Journal of Fasting and Health
http://jfh.mums.ac.ir
JFH

Valuation of Ocular Accommodation, Convergence and Fusional Vergence Changes during Ramadan

Seyed Hosein Hoseini-Yazdi[1], Ebrahim Jafarzadehpur[2*], Ali Mirzajani[2], Mohsen Nematy[3]

[1]Department of Optometry, Faculty of Rehabilitation, Tehran University of Medical Sciences, Tehran, Iran
[2]Department of Optometry, Faculty of Rehabilitation, Tehran University of Medical Sciences, Tehran, Iran
[3]Department of Nutrition, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

ARTICLE INFO

Article type:
Orginal Article

Article history:
Receive: 15-Oct-2012
Revise: 15- Jan-2013
Accept: 10-Jan-2013
Publish: 01 July 2013

Keywords:
Ocular
Accommodation
Convergence
Binocular fusion
Ramadan

ABSTRACT

Purpose: There are a few researches regarding the effects of Islamic fasting on visual system. The aim of this study was to investigate the effects of Ramadan fasting on the amplitude of accommodation (AA), near point of convergence (NPC), positive and negative fusional vergences (PFV and NFV, respectively) in visually healthy fasters.

Methods: AA, NPC, PFV and NFV at far (6m) and near (40cm) were measured in 30 male students. Nutritional habits in a week before each examination visit were assessed with the Food Frequency Questionnaire (FFQ).

Results: Mean age and fasting average experience were 23.9 and 10 years, respectively. AA and NPC showed significant changes (p<0.05) during Ramadan; but there was no significant difference before and after Ramadan in these parameters. NFV blur, break and recovery points at far significantly reduced in Ramadan than before (p=0.003, p=0.005, p=0.003, respectively) with insignificant compensation after Ramadan. Results showed that there was no significant correlation between changes in diet pattern and AA, NPC and distant NFV variations (p<0.05).

Conclusion: Some visual problems may be reported at far and near visual tasks during Ramadan; but most of the problems may be resolved after it. Some visual preparations may be needed for more effective visual activities during Ramadan; essentially for students with intensive visual tasks. Vision therapy may be suggested along with nutrient pattern improvement during Ramadan.

Please cite this paper as:
Hoseini-Yazdi H, Jafarzadehpur E, Mirzajani A, Nematy M. Evaluation of Ocular Accommodation, Convergence and Fusional Vergence Changes during Ramadan. J Fasting Health. 2013;1(1):13-18.

Introduction

Fasting during the month of Ramadan is an Islamic obligatory and millions of Muslims around the world refrain eating and drinking from sunrise to sunset according to this Islamic rule. Many investigations have been performed regarding the effect of fasting on human body as follows; the changes occur in body weight, (1) appetite, (2) renal functions in kidney transplant recipients, (3) blood pressure, (4) blood lipid levels, (5) and blood glucose. (6) Islamic fasting might have special effects on vision and ocular function of Muslims. Previous studies have shown that there is no association between Islamic fasting and progression of myopia. (7-10)

* *Corresponding author:* Ebrahim Jafarzadehpur,
PhD, Optometry department, Rehabilitation Faculty, Tehran University of Medical Sciences (TUMS), Shahnazary St., Mohseni Sq., Mirdamad Blvd., Tehran, Iran. Tel: 19821-22228051-2; Fax: 19821-22262450;
E-mail: ejafarzadehpur@tums.ac.ir

Moreover, intraocular pressure changes due to fasting in healthy individuals have not been considerable. (11, 12)

Nocturnal sleep, daytime alertness and psychomotor performance are decreased in Ramadan; and this may lead to reduction of working hours during the month of Ramadan. (13) Decreasing nocturnal sleep may affect accommodative functions, on the other hand. (14) Nevertheless, the effect of insufficient nocturnal sleep accompanied with Ramadan fasting on amplitude of accommodation is a matter of research. Significant decrease in basic tear secretion and tear break up time has been observed during religious fasting. (15) Furthermore, it is found that tear break-up can create optical aberrations which contribute to the decline in image quality observed objectively and psychophysically. (16) Reduction of accommodative function and retinal image quality are two important factors in disrupting sensory fusion. (17) However, researches are few and not conclusive regarding the direct impact of Islamic fasting on visual skills.

