THE EFFECT OF DAILY RELIGIOUS FASTING ON TEAR FILM CHARACTERISTICS AND OCULAR SURFACE

WAN NUR FARHANA BINTI IBRAHIM, BOptom.

DEPARTMENT OF OPTOMETRY AND VISUAL SCIENCE, KULLIYYAH OF ALLIED HEALTH SCIENCES, INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA, JALAN SULTAN AHMAD SHAH, BANDAR INDERA MAHKOTA, 25200 KUANTAN, PAHANG.

farhanaibr93@gmail.com

MOHD ZULFAEZAL BIN CHE AZEMIN, PhD (CORRESPONDING AUTHOR)

DEPARTMENT OF OPTOMETRY AND VISUAL SCIENCE, KULLIYYAH OF ALLIED HEALTH SCIENCES, INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA, JALAN SULTAN AHMAD SHAH, BANDAR INDERA MAHKOTA, 25200 KUANTAN, PAHANG.

zulfaezal@iium.edu.my

ABSTRACT

Religious fasting is an act of refraining oneself from eating and drinking beginning at dawn until sunset. The changes in meal time and long period of meal constraint may influence the tear quality and ocular surface. The purpose of this study was to investigate the effect of daily religious fasting on tear film characteristics and ocular surface integrity. This is a prospective study involving 29 eyes from 29 healthy participants. The tear film characteristics were assessed by measuring the non-invasive tear break-up time (NITBUT), tear meniscus height (TMH), total tear secretion, and fluorescein ocular surface staining method was used to determine the ocular surface integrity. The measurements were performed in the morning (8.00 to 10.00 a.m.) and evening (4.00 to 6.00 p.m.) during each non-fasting and fasting period. The results showed no statistically significant difference noted for all parameters measured in the morning when comparison was made between non-fasting and fasting periods. Conversely, in the evening, NITBUT value was significantly lower during fasting period, ($p = 0.001$), but, TMH, total tear secretion and ocular surface staining revealed no significant differences between non-fasting and fasting periods. Our study revealed that daily religious fasting only significantly reduced the NITBUT value in the evening which possibly due to dehydration; however, it did not affect TMH, total tear secretion and ocular surface integrity. The absence of fluid loading at pre-dawn meal could be the reason of non-noticeable differences noted in the morning.

KEYWORDS: Daily religious fasting; Pre-dawn meal; Non-invasive tear break-up time; Tear meniscus height; Total tear secretion; Ocular surface staining

INTRODUCTION

Fasting in Islam is an act of refraining oneself from eating, drinking, smoking, and sexual intercourse, begins at dawn and ends at sunset. During fasting, a person daily diet regime had changed from generally three recommended meals which are breakfast, lunch, and dinner to only two large meals. The two meals will be the early breakfast before sunrise (known as pre-dawn meal) and dinner at sunset. As no foods and drinks are allowed between these two meals, Muslims will commonly consume a substantial amount of foods and drinks at pre-dawn. Despite of the large meal taken, starvation and dehydration still cannot be avoided, particularly after long hours of meal restriction.

The altered eating habit and dehydration during fasting period cause many physiological changes in the body (Baser, Cengiz, Uyar, & Un, 2014). The ocular structure was no exception. Different effects either in the anterior or posterior segments had been observed in the human eye that fast (Baser et al., 2014; Heravian et al., 2015; Meo & Hassan, 2015). The idea of fluid restriction during the day could reduce tear secretion had gained interests of some researchers in investigating the effect of fasting on different tear film characteristics and ocular surface (Kayikçioğlu, Erkin, & Erakgün, 1999; Kerimoglu et al., 2010; Koktekir, Bozkurt, Gonul, Gedik, & Okudan, 2014) suggesting that fasting may actually contribute to dry eyes.

Generally, fasting can be divided into two categories which are the obligatory fasting and voluntary fasting. Obligatory fasting is the extended period of fasting performed by all Muslims in the whole month of Ramadhan. Meanwhile, as for the voluntary fasting, it is being regarded as the daily basis of religious fasting, can be performed in any days and months. However, Muslims are recommended to fast during special days following the traditions of Prophet Muhammad (peace be upon him). Among the recommended special days include fasting on each Monday and Tuesday, the 13th, 14th and 15th of each lunar month, six days in the month of Syawal, and the day of Arafat.

This study will be focusing on daily religious fasting by investigating its effect on tear film characteristics and ocular surface.

MATERIALS & METHODS

This is a prospective study involving 29 eyes from 29 participants, recruited via convenience sampling.

