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Evaluation of the effects of single vision lenses with additional near-power on computer-induced asthenopia

Avaliação dos efeitos de lentes de visão simples com poder adicional de perto na astenopia induzida por computador

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ABSTRACT

Objective: *Compared to standard spectacle lenses, do +0.40 EyeZenTM lenses reduce symptoms of asthenopia induced by computer?* ***Methods:*** *A prospective clinical study was carried out with 39 volunteers who spent more than 4 hours a day using a computer (age, 27.31±4.24; male: female =13:26). Asthenopia and visual comfort were assessed using a questionnaires. All participants completed the asthenopia questionnaire with updated regular lenses (baseline). After 4 weeks of +0.40 Eyezen™ lenses wearing all subjects answered the asthenopia questionnaire and a second questionnaire to establish their level of satisfaction with these lenses. Statistical analysis was performed usind the Shapiro-Wilk test and Wilcoxon test, and p-values less than 0.05 were considered statistically significant.* ***Results:-*** *Compared to standard spectacle lenses (baseline), +0.40 EyeZenTM lenses wearing reduced the total asthenopia score from17.44 ± 5.51 to 13.18 ± 10.22 (p < 0.001). Regarding the perception of the visual comfort levels with these lenses in the management of digital devices, more than 90% of subjects said they were entirely or delighted with their visual comfort..* ***Conclusions:*** *Digital asthenopia induced by computer was significantly reduced by +0.40 EyeZen lenses wearing.*

Keywords: *Computer vision syndrome; Asthenopia; Occupational diseases; Occupational medicine*

RESUMO

Objetivo: Comparadas com lentes oftálmicas regulares, as lentes de visão simples com +0,40D de poder adicicional de perto reduzem os sintomas de astenopia induzida por computador? **Métodos:** Foi realizado um estudo clínico prospectivo com 39 voluntários que passavam mais de 4h diárias utilizando computador (idade: 27,31±4,24 anos; masculino:feminino = 26:13). A astenopia e a percepção do conforto visual foram avaliadas com questionários. Todos os participantes respoderam ao questionário de astenopia com lentes regulares atualizadas (baseline). Após 4 semanas de uso das lentes +0.40 Eyezen™ os participantes responderam aos questionários de astenopia e de conforto visual. A análise estatística foi feita com os testes de Shapiro-Wilk e Wilcoxon. Valores de p<0,05 foram considerados estatísticamente significantes. **Resultados:** Comparadas com lentes oftálmicas regulares (baseline), o uso das lentes de visão simples com +0,40D de poder adicional de perto reduziu o escore total de astenopia de 17,44 ± 5,51 para 13,18± 10,22 (p< 0,001). Mais de 90% dos participantes se declaram completamente ou muito satisfeitos com o conforto visual percebido no uso de dispositivos digitais. **Conclusão:** A astenopia induzida por computadores foi significativamente reduzida pelo uso das lentes +0,40 Eyezen™ combinadas Crizal® Sapphire™.

Descritores: Síndrome da visão do computador; Astenopia; Doenças ocupacionais; Medicina ocupacional

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Introduction

With the increasing use of electronic devices - computers, tablets, smartphones, or e-books – there is an increased effort for near vision, and all this entails: increased accommodation/convergence, increased visual attention, and decreased blinking with dry eye (DE) symptoms[1]. If this effort is pronounced and/or maintained failure of the adaptation mechanisms might occur, with the exhaustion of the ocular muscles (intrinsic and extrinsic muscles) and subsequent visual fatigue leading to the inability to accomplish the tasks that were intended – digital asthenopia (DA) [1-3]. On screens, characters are becoming smaller and more pixelated [4,5]. Eyes are exposed to the brightness of our screens for a longer time [6]. In addition to reading books, we also read on smartphones, e-books, tablets, and computers at different distances (some of them quite short) and in various postures [4-6]. Single vision lenses with additional near-power has been developed to relieve accommodative effort and improve performance in activities that require frequent use of near vision closely, as with users of digital screens [7]. The purpose of the present study was to evaluate the effects of single vision lenses with additional near-power (+0.40 EyeZenTM) on asthenopia induced by computer.

