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Prevalence and risk factors of symptomatic dry eye disease in Lebanon

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ABSTRACT

Purpose: To estimate the prevalence of symptomatic dry eye disease (DED) and investigate its associated risk factors in the Lebanese population.
Methods: Population-based cross-sectional study of 602 participants from Lebanon aged 18 years and older. Ocular Surface Disease Index (OSDI) questionnaire on dry eye symptoms was used to evaluate the prevalence of symptomatic DED. Chi-square test was used to investigate the association between DED status and risk factors such as age, gender and smoking tobacco.
Results: The percentage of DED among the study population (271 males and 331 females) was 36.4% with OSDI score $\geq$ 13 (mild to moderate and severe OSDI status). The most reported DED symptom in the population was sensitivity to light. Smokers reported higher DED symptoms than non-smokers. Older and smoker populations were more likely to report significantly higher OSDI scores ($p < 0.05$). Moreover, gender was not statistically associated with DED ($p > 0.05$).
Conclusion: Symptomatic DED is substantial in Lebanon. It is statistically associated with the age of population and their tobacco exposure.

1. Introduction

For a long time, dry eye disease (DED) was restricted to the symptoms of eye dryness caused by instability of the aqueous tear film. However, this definition outlines ineffectively the clinical representation of dry eye disease [1]. Nowadays, the 2017 Tear Film and Ocular Surface Society - Dry Eye Workshop (TFOS DEWS II) Report has defined dry eye as "… a multifactorial disease of the ocular surface characterized by a loss of homeostasis of the tear film, and accompanied by ocular symptoms, in which tear film instability and hyperosmolarity, ocular surface inflammation and damage, and neurosensory abnormalities play etiological roles." [2]

DED is widely diagnosed in ophthalmology with symptoms that have been found to be diminishing the patients' capacity in performing their daily activities, and thus affecting their life quality. The epidemiological studies have estimated the prevalence range of DED between 5% and 50% in the studied populations where it is more common in elderly and females [2]. Many risk factors could be associated with the increase of DED prevalence such as age, gender, contact lens wear, refractive surgery, diabetes, smoking and additional medications (e.g. anti-cholinergic, diuretics, β-blockers) [3,4].

A series of recent studies has estimated the worldwide prevalence of DED using the survey approach [5,6] or in conjunction with clinical signs and diagnostic approach [7,8]. Different assessment tools such as Ocular Surface Disease Index (OSDI), National Health and Wellness Survey, six-item questionnaire on symptomatic dry eye disease have been applied to assess qualitatively or quantitatively the epidemiology of DED [5–10]. Moreover, the OSDI survey has shown simplicity and acceptable test-retest repeatability with high reliability and validity as an assessment tool of dry eye disease. It has also shown an effective discrimination between normal, mild to moderate, and severe DED using vision-related function, ocular symptoms and environmental triggers analysis [11]. In the Middle East, the symptomology OSDI questionnaire has been applied in Jordan, Saudi Arabia and Lebanon [5,12,13]. In the Jordanian study, the prevalence of DED among non-clinical population was estimated as 59% and the significant risk factors for DED were contact lens wear and age only [5]. The Saudi Arabian study has also focused on OSDI with clinical examinations in order to assess the effect of indoor and outdoor environments on the DED among workers. On the other hand, the OSDI questionnaire has been utilized in Lebanon only to evaluate the severity of DED symptoms in glaucoma patients treated with different prostaglandin analogues rather than assessing the prevalence of DED among the general population [13].

Lebanon is still in need for assessment of the prevalence of DED in

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order to begin the process of promoting awareness of DED in the Lebanese population and its associated risk factors. In the present study, the OSDI survey was applied for the first time on a sample of the general population of Lebanon in order to assess quantitatively the prevalence of symptomatic DED and identify the possible risk factors of DED.

2. Materials and methods

This cross-sectional study was conducted between July 2018 and January 2019 on the general population of Lebanon using the validated OSDI survey.