The study adhered to the tenets of Declaration of Helsinki, and the study procedures were approved by the Kuliyyah Postgraduate and Research Committee (KPGRC, ID Number: KAHS 21). All participants gave their informed consent to participate in the study. Only healthy participants aged between 19 to 30 years old were recruited. The participants with history of ocular trauma, surgery, significant underlying of ocular pathology or systemic diseases, or taking medications such as antihistamine, anti-depressant, acetaminophen, bencodiazepine,

steroids and hormones for contraception and infertility were excluded. Exclusion criteria were smokers, contact lens wearer, pregnant woman, lactating mother and female having menstruation as it may alter the tear parameters studied.

TMH and NITBUT were assessed using OCULUS Keratograph 5M (OK5M). During these measurements, participants were seated in front of OK5M and were asked to fixate straight at the fixation light. NITBUT measurement was taken first. OK5M was adjusted so that the mires were in focus in front of the tested eye and the participants were asked to blink twice before refrained from blinking. A video was automatically recorded as soon as the participant opened the eyes after the second blink. The time taken for the first distorted mire appeared on the cornea was taken as measurement of NITBUT. Immediately after NITBUT, TMH was measured under fixed white illumination with 10X magnification. Image of TMH was captured and TMH was measured at the center of lower eyelid directly below the pupil, using an integrated scale in OK5M.

For the assessment of ocular surface integrity, the fluorescein ocular surface staining graded using Oxford grading score (Bron et al., 2003) was used. An iPhone 6 (equipped with 8-megapixel iSight camera with 1.5μ pixels resolution, autofocus and $f/2.2$ aperture) was attached at the slit lamp to record the video during the ocular surface evaluation. White light and blue exciter filter together with complementary yellow barrier filter were used to ensure better assessment of fluorescein staining. All the videos were focused only on the primary gaze, as this is the region significantly stained in dry eyes (Yoon, Im, Kim, & You, 2011). No attempt of grading the nasal and temporal conjunctiva at the extreme gaze was made. All videos were recorded with 16X magnification.

Five minutes after assessment of ocular surface staining, Schirmer's I test was performed. Approximately 5 mm of one end of the sterilized Haag-Streit Schirmer strip to measure the amount of tears produced over a period of 5 minutes. It was folded and placed at the junction of inner two-third and outer one-third of the lower conjunctiva fornix. The participant was asked to close the eyes throughout the test which is for 5 minutes.

All of the measurements were taken twice, during fasting and non-fasting periods. Periods of fasting and non-fasting were alternated. During each period, the tests were performed in the morning (8.00 to 10.00 a.m.) and repeated in the evening (4.00 to 6.00 p.m.). Measurements were repeated in the same order, at the similar time-points during the second visit. The temperature and humidity of the examination room were kept constant which is at 25.0 °C to 26.0 °C and 60% to 65%, respectively. This is done by maintaining the temperature and the fan setting of the air-conditioner.

The data were analysed by using SPSS (version 12 for Windows, SPSS, Inc., Chicago, IL, USA). Parameters were assessed for normal distribution using histogram and Shapiro-Wilk test. A paired sample t-test was performed to compare normally distributed parameters between non-fasting and fasting periods while the non-parametric test used was Wilcoxon signed rank

test. All data were presented in mean ± standard deviation (SD) or median ± interquartile range, with the former for normally distributed data. A p value of less than 0.05 was accepted as statistically significant.

RESULTS

A total of 12 males and 17 females were recruited in the study. The mean age of the participants was 22.10 ± 1.21 years. Mean or median values of NITBUT, TMH, total tear secretion and ocular surface staining at different time points during non-fasting and fasting periods are given in Table 1.

There was no significant difference noted on the values of NITBUT in the morning between non-fasting and fasting periods (p = 0.730). However, in the evening, the difference was significant (p = 0.001) with lower NITBUT on a fasting day (8.54 ± 13.00) seconds) as compared to non-fasting day (4.72 ± 3.76 seconds).

The mean values of TMH, total tear secretion, and ocular surface staining were not significant during non-fasting and fasting periods, both in the morning and evening.

Table 1 Measurements of NITBUT, TMH, total tear secretion and ocular surface staining during non-fasting and fasting periods.

Parameters Studied	Time of Measurement	Non- fasting	Fasting	p-value
NITBUT (s)	Morning +	11.20 ± 7.70	10.60 ± 6.57	0.730
	Evening *	8.54 ± 13.00	4.72 ± 3.76	**0.001**
TMH (mm)	Morning *	0.27 ± 0.12	0.27 ± 0.12	0.820
	Evening +	0.28 ± 0.07	0.27 ± 0.07	0.469
Total tear secretion (mm/5 min)	Morning +	14.79 ± 10.65	13.79 ± 9.88	0.599
	Evening +	15.55 ± 9.54	12.93 ± 9.65	0.076
Fluorescein ocular surface staining	Morning +	0.99 ± 1.07	0.67 ± 0.78	0.104
(Oxford scheme)	Evening *	1.00 ± 1.00	1.00 ± 1.00	0.251

Non-invasive tear break up time (NITBUT); Tear meniscus height (TMH)

Bold value is significant.