Methods

This prospective clinical study followed the tenets of the Declaration of Helsinki and was approved by the Research Ethics Committee of Faculty of Medicine, University of São Paulo, São Paulo, Brazil (87584318.1.3001.0065; 10/16/2018). Written informed consent was obtained from participants before their enrollment. The inclusion criteria were: (i) healthy adults aged 20–34 years who spend more than 4h daily working on VDTs, and (ii) refractive errors with spherical components between ± 4D and cylindrical between ±2.00 D corrected with updated glasses equipped with standard lenses. The exclusion criteria were: (i) active condition of an allergic, inflammatory or infectious nature, on the ocular surface; (ii) users of medications that influence the vision and/or muscle function; (iii) contact lens wearers; (iv) strabismus and/or amblyopia; and (v) anisometropia greater than 1.50 D. Forty-nine eligible volunteers were recruited.

Ophthalmic screening test included slit-lamp microscopy, cover and cover-uncover tests, non-contact intraocular pressure measurement, accommodation amplitude (AA), and near the point of convergence (NPC) measurements, ocular refraction under cycloplegia, corrected distance visual acuity and indirect fundoscopy. After passing the screening test, all subjects were designated to receive new glasses with the same optical corrections equipped with +0.40 Eyezen™lenses combined with Crizal® Sapphire™ anti-reflective coating.

Asthenopia digital was evaluated using a modified version of the questionnaire developed by Ames et al [8]. The survey consisted of 10 questions related to asthenopia graded on a scale from 0 to 6, with 0 defined as none and six as most severe; a score of 60 correspondings to the most severe asthenopia.

All subjects completed the asthenopia questionnaire with their glasses equipped with standard lenses (baseline). After four weeks of single vision lenses with additional near-power of +0.40 D all subjects answered the asthenopia questionnaire and a second questionnaire to establish their level of satisfaction in terms of visual comfort and perceived benefits, especially when using digital devices. Statistical analyses were performed using R Studio Program ver. 1.2.5001 (RStudio, Boston, MA, USA). Since the assumption of normality was rejected (Shapiro-Wilk test), comparisons of both glasses concerning asthenopia scores were made with the non-parametric Wilcoxon test and p-values less than 0.05 were considered statistically significant. Since the assumption of normality was rejected (Shapiro-Wilk test), comparisons of both glasses concerning asthenopia scores were made with the non-parametric Wilcoxon test and p-values less than 0.05 were considered statistically significant.

Results

The age of the participants was 27.31± 4.24 years (20-34 years), is 26 (67%) females, and 13 (33%) males. Concerning the number of equipment with digital screens viewed simultaneously in daily life, 22 (56%) reported three or more devices. Thirty-three (85%) subjects reported everyday computer use for more than 6 hours. Ametropia distribution by the mean sphere of the right eye is shown in Figure 1. The cylinder distribution of the right eye is shown in Figure 2. It indicates a high percentage of low astigmatism values, with 82% of the sample having a cylinder of fewer than 0.5 diopters.

The AA measurements before and after 4 weeks of the +0.40 EyeZen™ lenses wearing were 11.50±1,88 D and 11.61±1,62D, respectively (p=0.521). The NPC measurements were 6.50±2.89 cm and 6.71±3.42 cm, respectively (p=0.939).

Total asthenopia score in the use of glasses equipped with standard lenses (baseline) was 17.44 ± 5.42 (maximum possible overall asthenopia score was 60). Tired eye, sore/aching eye, and visual discomfort mean scores were above 2.0. After four weeks of single vision lenses with additional near-power of +0.40 D we-

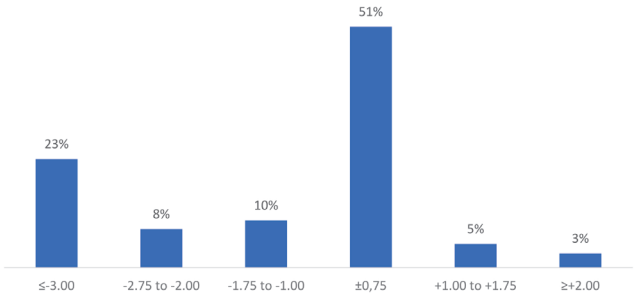

Figure 1. Ametropia distribution (right eye mean sphere).

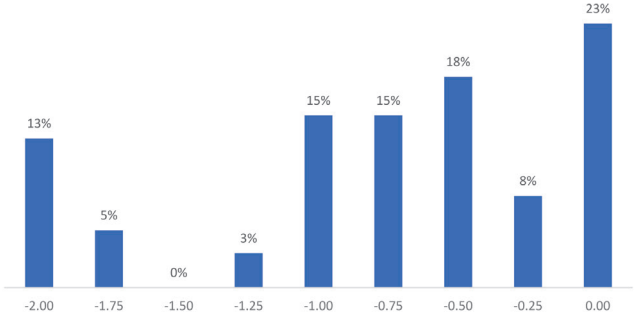

Figure 2. Cylinder distribution (right eye cylinder).