In Ramadan, there is a considerable increase in amount of reading, especially to recite the Holy Quran. Increased need for visually demanding tasks and changes in food habits and metabolic conditions in this month call further investigations on possible visual changes during this month. Accordingly, this study designed to evaluate AA, NPC, PFV and NFV of Islamic fasters in Ramadan.

Material and Methods

In this cross sectional study AA, NPC, PFV and NFV of 30 male students from the student dormitory of Imam Ali (AS), affiliated to Tehran University of Medical Sciences, were measured during three days before Ramadan, middle three days and three days after this month. Participants were included in the study if were fasting at least for 25 days in Ramadan. In addition, they were required to be less than 35 years old with minimum uncorrected visual acuity of 20/25 in each eye and without any ocular or medical pathology.

Participants took part in three optometric examinations, before, during and after Ramadan. Examination time before and after Ramadan was during breakfast to lunch and lunch to dinner times; while in Ramadan it was in between dawn and breakfast meals. Participants' full ocular and systemic histories were recorded. Visual acuity was measured with Snellen acuity chart at 6 meters and dry retinoscopy was performed to ensure the absence of significant refractive errors. To determine participants' inclusion or exclusion, heterophoria at 6 m and 40 cm and sterioacuity at 40 cm were measured with alternate cover test method, (18) and TNO plates,(19) respectively. Then, AA, NPC, PFV and NFV at far (6m) and near (40cm) were quantitatively measured randomly by an optometrist. All participants signed an informed consent in accordance with the tenets of the Declaration of Helsinki.

AA was monocularly measured with push up technique. The 6 point (20/30) optotype was held in front of each eye. As the participant should see the optotype clearly; so the target was moved to him slowly. If he reported that the optotype was unclear, the distance between the target and spectacle plane was measured. This distance was converted to dioptric value and was considered as the amplitude of accommodation. (20)

PFV and NFV blur, break and recovery points were measured at 40 cm and 6 m with a horizontal prism bar (21), using a vertical row of 20/30 letters as the target. (18)

NPC was evaluated by asking the participant if the isolated 20/50 letter (accommodative target) was seen as single when the examiner held the target approximately 20 cm in front of his eyes. Then he was asked to say when the object appeared to be double. Also the examiner watched the participants' eyes carefully. Any ocular deviation or misalignment during the NPC measurement showed the near point of convergence objectively. The distance from this point to forehead plane was recorded as the near point of convergence. (18, 21)

To be unaware of the results of previous visits, the study was blinded by recording the results from each visit in three separated record sheets. In addition, to consider nutritional status of participants over one week before each visit, the Food Frequency Questionnaire (FFQ) (22) was completed.

Results from this study were analyzed with SPSS 16 by repeated measures of ANOVA, paired t-test, Friedman nonparametric test and Spearman nonparametric correlation.

Result

Of 41 dormitory students examined, 30 ones had inclusion criteria for this study and were examined in 3 visits before, during and after the month of Ramadan. These participants, all male, with the mean age of 23.9±2.34 years (range: 21-30 years) had an average experience of fasting for 10.1±2.68 years (minimum 5and maximum 15 years).

Table 1. Mean ± SD of AA, NPC and Distant NFV Before, During and After Ramadan 10.1±2.68 years (minimum 5 and maximum 15 years).

Variable	Before Ramadan	During Ramadan	After Ramadan	P_1*	P_2**	P_3***
Right Eye Amplitude of Accommodation	13.94±2.67	12.33±2.50	13.37±2.20	<0.0001	0.002	0.184
Left Eye Amplitude of Accommodation	13.93±2.68	12.33±2.50	13.33±2.20	<0.0001	0.002	0.086
Near Point of Convergence	7.67±3.25	8.70±3.60	7.83±2.76	0.006	0.005	0.267
Negative Fusional Vergence at far, Blur point	11.24±4.35	8.57±2.23	8.36±2.72	0.003	0.611	<0.0001
Negative Fusional Vergence at far, Break point	11.21±4.56	8.64±2.37	8.36±2.72	0.005	0.515	<0.0001
Negative Fusional Vergence at far, Recovery point	8.86±4.23	6.36±2.31	6.29±2.70	0.003	0.865	0.001

*Comparison between before and during Ramadan

** Comparison between during and after Ramadan

*** Comparison between before and after Ramadan

Results of statistical analysis did not show any significant difference in PFV blur, break and recovery points at far and near and NFV blur, break and recovery points at near before, during and after Ramadan (Repeated measure ANOVA, $p>0.05$).