*Data displayed in median ± interquartile range; p-value analysed using Wilcoxon Signed-rank test.

+Data displayed in mean ± standard deviation; p-value analysed using paired sample t-test.

DISCUSSION

Fasting in Islam inhibits Muslims to consume foods and drinks beginning at the dawn until the sunset. Preparing themselves for fasting, Muslims are recommended to have a last meal before dawn. Usually, large amount of food and water will be consumed in order to compensate for any potential effect of starvation and dehydration during the daytime. Following the way of Prophet Muhammad (peace be upon him), the best approach for Muslims is, to take their last meal just before dawn. Despite of the recommendation, some Muslims prefer to have their last meal at midnight dinner before going to sleep. In this study, it was found that more than half of the participants (N=18) took their last meal on the midnight instead of having it near dawn.

Concern on a prolonged period of fluid restriction reduce tear secretion has led to many studies on various tear film characteristics and ocular surface in conjunction to fasting in Ramadhan (Kayikçioğlu et al., 1999; Kerimoglu et al., 2010; Koktekir et al., 2014). In addition to other authors mentioned, Kerimoglu et al. (2010) also studied on the effect of altered eating habits during Ramadhan fasting on tear secretion.

All of the studies were conducted during the month of Ramadhan in which Muslims are required to fast for the whole month and to the best of our knowledge, there is no study reports on the effect of daily religious fasting on tear film characteristics and ocular surface. Therefore, we are interested to assess NITBUT, TMH, total tear secretion and ocular surface integrity among individual that fast for a daily basis.

In this study, we found that the values of total tear secretion in the morning was not significant when measurements were compared between fasting and non-fasting periods ($p = 0.599$). Conversely, Kerimoglu et al. (2010) found a significantly higher value of total tear secretion in the morning of the fasting day which they explained by the effect of fluid loading at the pre-dawn meal. In order to study this effect, they only recruited the participants who had their last meal just before dawn, excluding any participants that take midnight dinner as their last meal. The same effect of fluid loading during pre-dawn meal could not be observed in our population as most of the participants (N = 18) agreed that they only had their last meal at night before going to bed. This absence of fluid loading thus explained the non-noticeable difference noted between morning measurements of the non-fasting and fasting days. In the evening, our study found that the total tear secretion was lower on the fasting day as compared to the non-fasting day. Despite of the lower value observed during the fasting day, the value was not statistically significant. The same trend was observed by Kerimoglu et al. (2010) in their studied population. They explained that the effect observed was due to large amount of water consumed during pre-dawn meal preventing any significant decrease in tear secretion towards the evening. The same explanation was not applicable in our study as more than half of the participants did not take pre-dawn meal. Contrary with Kerimoglu et al. (2010) and our finding, Koktekir et al. (2014) concluded that fasting significantly decreases the total tear secretion

during fasting period, when the measurement was made after approximately 12 hours of fasting. The significantly low value of total tear secretion was described by the effect of dehydration following fluid restriction. They assessed the hydration status by measuring the tear osmolarity; an increment of the value indicates a hyperosmolar state. Although dehydration was also expected to occur in daily religious fasting, it did not cause any significant reduction in tear secretion as observed in our study. Hence, we speculate that the dehydration effect observed in the study by Koktekir et al. (2014) could be secondary to cumulative effect after several days of fasting. Nevertheless, a new study needs to be conducted in clarifying this effect.

TMH was also measured in this study as its values can provide an estimation of the total tear volume. The values were also not significant during both non-fasting and fasting periods, regardless of the time of measurement. The possible explanation for these observations noted could primarily due to no significant effect in total tear secretion values. This is because tear secretion has been regarded as the major factors that contribute to changes in meniscus volume (Yokoi, Bron, Tiffany, Maruyama, Komuro, & Kinoshita, 2004); any reduction in tear secretion will lead to decrease in tear volume. In our study, as daily religious fasting revealed no significant effect on the total tear secretion, the TMH values therefore were also not affected.