Table 1
Changes in asthenopia questionnaire responses in the use of glasses equipped with standard lenses (baseline) and with single vision lenses with additional near-power of 0.40 D (n = 39)

Symptoms	Standard lenses	+0.40EyeZen™ lenses	p-value
Tired eye	2.69 ± 0.77	2.31 (1.44)	0.2512
Sore/aching eye	2.21 ± 1.00	2.03 (1.81)	0.2887
Irritated eye	1.74 ± 1.12	1.46 (1.47)	0.1407
Watery eye	1.15 ± 1.33	1.26 (1.52)	0.9622
Dryness	1.72 ± 1.12	1.05 (1.32)	0.0032*
Eye strain	1.80 ± 1.24	1.28 (1.28)	0.0460*
Hot/burning eye	0.92 ± 0.90	0.54 (1.17)	0.0052*
Blurred vision	1.39 (0.94)	0.69 (1.10)	0.0007*
Difficulty in focusing	1.74 ± 1.39	1.39 (1.14)	0.3194
Visual discomfort	2.08 ± 0.93	1.18 (1.59)	0.004*
Total	17.44 ± 5.42	13.18 (10.22)	0.0024*

Values presented in mean and standard deviation * Wilcoxon Test®

aring, the ratings for five items (dryness, eye strain, hot/burning eye, blurred vision, and visual discomfort) were significantly decreased, and the total asthenopia score drops to 13.18± 10.22 ($p < 0.001$) (Table 1).

The results of visual comfort satisfaction levels with +0.40 Eyezen™ lenses with Crizal® Sapphire™ coating are shown in Figure 3.

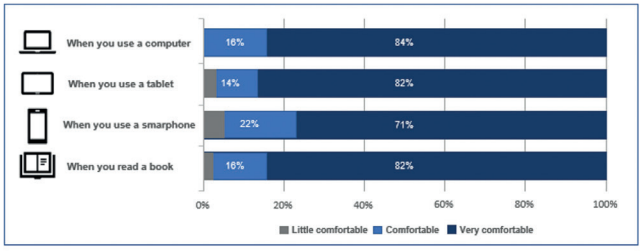

Figure 3: Levels of visual comfort with glasses equipped with +0.40 EyeZen™ lenses, combined with Crizal® Sapphire™ coating

Regarding the perception of the visual comfort levels with +0.40 Eyezen™ lenses combined with Crizal® Sapphire™ coating in the management of digital devices, more than 90% of subjects said they were entirely or delighted with their visual comfort.

Discussion

This study included health adult volunteers 20-34 years old engaged in 4 or more hours of daily near work computer screen watching. However, 85% of them reported daily computer use for more than 6 hours. In the present investigation, computer work was shown to affect subjective asthenopia symptoms (Table 1) significantly. Previous studies have shown that computer use for more than 4 hours at a time can increase eye discomfort substantially [9,10] . Similarly, readers of electronic books with liquid crystal display (LCD) monitors also experienced marked visual fatigue [11]. While symptoms are usually transient, the condition can cause significant, frequent, discomfort for sufferers and may have substantial economic consequences when vocational computer users are affected through increased errors and more frequent breaks[12].

Recent studies have reported a relationship between VDT use and mental symptoms and the dose-response effect of near work [13,14]. However, DA is a multifactorial condition with several potential contributory causes, such as uncorrected refractive error, oculomotor diseases, tear abnormalities, and/or musculoskeletal problems [15,16]. The subjects recruited for the study had their refractive errors properly corrected and did not present oculomotor diseases or accommodative or converge problems. AA was measured by the push-up method, which determines the level of amplitude based on the stimulus location. The convergence and accommodative systems work together during near work and form two components of the triad response to near work (the other being miosis) [17]. Cortical commands control the abduction and adduction of the eyes to diverge and converge, for a target moving respectively from near to far or vice versa [18]. NPC was measure by approaching an optotype until the examined one sees in diplopia. A significant decrease in AA was demonstrated after 40 minutes of computer activity as a result of fatigue of accommodation [19].

