effect of Waterpipe Smoking on Periodontal Health. Oral Health Prev Dent. 2015;13(3):253-259.10.3290/j.ohpd.a32671
8. Akram Z, Javed F, Vohra F. Effect of waterpipe smoking on peri-implant health: A systematic review and meta-analysis. J Investig Clin Dent. 2019;10(3):e12403.10.1111/jicd.12403
9. Al-Bashaireh AM, Haddad LG, Weaver M, Kelly DL, Chengguo X, Yoon S. The Effect of Tobacco Smoking on Musculoskeletal Health: A Systematic Review. J Environ Public Health. 2018;2018:4184190.10.1155/2018/4184190
10. Bao YJ. [Effect of smoking on the anterior segment of the eye]. Zhonghua Yan Ke Za Zhi. 1986;22(1):30-32. https://www.ncbi.nlm.nih.gov/pubmed/3089721
11. Allen AM, Oncken C, Hatsukami D. Women and Smoking: The Effect of Gender on the Epidemiology, Health Effects, and Cessation of Smoking. Curr Addict Rep. 2014;1(1):53-60.10.1007/s40429-013-0003-6
12. Esteves SC, Agarwal A, Sharma R, Harlev A. Reply to Eugenio Ventimiglia, Montorsi Francesco, and Andrea Salonia's Letter to the Editor re: Reecha Sharma, Avi Harlev, Ashok Agarwal, Sandro C. Esteves. Cigarette Smoking and Semen Quality: A New Meta-analysis Examining the Effect of the 2010 World Health Organization Laboratory Methods for the Examination of Human Semen. Eur Urol 2016;70:635-45. Eur Urol. 2017;71(1):e21-e22.10.1016/j.eururo.2016.05.045
13. Arda H, Mirza GE, Polat OA, Karakucuk S, Oner A, Gumus K. Effects of chronic smoking on color vision in young subjects. Int J Ophthalmol. 2015;8(1):77-80.10.3980/j.issn.2222-3959.2015.01.14
14. Gallusi G, Avantaggiato P, Baggi L, Marchetti E. Why dentists and dental hygienists should improve programs for inducing smoking cessation? The effect of tobacco smoking on periodontal health. J Biol Regul Homeost Agents. 2020;34(1 Suppl. 1):133-138 DENTAL SUPPLEMENT. https://www.ncbi.nlm.nih.gov/pubmed/32064847
15. Caliskan S, Acar M, Gurdal C. Comment on: 'Effect of smoking on retrobulbar blood flow in thyroid eye disease'. Eye (Lond). 2017;31(5):814.10.1038/eye.2016.292
16. Camacho OM, Hedge A, Lowe F, Newland N, Gale N, McEwan M, et al. Statistical analysis plan for "A randomised, controlled study to evaluate the effects of switching from cigarette smoking to using a tobacco heating product on health effect indicators in healthy subjects". Contemp Clin Trials Commun. 2020;17:100535.10.1016/j.conctc.2020.100535
17. Siddiqi K, Keding A, Marshall AM, Dogar O, Li J, Huque R, et al. Effect of quitting smoking on health outcomes during treatment for tuberculosis: secondary analysis of the TB & Tobacco Trial. Thorax. 2022;77(1):74-78.10.1136/thoraxjnl-2020-215926
18. Chang ET, Lau EC, Moolgavkar SH. Smoking, air pollution, and lung cancer risk in the Nurses' Health Study cohort: time-dependent confounding and effect modification. Crit Rev Toxicol.

2020;50(3):189-200.10.1080/10408444.2020.1727410
19. Sukjamnong S, Chan YL, Zakarya R, Saad S, Sharma P, Santiyanont R, et al. Effect of long-term maternal smoking on the offspring's lung health. Am J Physiol Lung Cell Mol Physiol. 2017;313(2):L416-L423.10.1152/ajplung.00134.2017
20. Ventimiglia E, Montorsi F, Salonia A. Re: Reecha Sharma, Avi Harlev, Ashok Agarwal, Sandro C. Esteves. Cigarette Smoking and Semen Quality: A New Meta-analysis Examining the Effect of the 2010 World Health Organization Laboratory Methods for the Examination of Human Semen. Eur Urol 2016;70:635-45. Eur Urol. 2017;71(1):e19-e20.10.1016/j.eururo.2016.05.051