According to the results of paired t-test, AA of both right and left eyes were significantly reduced during Ramadan than before ($p<0.0001$); but no significant difference was observed between their values before and after Ramadan ($p=0.184$, $p=0.084$, respectively); such that AA of right and left eyes reduced 1.62±2.11 D and 1.60±2.13 D respectively in comparison with before Ramadan; and increased 1.04±1.72 D both in right and left eyes after the month of Ramadan in comparison with the middle of this month ($p=0.002$).(See table 1 and figure 1)

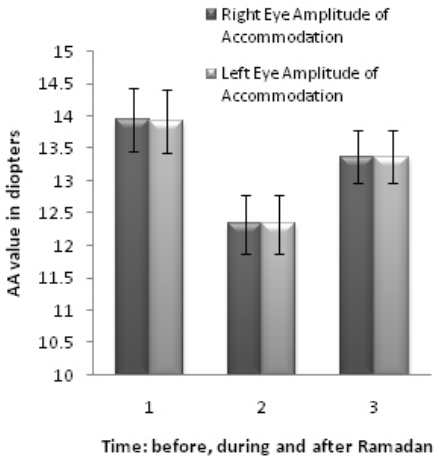

Figure 1. AA Values Before, During and After Ramadan. (The Error Bars Represent ± Standard Error of Mean).

NPC was increased significantly during Ramadan than before (Paired t-test, $p=0.006$); but there was no significant difference between its values before and after this month (Paired t-test, $p=0.538$); such that NPC was increased 0.86±1.54 cm during Ramadan than before; and reduced 0.86±1.54 cm after this month than midmonth. (See table 1 and figure 2)

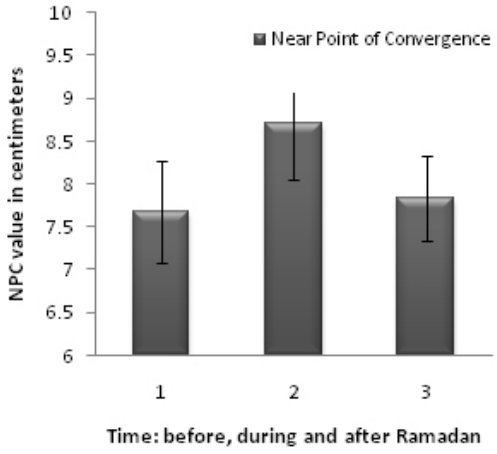

Figure 2. NPC Values Before, During and After Ramadan. (The Error Bars Represent ± Standard Error of Mean).

NFV blur, break and recovery points at far were considerably reduced during Ramadan than before (Paired t-test, $p=0.003$, $p=0.005$, $p=0.003$, respectively); but no significant change occurred in its values after Ramadan than the middle of this month (Paired t-test, $p=0.611$, $p=0.515$, $p=0.865$, respectively). (See table 1 and figure 3)

Diet analysis of foods consumed a week before visits using Friedman nonparametric test showed

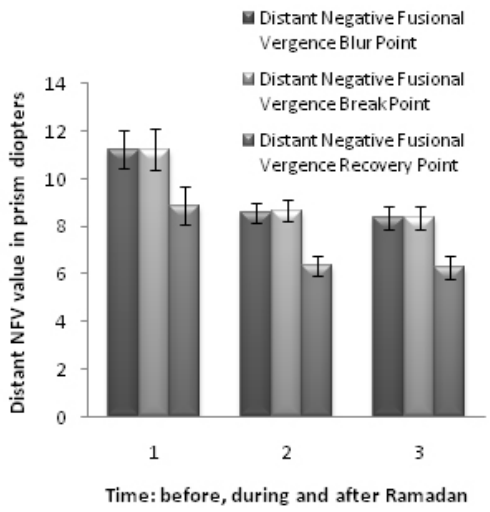

Figure 3. Distant NFV Values Before, During and After Ramadan. (The Error Bars Represent ± Standard Error of Mean).

that there were no significant changes in consuming amounts of carbohydrates (bread, rice, spaghetti, and candies), meats, legumes, stews, fruits, vegetables, nuts, dairy, and beverages in Ramadan than before and after it. On the other hand, consuming egg was reduced; and consumption of simple sugars such as table sugar, jelly, honey and date were significantly increased (p<0.05). Results using Spearman test showed that there was no significant correlation between changes in diet pattern and AA, NPC and distant NFV variations (p<0.05).