Another study showed a drop in accommodative power of +0.4D after 20 minutes of near-vision work for a traditional reading task [20]. The EyeZen™ lenses were developed to relieve the accommodative stress that occurs in near work.21 The additional power values selected are related both to the fact that the AA of accommodation decreases with age [17]. and that accommodative power drops after sustained and prolonged near-vision work [19-20]. For this reason, the additional refractive power provided is +0.40D for the 20-34 age group, +0.60D for the 35-44 age group, and 0.85D for the 45-50 age group [21]. With the increasing use of Eyezen™ lenses that relieve the symptoms of visual fatigue, one of the questions is how these lenses would affect or not wearers binocular vision. In this research, there were no statistically significant differences in AA or NPC measurements baseline and after +0.40 EyezenTM lenses wearing. Hence, in the conditions of this study, +0.40 EyezenTM lenses did not impact the binocular functions of the eye.

Portello et al. [22] identified a clear split of computer-related symptoms into two categories: those associated with the accommodation (a blurred vision after computer use, difficulty refocusing from one distance to another and visual discomfort) and those that seemed linked to DE (tired eye, sore/aching eye,

hot/burning eye, irritated eye, dryness, and eyestrain). Blurred vision and visual discomfort symptoms scores associated with accommodation were significantly reduced with single vision lenses with additional near-power of +0.40 D wearing. Tired eye, dryness, and hot/burning eye symptoms scores linked to DE also were significantly decreased with single vision lenses with additional near-power of +0.40 D wearing. The anti-reflective Crizal® Saphire™ coating doesn't just help with glare but also reduces reflections from all directions, providing better aesthetics and enhanced UV protection [23].

The DE syndrome has been reported in up to 60% of individuals who work with video monitors [24]. This prevalence is very high, whereas as when considering that the prevalence of DE syndrome in the general population is approximately 10% [25]. Reduced blink rate is consistently reported with computer use [26,27], which enables the greater evaporative loss of tears, thus causing increased in ocular symptoms [28]. Changes to tear film composition such as reduced mucin production, an increase of inflammatory markers, and tear osmolarity have been reported in computer users [29,30].

It is worth highlighting the hazard linked to blue-violet light chronic exposure in LED backlit devices has been an identified issue in recent years [21]. It seems clear blue-violet light is closely linked with visual fatigue, like reading or working with an LED-backlit screen leads to tensional and ocular symptoms [31-33]. As the harmful effects of blue light are gradually realized by the public, eye discomfort related to blue light is becoming a more prevalent concern. Because of blue light's short wavelength, the focus is not located in the center of the retina but rather in the front of the retina, so that the long exposure time to blue light causes a worsening of visual fatigue and nearsightedness. Symptoms such as diplopia and inability to concentrate can affect people's learning and working efficiency[34]. A previous report found the blue light emitted from the screen of a smart mobile device can cause eye fa¬tigue[35]. In addition, blocking blue light with a special lens significantly reduced visual fatigue as measured by critical flicker frequency[36].

It also causes dry eye, with symptoms worsening when carrying out close-up activities with any type of digital screen equipped with blue-violet-light-emitting LED lighting [10,37,38].

Discomfort glare is also an issue, as the LED lights present in backlight with increasing discomfort as the blue-violet light intensifies [39,40]. The +0.40 EyeZenTM lenses used in this study selectively filters out 20% of blue-violet light (415nn to 455 nm) reaching the eye and allow beneficial light to pass through (visible light, including blue-turquoise) [41]. Lenses with more than 70% of blue-light transmission do not significantly affect contrast sensitivity, color vision, and visual performance 42. In vitro tests have shown that blocking 20% of blue-violet light would reduce the rate of retinal cell (RPE) death by apoptosis by 25% [42].This should contribute to longer-term health benefits, and particularly to the prevention of premature aging of the eyes [43].

More than 90% of the study subjects said they were entirely or delighted with their visual comfort, especially in the management of digital devices with +0.40 Eyezen™ 0.4 lenses combined with Crizal® Sapphire™ coating wearing.

One limitation of this study was the evaluation of DA using a questionnaire since the responses are somewhat subjective and can be affected by responders' daily physical and mental conditions [44].

In conclusion, the results from the present study showed that DA was significantly reduced with single vision lenses with additional near-power of +0.40 D wearing for four weeks.