2.1. Population

The participants of the population were randomly selected from different Lebanese provinces and were asked to fill an online version of the questionnaire distributed throughout different online platforms. A total of 602 participants aged 18 years and older were asked to participate in this non-clinical study following the indication of the exclusion criteria for this study. The exclusion criteria included participants with eye surgeries, active ocular diseases, ocular or systemic medications which are known to interfere with tear film production or ocular surface integrity, and contact lens wearers.

2.2. Study tool

The OSDI questionnaire developed by the Outcomes Research Group at Allergan Inc. (Irvine, California) was applied in this study to provide a quantitative assessment of DED symptoms for the past week [11]. The 12-item OSDI questionnaire includes three subscales: 5 questions to assess the ocular symptoms, 4 questions for the vision related function and 3 questions for the environmental triggers. Each item was graded on a scale of 0 to 4 that ranges from none of the time to all of the time. The total OSDI score was then calculated according to the following formula:

$$OSDI\ Score = \frac{Sum\ of\ scores\ for\ all\ questions\ answered\ \times 100}{Total\ number\ of\ questions\ answered\ \times 4}$$

The OSDI status was then determined with a cut off value OSDI score ≥ 13 to differentiate between normal status and DED status (mild to moderate and severe) [14,15]. The scale of measure of the OSDI status was divided into three intervals: the interval of normal cases [0, 13[,the interval of the mild-to-moderate cases [13, 33[, and the interval of the severe cases [33, 100]. The following risk factors for DED were also studied in the population: gender, age, smoking status and type (cigarette, water pipe and both).

2.3. Study analysis

The data was analyzed by using the Statistical Package for the Social Sciences, version 21 (SPSS). The prevalence of symptomatic DED in the participants was determined by descriptive analysis of the percentage of population with OSDI score ≥ 13 (mild to moderate and severe OSDI status) along with chi-square test to detect any significant differences between the evaluated variables.

2.4. Ethical considerations

The Institutional Review Board (IRB) of the research committee at the Modern University for Business and Science (MUBS) approved the protocol of the study. The study was conducted according to the principles contained in the Declaration of Helsinki. Informed consent was obtained from all the participants. The latter were aware of the purpose and benefits of the study. Confidentiality and absence of potential risk was kept during data collection and analysis.

3. Results

Based on Table 1, out of the 602 respondents, 271 were males and 331 were females (sex ratio: M:F = 1:1.22). Looking at the population from the age perspective, the participants were grouped into three categories: ages range between 18–24, 25–44, and ≥ 45 years old. The majority of the participants belonged to the age interval of 25–44 (49.2%) and the mean age was 29.77 (SD 10.340). Almost half of the participants (54%) were smokers. The majority of the tobacco utilized by the smokers was water pipe (49.8%). In addition that 36.4% of the population was diagnosed with DED ranging between mild to moderate and severe OSDI status (OSDI score ≥ 13).

The descriptive statistics in Table 1 recorded higher mean OSDI scores in females (mean = 13.76), age group ≥ 45 (mean = 17.99), smokers (mean = 14.54), and those who smoke both types (mean = 16.44). Furthermore, the statistical analysis performed using the chi-square test in order to study the statistical association between OSDI status and risk factors showed interesting significant differences ($p < 0.05$) in OSDI scores between the age intervals ($p = 0.034$), smokers and non-smokers ($p = 0.004$), and between the three smoking types ($p = 0.018$). However, no statistical difference in OSDI scores between males and females ($p = 0.737 > 0.05$) was revealed.

Based on the descriptive study of DED prevalence in Table 2, the relative prevalence of DED in females was slightly higher than in males. Regarding the age intervals, the highest relative prevalence of DED was obviously related to the population aged ≥ 45 (53.42%) compared to approximately similar relative prevalence for the other intervals. Regarding to the smoking status, smokers have shown interesting higher relative prevalence of DED compared to non-smokers. In addition, participants who smoke cigarettes with waterpipe (both) have shown

Table 1
OSDI mean scores, standard deviation, Chi-square test of OSDI status and distribution of responses according to gender, age group, smoking status and type.