Discussion

In this study we found that significant increase in NPC along with significant reduction of AA occurred simultaneously during Ramadan. Right and left eyes AA reduced 1.62±2.11 D and 1.60±2.13 D during Ramadan than before. Despite the statistical significance of this reduction, a change of at least 1.50 D, according to some researchers' viewpoint, is needed to be considered as a significant variation on repeated measurements of accommodative amplitude; smaller changes are accepted as expected variations. (23) On the other hand, mean AA of right and left eyes were 12.33±2.50 D during Ramadan. Considering the participants' mean age which was 23.9 years, this value is more than the minimum expected AA, based on the Hoffstetter formula. (24) Despite the significant reduction of monocular AA during Ramadan, its value was within the normal range in these young and visually normal participants. Another consideration is the fact that despite a significant increase in AA after Ramadan than the midmonth, its value showed reduction than before Ramadan. Although it was not statistically significant, the mean decreases were 0.57 D and 0.55 D in right and left eyes, respectively; but this may be significant in larger samples, different age groups or individuals with accommodative and convergence disorders. The mean NPC value was 8.70±3.60 cm in this month. Although NPC values of 5-7 cm is considered normal by some authors, (25-27) a range of 8-15 cm is considered normal in many researches, (28-31) however. As NPC values greater than 10 cm is a diagnostic criterion for convergence insufficiency, it seems that despite the statistically significant increase in NPC value during Ramadan than before, this is not clinically significant. But if larger samples, different age groups or patients with accommodative and binocular disorders are studied, it is possible to judge more confidently in this regard.

It seems that psychological factors and variations in biological time play a causative role in reducing AA and increasing NPC in this month. Different investigations on Ramadan and Islamic fasting have shown that the daytime fasting required during Ramadan lead changes to many aspects of the participants' lifestyle, including sleep patterns and activity, in addition to complete absence of food and fluid intake. (32) Indeed the amounts of physical, mental and social activity performed in the daytime decrease in Ramadan. (32) During the fasting time, some behavioral disturbances, such as feeling tired and being unwilling to work have been observed, also. (33) On the other hand, subjective alertness and mood have reported to decrease during Ramadan intermittent fasting. (34) Therefore psychological factors such as feeling tiredness and being unwilling to work may cause subjects not to do their best during demanding visual tasks. In the study by *Zerguini et al* (35) on the impact of Ramadan on physical performance in professional soccer players, it was noted that the phase shift of food intake and disruption of sleep patterns affected actual and perceived physical performance. Meckel *et al* (36) concluded that Ramadan fasting may lead to a significant decrease in athletic performance capacities while this could not necessarily relate to changes in caloric intake and sleeping hours during the fast. Although these studies are not in the field of vision, but have related the athletes' decrease in physical performance to disruption of biological time.

Moreover, nutritional pattern analysis showed no significant difference in most nutrient groups' consumption over a week before each examination visit with each other; and significant differences were observed in protein and sugar taking in Ramadan compared to before Ramadan.

There was no significant correlation between AA and NPC variations with nutrients consumed during Ramadan, however.

Although no significant variations observed in PFV values at far and near and NFV values at near, but NFV blur, break and recovery points at far were significantly reduced during Ramadan than before (Paired t-test, p=0.003, p=0.005, p=0.003, respectively) and this reduction was not compensated after Ramadan (Paired t-test, p=0.611, p=0.515, p=0.865, respectively). Antona *et al* (37) studied the repeatability in the measurement of horizontal fusional vergences and found that NFV measurements showed better repeatability than PFV at both near and distance. Therefore the reduction of NFV that we observed during Ramadan was meaningful. However, NFV was not needed at far in this sample, as none of the participants had distance esophoria. Since NFV has a little role in maintaining fusion at distance, it seems that the mechanism to compensate its reduction in Ramadan occurs weakly. The third examination was in a week after Ramadan, and thus it is not clear whether amounts of blur, break and recovery points of NFV at far would equal with those before Ramadan; and if yes, how much time does this compensation take to occur after Ramadan.