References

1. Vaz FT, Henriques SP, Silva DS, Roque J, Lopes AS, Mota M. Digital Asthenopia: Portuguese Group of Ergophthalmology Survey. Acta Med Port. 2019;32(4):260–5.
2. Rosenfield M. Computer vision syndrome: a review of ocular causes and potential treatments. Ophthalmic Physiol Opt. 2011;31(5):502–15.
3. Blehm C, Vishnu S, Khattak A, Mitra S, Yee RW. Computer vision syndrome: a review. Surv Ophthalmol. 2005;50(3):253–62.
4. The Vision Council. Eyes overexposed: The digital device dilemma: Digital eye strain report. 2016. [cited 2020 Sep 6]. Available from: https://www.thevisioncouncil.org/content/digital-eye-strain
5. Gowrisankaran S, Sheedy JE. Computer vision syndrome: A review. Work. 2015;52(2):303–14.
6. Wang AH, Chen MT. Effects of polarity and luminance contrast on visual performance and VDT display quality. Int J Ind Ergon. 2000;25(4):415–21.
7. Eyezen Digital Glasses. For those of us who use digital tech. a lot. Review. [cited 2020 Sep 6]. Available from : https://www.sarkemedia.com/eyezen-digital-glasses
8. Ames SL, Wolffsohn JS, McBrien NA. The development of a symptom questionnaire for assessing virtual reality viewing using a head-mounted display. Optom Vis Sci. 2005;82(3):168–76.
9. Logaraj M, Madhupriya V, Hegde S. Computer vision syndrome and associated factors among medical and engineering students in chennai. Ann Med Health Sci Res. 2014;4(2):179–85.
10. Benedetto S, Drai-Zerbib V, Pedrotti M, Tissier G, Baccino T. E-readers and visual fatigue. PLoS One. 2013;8(12):e83676.
11. Kim DJ, Lim CY, Gu N, Park CY. Visual fatigue induced by viewing a tablet computer with a high-resolution display. Korean J Ophthalmol. 2017;31(5):388–93.
12. Daum KM, Clore KA, Simms SS, Vesely JW, Wilczek DD, Spittle BM, et al. Productivity associated with visual status of computer users. Optometry. 2004;75(1):33–47.
13. Larsman P, Kadefors R, Sandsjö L. Psychosocial work conditions, perceived stress, perceived muscular tension, and neck/shoulder symptoms among medical secretaries. Int Arch Occup Environ Health. 2013;86(1):57–63.
14. Nakazawa T, Okubo Y, Suwazono Y, Kobayashi E, Komine S, Kato N, et al. Association between duration of daily VDT use and subjective symptoms. Am J Ind Med. 2002;42(5):421–6.
15. Gowrisankaran S, Sheedy JE. Computer vision syndrome: A review. Work. 2015;52(2):303–14.
16. Jaiswal S, Asper L, Long J, Lee A, Harrison K, Golebiowski B. Ocular and visual discomfort associated with smartphones, tablets and computers: what we do and do not know. Clin Exp Optom. 2019;102(5):463–77.
17. Ciufreda KJ. Accommodation, the pupil, and presbyopia. In: Benjamin WJ, editor. Borish's clinical refraction. Saint Louis: Butterworth Heinemann Elsevier; 2006. p. 93–144.
18. Gamlin PD. Neural mechanisms for the control of vergence eye movements. Ann N Y Acad Sci. 2002;956(1):264–72.
19. Kwon K, Woo JY, Park M, et al. The change of accommodative function by the direction of eye movements during a computer game. J Korean Ophthalmic Opt Soc. 2012;17:177–84.
20. Chi, CF, Lin, FT. A comparison of seven visual fatigue assessment techniques in three data-acquisition VDT tasks. Human Factors 1998; 40: 577–590