Variable		Frequency (%)	Mean of OSDI (SD)	Chi-square test vs. OSDI Status	p-value
Gender	Male	271 (45 %)	12.02 (12.22)	0.610	0.737
	Female	331 (55 %)	13.76 (14.17)		
Age	18 – 24	235 (39 %)	11.99 (12.59)	10.404	0.034
	25 – 44	296 (49.2 %)	12.56 (13.14)		
	≥ 45	71 (11.8 %)	17.99 (15.55)		
Smoking Status	Non – smoker	277 (46 %)	11.15 (11.53)	10.846	0.004
	Smoker	325 (54 %)	14.54 (11.55)		
Smoking Type	Water pipe	162 (26.9 %)	13.91 (14.98)	15.329	0.018
	Cigarette	88 (14.6 %)	14.06 (14.85)		
	Both	75 (12.5 %)	16.44 (13.24)		
OSDI Status	Normal	383 (63.6 %)	5.33 (4.37)	–	–
	Mild to Moderate	163 (27.1 %)	20.37 (5.32)		
	Severe	56 (9.3 %)	43.75 (14.00)		

Table 2
Relative prevalence of DED-diagnosed population based on OSDI score and distribution of responses according to gender, age group, smoking status and type.

Variable		Frequency of Non-DED (OSDI score < 13)	Frequency of DED-diagnosed (OSDI score > 13)	Relative prevalence of DED-diagnosed
Gender	Male	177	94	34.68 %
	Female	205	126	38.06 %
Age	18 – 24	155	80	34.04 %
	25 – 44	194	102	34.46 %
	≥ 45	33	38	53.52 %
Smoking Status	Non – smoker	193	84	30.32 %
	Smoker	189	136	41.84 %
Smoking Type	Water pipe	100	62	38.27 %
	Cigarette	51	37	42.04 %
	Both	38	37	49.33 %

highest relative prevalence of DED (49.33%) compared to the slight difference between cigarette and waterpipe smokers.

The most frequent symptom in the studied population was the sensitivity to light (13.45% of the population has reported the symptom ranging from half to all of the time). All of the symptoms of dry eye except sensitivity to light (ranging from half to all of the time) were more prevalent in smokers than non-smokers, with almost 2.5 times increase in the percentage of reporting blurred and poor vision symptoms as shown in Fig. 1.

4. Discussion

In the current study, the priority was given to the general population with some exclusion criteria (mentioned in the population section of the methodology) to avoid any interference of temporary (viral infections, medication-related disturbance) or permanent medical factors (ocular surface disturbance from surgeries) on the studied risk factors.

Using the OSDI survey to estimate quantitatively the prevalence of the symptomatic DED based on the participants who scored ≥ 13 (a cut off value of OSDI score), 36.4% of the selected population has reported intense DED (ranging from mild to severe status). It is clear that DED is more prevalent in Lebanon than Hong Kong [7], Nigeria [8], and UK [6] but is still less than that in Jordan [5]. The disparity of the DED estimation among the epidemiology studies could be related to the difference in cut-off score used for symptomatic DED diagnosis [5], the mean age of the studied population [16] or the inclusion of specific risk factors such as wearing contact lens which could overdraw the symptoms of eye dryness due to the material effect of contact lenses on the ocular surface (especially the tear film structure and physiology) [17] or the improper lens care system applied from the wearers [18].

4.1. Association between gender and OSDI status

In agreement with the previous studies [5,7,8], the current study showed no association between DED and gender ($p > 0.05$), whereby very little difference in the mean values of OSDI scores were recorded accordingly with the relative percentages of DED-diagnosed (OSDI score ≥ 13) and the reported dry eye symptoms among males and females. However, the Jordanian study has found that only females (aged > 45) were more affected with DED than males [5]. This age-adjusted theory of lower prevalence in men than women was significantly indicated by Moss et al [16] and explained by the effect of hormonal loss during menopause on the ocular dryness of women [19]. Thus, the non-elderly population (only 11.8% were aged ≥ 45) could explain the absence of association between DED status and gender in the current study.