Conclusion

Results showed that a considerable increase in NPC value and a significant decrease in AA and distant NFV were occurred during Ramadan than before; however the changes were compensated after Ramadan except for NFV at far. Significant variations in both distant and near PFV and near NFV were not observed in Ramadan. Although these changes were not clinically considerable in the young and visually normal participants of this study, but in other age groups, larger samples and individuals with nonstrabismic visual disorders, they might have clinical impacts. It is advised to prescribe proper accommodative and convergence trainings by optometrists to Islamic fasters during Ramadan to prevent these variations. More researches in this field are required.

Acknowledgement

This article was extracted from the thesis prepared by Mr.Hoseini-Yazdi to fulfill the requirements to hold the MSc degree. The authors are also extremely thankful to all the volunteers for their participation in this project.

References

1. Ziaee V, Razaei M, Ahmadinejad Z, Shaikh H, Yousefi R, Yarmohammadi L, et al. The changes of metabolic profile and weight during Ramadan fasting. Singapore Med J 2006; 47(5):409-414.
2. Finch GM, Day JE, Razak, Welch DA, Rogers PJ. Appetite changes under free-living conditions during Ramadan fasting. Appetite. 1998; 31(2):159-70.
3. Abdalla AH, Shaheen FA, Rassoul Z, Owda AK, Popovich WF, Mousa DH, et al. Effect of Ramadan Fasting on Moslem Kidney Transplant Recipients. Am J Nephrol 1998;18:101-104
4. Ural E, Kozdag G, Kilic T, Ural D, Sahin T, Celebi O, et al. The effect of Ramadan fasting on ambulatory blood pressure in hypertensive patients using combination drug therapy. J Hum Hypertens. 2008; 22(3):208-10.
5. Temizhan A, Tandogan I, Dönderici O, Demirbas B. The effects of Ramadan fasting on blood lipid levels. Am J Med. 2000; 109(4):341-2.
6. Iraki L, Bogdan A, Hakkou F, Amrani N, Abkari A, Touitou Y. Ramadan diet restrictions modify the circadian time structure in humans. A study on plasma gastrin, insulin, glucose, and calcium and on gastric pH. J Clin Endocrinol Metab. 1997; 82(4):1261-73.
7. Miratashi SAM, Shoja MR. Effect of Ramadan fasting on physiologic myopia. The journal of Qazvin University of Medical Sciences & Health Services. 2000; 15: 26-33. [Persian]
8. Ghasemi Boroumand M, Aghazadeh Amiri M, Amiri Z. Relationship between fasting and myopic changes in the age group of 21-40 years. Pejouhandeh Res J. 2000;17(5): 33-37. [Persian]
9. Salehi A, Meamarzadeh SA, Akhlaghi MR, Rismanchian A, Jafari AG. Effect of Ramadan fasting on physiologic myopia. Journal of Shahrekord University of Medical Sciences 2008; 10(2):88-93.
10. Zandi AR. Evaluation of myopic degree mean 1 month before and after Ramadan. J Res Med Sci. 2003; 3(8): 115. [Persian]
11. Rabbanikhah Z, Rafati N, Javadi MA, Sanago M. Effect of Religious Fasting on Intraocular Pressure in Healthy Individuals. Bina J Ophthalmol 2005; 10 (4): 489-492.
12. Kayakcioglu O, Guler C. Religious fasting and intraocular pressure. J Glaucoma 2000; 9:413-414.
13. Roky R, Houti I, Moussamih S, Qotbi S, Aadil N. Physiological and chronobiological changes during Ramadan intermittent fasting. Ann Nutr Metab 2004; 48:296-303.