21. Molina VJ. Single vision lenses with additional near power: meeting the challenge of clinic the digital age. Points de Vue – International Review of Ophthalmic Optics; 2017. p. 1–9. [cited 2020 Sep 6]. Available from: https://www.pointsdevue.com/article/single-vision-lenses--additional-near-power-meeting-visual-challenge-digital-age?lang=
22. Portello JK, Rosenfield M, Bababekova Y, Estrada JM, Leon A. Computer-related visual symptoms in office workers. Ophthalmic Physiol Opt. 2012;32(5):375–82.
23. Crizal Sapphire [Internet]. [cited 2020 Sep 10]. Available from: https://www.crizal.com.br/lentes-crizal-sapphire/
24. Kawashima M, Yamatsuji M, Yokoi N, Fukui M, Ichihashi Y, Kato H, et al. Screening of dry eye disease in visual display terminal workers during occupational health examinations: the Moriguchi study. J Occup Health. 2015;57(3):253–8.
25. Hashemi H, Khabazkhoob M, Kheirkhah A, Emamian MH, Mehravaran S, Shariati M, et al. Prevalence of dry eye syndrome in an adult population. Clin Exp Ophthalmol. 2014;42(3):242–8.
26. Himebaugh NL, Begley CG, Bradley A, Wilkinson JA. Blinking and tear break-up during four visual tasks. Optom Vis Sci. 2009;86(2):E106–14.
27. Cardona G, García C, Serés C, Vilaseca M, Gispets J. Blink rate, blink amplitude, and tear film integrity during dynamic visual display terminal tasks. Curr Eye Res. 2011;36(3):190–7.
28. Belmonte C, Nichols JJ, Cox SM, Brock JA, Begley CG, Bereiter DA, et al. TFOS DEWS II pain and sensation report. Ocul Surf. 2017;15(3):404–37.
29. Uchino Y, Uchino M, Yokoi N, Dogru M, Kawashima M, Okada N, et al. Alteration of tear mucin 5AC in office workers using visual display terminals: the Osaka Study. JAMA Ophthalmol. 2014;132(8):985–92.
30. Fenga C, Aragona P, Di Nola C, Spinella R. Comparison of ocular surface disease index and tear osmolarity as markers of ocular surface dysfunction in video terminal display workers. Am J Ophthalmol. 2014;158(1):41–48.e2.
31. Shang YM, Wang GS, Sliney D, Yang CH, Lee LL. White light-emitting diodes (LEDs) at domestic lighting levels and retinal injury in a rat model. Environ Health Perspect. 2014;122(3):269–76.
32. Siegenthaler E, Bochud Y, Bergamin P, Wurtz P. Reading on LCD vs e-Ink displays: effects on fatigue and visual strain. Ophthalmic Physiol Opt. 2012;32(5):367–74.
33. Eldeeb R, Sreedharan J, Gopal K. Computer use and vision-related problems among university students in Ajman, Arab Emirate N Shantakumari. Ann Med Health Sci Res. 2014;4(2):258–63.
34. Zhao HL, Jiang J, Yu J, Xu HM. Role of short-wavelength filtering lenses in delaying myopia progression and amelioration of asthenopia in juveniles. Int J Ophthalmol. 2017;10(8):1261–7.
35. Tosini G, Ferguson I, Tsubota K. Effects of blue light on the circadian system and eye physiology. Mol Vis. 2016;22:61–72.
36. Ide T, Toda I, Miki E, Tsubota K. Effect of blue light-reducing eye glasses on critical flicker frequency. Asia Pac J Ophthalmol (Phila). 2015;4(2):80–5.
37. Patel S, Henderson R, Bradley L, Galloway B, Hunter L. Effect of visual display unit use on blink rate and tear stability. Optom Vis Sci. 1991;68(11):888–92.
38. Tsubota K, Nakamori K. Dry eyes and video display terminals. N Engl J Med. 1993;328(8):584.
39. Bullough J, Zengwei F, Van Derlofske J. Discomfort and disability glare from halogen and HID Headlamp System. Transportation Lighting Group, Lighting Research Center, Rensselaer Polytech Institute, SAE Technical Papers. 2002-01-0010. [cited 2020 Sep 6]. Available from: https://www.sae.org/publications/technical-papers/content/2002-01-0010/
40. Sivak M, Schoettle B, Minota T, Flannagan MJ. Blue contend of LED headlamps and discomfort glare. 2005. UMTRI-2005-2. [cited 2020 Sep 6]. Available from: https://deepblue.lib.umich.edu/bitstream/handle/2027.42/57444/98625.pdf
41. Barrau C, Kudla A, Tessieres M. Eye Protect System Lenses: from research to harmful light filtering. Poin de Vue. Int Rev Ophthalmic Optics. 2016:309-327.
42. Leung TW, Li RW, Kee CS. Blue-Light Filtering Spectacle Lenses: Optical and Clinical Performances. PLoS One. 2017;12(1):e0169114.
43. Arnauld E, Barrau C, Nanteau C, Gondouin P, Fontaine V, Villette T, et al. Characterization of the blue light toxicity spectrum on A2E-loaded RPE cells in sunlight normalized conditions. Invest Ophthalmol Vis Sci. 2013;54(15):6101.
44. Kim DJ, Lim CY, Gu N, Park CY. Visual fatigue induced by viewing a tablet computer with a high-resolution display. Korean J Ophthalmol. 2017;31(5):388–93.

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