4.2. Association between age and OSDI status

The significant association between age intervals and DED ($p < 0.05$) in the current study was concordant with many previous studies [5–9]. The significant increase of OSDI means scores and the relative percentages of DED-diagnosed (OSDI score ≥ 13) with the age intervals indicated an obvious prevalence of DED in the older population especially those who aged ≥ 45. The explanation of this outcome is diagnosed by the age-related changes in the eyelids and lacrimal system in older populations [20] that are more exposed to systemic diseases e.g. Diabetes, Rheumatoid arthritis and the use of systemic and topical medications that interfere with normal tear function [6,16].

4.3. Association between smoking and OSDI status

As the published data regarding the association between DED and smoking are partially inconsistent [5,10,16,21,22], smoking is still an unclear risk factor of dry eye disease. In the Lebanese society where tobacco (especially cigarette and water pipe) is widely smoked [23], a significant association has been observed between smoking and OSDI status ($p < 0.05$). Smokers who reported higher OSDI mean scores have relative percentages of DED-diagnosed (OSDI score ≥ 13). This significant association between smoking and DED could be supported

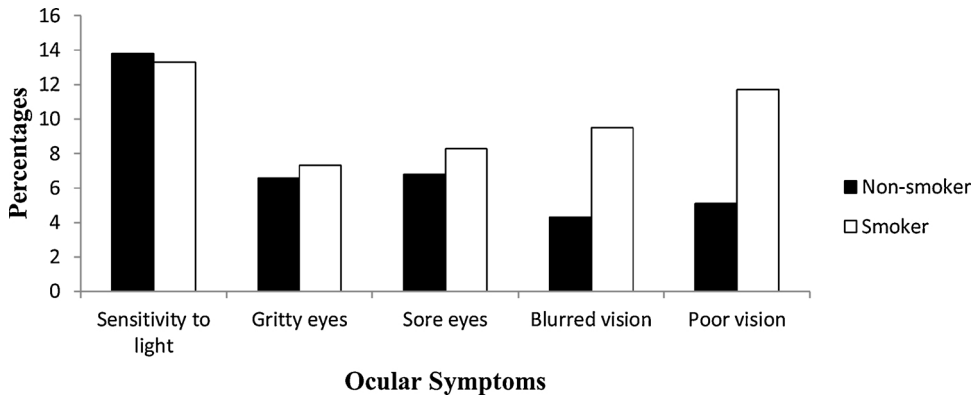

Fig. 1. Percentages of ocular symptoms (ranging from half to all of the time) in smokers and non-smokers.

by the clinical study of aktas et al. that reported an increase of the tear film osmolarity among smokers, which can in turn damage the ocular surface and tear function [21]. In addition, the higher occurrence of intense dry eye symptoms (ranging from half to all of the time) in smokers could also support this association based on the higher ocular surface sensitivity (due to defects in the ocular surface defense) in populations that are more exposed to the irritative toxins in tobacco smoke [21,24].

4.4. Association between Smoking type and OSDI status

As smoking toxins may decrease blood flow or develop clot within eye capillaries and therefore limit the access of essential nutrients to the eye [25] and based on the in-equivalency between cigarette and waterpipe in terms of toxins and smoke exposure [26], the current paper has studied the relation between DED and the common types of tobacco in Lebanon to find a significant association between DED status and the types of tobacco smoked ($p < 0.05$). Participants who smoke both cigarette and waterpipe reported the highest mean score of OSDI and the relative percentages of DED-diagnosed (OSDI score $\geq$ 13) due to their higher and longer exposure to tobacco. On the other hand, cigarette smokers have reported approximately similar mean score of OSDI and the relative percentages of DED-diagnosed (OSDI score $\geq$ 13) as waterpipe smokers. This result is inconsistent with the comparative analysis showing that waterpipe smokers are exposed to more toxins and smokes than cigarette ones [26]. This unexpected finding could be explained by a further work with controlled confounding factors such as age, gender and smoking rates and practices.