14. K Masuda, T Ueda, Y Nawa, Y Hara, H Uozato. Asthenopia Originating From Lack of Sleep during Late Night Shift. Invest Ophthalmol Vis Sci 2005; 46: E-Abstract 5611. © 2005 ARVO.
15. Rabbanikhah Z, Javadi MA, Karimian F, Rouhani MR, Zamani M, Banaee T, et al. Effect of Religious Fasting on Basal Tear Secretion, Tear Break up Time and Intraocular Pressure. Bina J Ophthalmol 2007; 12 (4): 485-491. [Persian]
16. Tutt R, Bradley A, Begley C, Thibos LN. Optical and visual impact of tear break-up in human eyes. Invest Ophthalmol Vis Sci 2000; 41(13):4117-23.
17. Caloroso EE, Rouse MW, Cotter SA. Clinical management of strabismus. Butterworth-Heinemann Medical, 1993.
18. Scheiman M, Wick B. Clinical management of binocular vision; heterophoric, accommodative, and eye movement disorders. Baltimore: Lippincott Williams &Wilkins, 2002.
19. Duckman RH. Visual development, diagnosis, and treatment of the pediatric patient. Philadelphia: Lippincott Williams & Wilkins, 2006.
20. Borsting E, Rouse MW, Deland PN, Hovett S, Kimura D, Park M, et al. Association of symptoms and convergence and accommodative insufficiency in school-age children. Optometry. 2003; 74(1):25-34.
21. Grisham D, Powers MK, Riles P, Visual skills of poor readers in high school. Optometry. 2007; 78(10):542-9.
22. Kathleen Mahan, L. Escott-Stumps, S. Krause's Food & Nutrition Therapy, 12th ed. Saunders, 2008.
23. Rosenfield M, Cohen AS. Repeatability of clinical measurements of the amplitude of accommodation. Ophthalmic Physiol Opt 1996; 16:247-249.
24. Hoffstetter HW. Useful age-amplitude formula. Optometric World 1950; 38(11):42-45.
25. Hoffman LG, Rouse M. Referral recommendations for binocular function and/or developmental perceptual deficiencies. J Am Optom Assoc 1980; 51:119–26.
26. Shippman S, Infantino J, Cimbol D, Cohen KR, Weseley AC. Convergence insufficiency with normal parameters. J Pediatr Ophthalmol Strabismus 1983; 20:158 61.
27. Hayes GJ, Cohen BE, Rouse MW, De Land PN. Normative values for the nearpoint of convergence of elementary schoolchildren. Optom Vis Sci 1998;75:506–12.
28. Helveston EM, Weber JC, Miller K, Robertson K, Hohberger G, Estes R, et al. Visual function and academic performance. Am J Ophthalmol 1985; 99:346–55.
29. Pickwell D. Binocular Vision Anomalies: Investigation and Treatment. London: Butterworths, 1989.
30. London R. Near point of convergence. In: Eskridge JB, Amos JF, Bartlett JD, eds. Clinical Procedures in Optometry. Philadelphia: Lippincott, 1991.
31. Griffin JR, Grisham JD. Binocular Anomalies: Diagnosis and Vision Therapy, 3rd ed. Boston: Butterworth-Heinemann, 1995.
32. Waterhouse J, Alkib L, Edwards B, Reilly T. Diurnal changes in sleep, food and fluid intakes, and activity during Ramadan, 2006, in the UK: some preliminary observations. Biological Rhythm Research. Dec 2008; 39(6), 449-467.
33. Karaagaoglu N, Yucecan S. Some behavioural changes observed among fasting subjects, their nutritional habits and energy expenditure in Ramadan. Int J Food Sci Nutr. 2000; 51(2):125-34.
34. Roky R, Iraki L, HajKhlifa R, Lakhdar Ghazal N, Hakkou F. Daytime Alertness, Mood, Psychomotor Performances, and Oral Temperature during Ramadan Intermittent Fasting. Ann Nutr Metab. 2000; 44(3):101-7.
35. Zerguini Y, Kirkendall D, Junge A, Dvorak J. Impact of Ramadan on physical performance in professional soccer players. Br J Sports Med. 2007; 41(6):398-400.
36. Meckel Y, Ismaeel A, Eliakim A. The effect of the Ramadan fast on physical performance and dietary habits in adolescent soccer players. Eur J Appl Physiol. 2008; 102(6):651-7.
37. Antona B, Barrio A, Barra F, Gonzalez E, Sanchez I. Repeatability and agreement in the measurement of horizontal fusional vergences. Ophthalmic Physiol Opt. 2008; 28(5):475-91.