This postulated dehydration effect induced by daily fasting may alter the tear film composition particularly the lipid and mucin layers (Kayikçioğlu et al., 1999) leading to formation of unstable tear film. However, contradicted to our study, Koktekir et al. (2014) and Kayikçioğlu et al. (1999) had concluded that Ramadhan fasting did not give any significant effect to the invasive technique of fluorescein tear break-up time (TBUT). Despite of the differences in the conclusions, a direct comparison could not be made as different techniques were used in measuring the tear film stability. We used the non-invasive technique to overcome the effect of poor reproducibility of fluorescein TBUT technique (Sweeney et al., 2013). As far as we know, there have been no studies in the literature mentioned on the effect of NITBUT at a particular time in fasting population. It is not known whether fasting will give a different effect when measured in the morning or evening. Hence, our study has been conducted at two time-points. Our result shows no noticeable difference in the morning measurements between non-fasting and fasting days ($p = 0.730$).

In evaluating the health of ocular surface among the fasting Muslims, the fluorescein ocular surface staining was performed. The fluorescein will penetrate the areas of the corneal epithelium and conjunctival epithelium where intercellular junctions are disrupted. This can occur due to inflammation of the epithelial surface cells as a result of tear hyperosmolarity (Lemp et al., 2007). Tear hyperosmolarity usually will be observed in dry eyes individual. In this present study, the results revealed no significant difference in the grades of ocular surface staining (graded using Oxford scheme), both in non-fasting and fasting periods, indicating ocular surface integrity was not affected by daily religious fasting. In contrast to our findings, Koktekir et al. (2014) found a significantly higher grade of ocular surface staining in the evening

of fasting period, graded using van Bijsterveld score with lissamine green dye. However, it is not clear why ocular surface integrity was negatively affected during Ramadhan fasting but not in daily basis fasting, but, we assumed that in order for ocular surface integrity to be significantly affected, an intense dehydration effect followed by several days of fasting may be required. Again, new study should be conducted in explaining this assumption.

CONCLUSION

In conclusion, this study suggested that daily religious fasting only significantly reduced NITBUT value in the evening, yet, it did not affect TMH value, tear secretion and ocular surface integrity. The last meal taken before fasting need to be considered as it may affect the results observed in the morning; considerable large amount of water consumed just before dawn can give significantly high values of NITBUT, TMH and total tear secretion.

ACKNOWLEDGEMENT

REFERENCES

Baser, G., Cengiz, H., Uyar, M., & Un, E. S. (2014). Diurnal alterations of refraction, anterior segment biometrics, and intraocular pressure in long-time dehydration due to religious fasting. *Seminars in Ophthalmology*, 1–6.

Bron, A. J., Evans, V. E., & Smith, J. A. (2003). Grading of corneal and conjunctival staining in the context of other dry eye tests. *Cornea*, *22*(7), 640-650.

Heravian, J., Nematy, M., Yazdani, N., Azimi, A., Yekta, A., & Hoseini-yazdi, S. H. (2015). Comprehensive evaluation of dehydration impact on ocular tissue during Ramadan fasting. *Journal of Fasting and Health*, *3*(1), 11–18.

Kayikçioğlu, Ö., Erkin, E. F., & Erakgün, T. (1999). The influence of religious fasting on basal tear secretion and tear break-up time. *International Ophthalmology*, *22*(2), 67–69.

Kerimoglu, H., Ozturk, B., Gunduz, K., Bozkurt, B., Kamis, U., & Okka, M. (2010). Effect of altered eating habits and periods during Ramadan fasting on intraocular pressure, tear secretion, corneal and anterior chamber parameters. *Eye*, *24*(1), 97–100.

Koktekir, B. E., Bozkurt, B., Gonul, S., Gedik, S., & Okudan, S. (2014). Effect of religious fasting on tear osmolarity and ocular surface. *Eye & Contact Lens: Science & Clinical Practice*, *40*(4), 239–242.

Lemp, M. A., Baudoiun, C., Baum, J., Dogru, M., Foulks, G. N., Kinoshita, S., … Toda, I. (2007). 2007 Report of the International Dry Eye Workshop (DEWS). *The Ocular Surface*, *5*(2), 75–

92.

Meo, S. A., & Hassan, A. (2015). Physiological changes during fasting in Ramadan. *Journal of Pakistan Medical Association*, *65*(5), 6–13

Sweeney, D. F., Millar, T. J., & Raju, S. R. (2013). Tear film stability: A review. *Experimental Eye Research*, *117*, 28–38.

Yokoi, N., Bron, A. J., Tiffany, J. M., Maruyama, K., Komuro, A., & Kinoshita, S. (2004). Relationship between tear volume and tear meniscus curvature. *Archives of Ophthalmology*, 1265-1269.

Yoon, K. C., Im, S. K., Kim, H. G., & You, I. C. (2011). Usefulness of double vital

staining with 1 % fluorescein and 1 % lissamine green in patients with dry eye syndrome. *Cornea*, *30*(9), 972–976.