The current study has investigated the first data on the prevalence of symptomatic DED among the Lebanese population. The outcome of this study could provide the Ministry of Health and the medical institutions/industries in Lebanon with new evidence and data regarding this ocular disease to be as a guiding platform for perspective investigations in the field of eye diseases. In addition, the non-governmental organizations, higher academic institutions, and the ministry can implement specific programs that can benefit from this outcome to spread the awareness of DED and its associated factors among the population. However, some limitations in the design of this study should be noted. The estimation of the DED prevalence relied only on the self-responding questionnaires where some responding bias or social desirability could affect these findings. Also, the findings are based only on subjective analysis which could be consistent or inconsistent with the clinical signs. Thus, further work is recommended to assess the occurrence of DED signs among the Lebanese population and study its association with the symptomatic DED.

In summary, about one-third of the studied population in Lebanon has been diagnosed with the symptomatic DED using the validated OSDI survey. The most prevalent symptom in the Lebanese population is the sensitivity to light. Smokers have shown higher prevalence of dry eye symptoms than non-smokers. This paper has clearly shown that older population and tobacco smokers were more likely to report the symptomatic DED. However, no association with gender was found in the population. The study provides a starting platform for further research studies in the evolution of dry eye disease in Lebanon.

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Declaration of Competing Interest

None.

References

[1] H. Brewitt, F. Sistani, M.H. Hannover, Dry eye disease : the scale of the problem, Surv Ophthalmol 45 (2001) S199–202.
[2] J.P. Craig, K.K. Nichols, E.K. Akpek, B. Caffery, H.S. Dua, C.K. Joo, et al., TFOS DEWS II definition and classification report, Ocul Surf 15 (2017) 276–283, https://doi.org/10.1016/j.jtos.2017.05.008.
[3] The International Dry Eye Workshop. The definition and classification of dry eye disease: report of the Definition and Classification Subcommittee of the International Dry Eye WorkShop (2007), Ocul Surf (2007) 75–92.
[4] F. Stapleton, M. Alves, V.Y. Bunya, I. Jalbert, K. Lekhanont, F. Malet, et al., TFOS DEWS II epidemiology report, Ocul Surf 15 (2017) 334–365, https://doi.org/10.1016/j.jtos.2017.05.003.
[5] M.M. Bakkar, W.A. Shihadeh, M.F. Haddad, Y.S. Khader, Contact Lens and Anterior Eye Epidemiology of symptoms of dry eye disease (DED) in Jordan : a cross-sectional non-clinical population-based study, Contact Lens Anterior Eye 39 (2016) 197–202.
[6] J. Vehof, D. Kozareva, P.G. Hysi, C.J. Hammond, Prevalence and risk factors of dry eye disease in a British female cohort, Br J Ophthalmol 98 (2014) 1712–1717, https://doi.org/10.1136/bjophthalmol-2014-305201.
[7] D.K.T. Lam, V.W.Y. Wong, V.W.S. Chow, C.C. Chi stanley, Epidemiology of dry eye syndrome in Hong Kong : a cross-sectional population-based study, Hong Kong J Ophthalmol 15 (2012) 58–62.
[8] S.N. Onwubiko, B.I. Eze, N.N. Udeh, O.C. Arinze, E.N. Onwasigwe, R.E. Umeh, Dry eye disease: prevalence, distribution and determinants in a hospital-based population, Contact Lens Anterior Eye 37 (2014) 157–161, https://doi.org/10.1016/j.clae.2013.09.009.
[9] K.F. Farrand, M. Fridman, I.O. Stillman, D.A. Schaumberg, Prevalence of diagnosed dry eye disease in the United States among adults aged 18 years and older, Am J Ophthalmol 182 (2017) 90–98, https://doi.org/10.1016/j.ajo.2017.06.033.
[10] L.L. Tan, P. Morgan, Z.Q. Cai, R.A. Straughan, Prevalence of and risk factors for symptomatic dry eye disease in Singapore, Clin Exp Optom 98 (2015) 45–53.
[11] R.M. Schiffman, M.D. Christianson, G. Jacobsen, J.D. Hirsch, B.L. Reis, Reliability and validity of the ocular surface disease index, Arch Ophthalmol 118 (2000) 615–621.
[12] R. Fagehi, H. Ghazal, S. Alrabiah, A. Abusharha, S. Alanazi, A. Alsaqr, et al., Ocular dryness assessment in Saudi employees working indoors and outdoors, Clin Optom 10 (2018) 51–56.
[13] W.G. El Hajj Moussa, R.G. Farhat, J.C. Nehme, M.A. Sahyoun, A.R. Schakal, et al., Comparison of efficacy and ocular surface disease index score between bimatoprost, latanoprost, Travoprost, and Tafluprost in Glaucoma patients, J Ophthalmol 2018 (2018), https://doi.org/10.1155/2018/1319628.
[14] J.R. Grubbs, S. Tollesson-Rinehar, K. Huynh, R.M. Davis, A review of quality of life measures in dry eye questionnaires, Cornea 33 (2014) 215–218, https://doi.org/10.1097/ICO.0000000000000038.
[15] C.L. Prokopich, E. Bitton, B. Caffery, L. Michaud, D.N. Cunningham, P.M. Karpecki, et al., Screening, diagnosis and management of dry eye disease : practical guidelines for canadian optometrists, Can J Optom 76 (2015) 4–26, https://doi.org/10.13140/RG.2.1.2788.4963.
[16] S.E. Moss, R. Klein, B.E.K. Klein, Prevalence of and risk factors for dry eye syndrome, Arch Ophthalmol 118 (2000) 1264–1268, https://doi.org/10.1001/archopht.118.9.1264.
[17] F. Stapleton, S. Stretton, C. Skotnitsky, D.F. Sweeney, Silicone hydrogel contact lenses and the ocular surface, Ocul Surf 4 (2006) 24–43, https://doi.org/10.1016/S1542-0124(12)70262-8.
[18] K. Sapkota, R. Martin, S. Franco, M. Lira, Common symptoms of Nepalese soft contact lens wearers : a pilot study, J Optom 8 (2015) 200–205, https://doi.org/10.1016/j.optom.2015.01.004.
[19] W. Mathers, D. Stovall, J. Lane, M. Zimmerman, S. Johnson, Menopause and tear function: the influence of prolactin and sex hormones on human tear production, Cornea 17 (1998) 353–358.
[20] N.J. Van Haeringen, Aging and the lacrimal system, Br J Ophthalmol 81 (1997) 824–826.
[21] S. Aktaş, M. Tetikoğlu, A. Koçak, M. Kocacan, H. Aktaş, H.M. Sağdık, et al., Impact of smoking on the ocular surface, tear function, and tear osmolarity, Curr Eye Res 42 (2017) 1585–1589, https://doi.org/10.1080/02713683.2017.1362005.
[22] D. Erginturk Acar, U. Acar, Z.O. Tunay, O. Ozdemir, H. Germen, The effects of smoking on dry eye parameters in healthy women, Cutan Ocul Toxicol 36 (2016) 1–4, https://doi.org/10.3109/15569527.2015.1136828.
[23] Z. El-Roueiheb, H. Tamim, M. Kanj, S. Jabbour, I. Alayan, U. Musharrafieh, Cigarette and waterpipe smoking among Lebanese adolescents, a cross-sectional study, 2003 – 2004, Nicotine Tob Res 10 (2008) 309–314, https://doi.org/10.1080/14622200701825775.
[24] A. Satici, M. Bitiren, I. Ozardali, H. Vural, The effects of chronic smoking on the ocular surface and tear characteristics : a clinical, histological and biochemical study, Acta Ophthalmol Scand 81 (2003) 583–587.
[25] J. Thomas, G.P. Jacob, L. Abraham, B. Noushad, G.P. Jacob, The effect of smoking on the ocular surface and the precorneal tear film, Australas Med J 5 (2012) 221–227.
[26] T. Eissenberg, A. Shihadeh, Waterpipe Tobacco and Cigarette Smoking. Direct Comparison of Toxicant Exposure, Am J Prev Med 37 (2009) 518–523, https://doi.org/10.1016/j.amepre.2009.07.014.