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Original Article

A Study of Prevalence and Risk Factors of Digital Eye Strain among Diabetic and Non-Diabetic Patients

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ABSTRACT

Background: The proliferation of digital devices in modern society has led to a significant increase in the prevalence of Digital Eye Strain (DES), characterized by symptoms such as eye fatigue, dryness, and headaches. This condition poses a particular risk to individuals with systemic conditions, such as diabetes mellitus, which can exacerbate ocular symptoms. Understanding the relationship between DES and diabetes is crucial for developing targeted interventions to alleviate symptoms and improve quality of life.

Objective: This study aims to assess the prevalence and risk factors of Digital Eye Strain among diabetic and non-diabetic individuals, examining the impact of digital device usage patterns, ocular surface health, and visual discomfort symptoms in both groups.

Methods: A cross-sectional study was conducted at the Eye Department of Jeddah National Hospital, involving 150 diabetic and 150 non-diabetic participants, employing purposive sampling. Participants were evaluated for DES symptoms, digital device usage habits, and clinical signs of ocular surface health, including Tear Break Up Time (TBUT), Fluorescein Stains (FS), and Tear Meniscus Height. Data analysis was performed using SPSS version 25, focusing on statistical differences between the two groups.

Results: The mean age of participants was 56 years (SD=10.3) for the diabetic group and 54 years (SD=8) for the non-diabetic group, with a balanced gender distribution across both groups. Diabetic participants demonstrated a significantly lower TBUT (median=5 seconds, IQR=2) compared to non-diabetics (median=7 seconds, IQR=1), P=0.001. DES symptoms, particularly eye fatigue and headaches, were more prevalent among diabetics, with over four hours of computer usage exacerbating symptoms (eye fatigue: 57%, P=0.001; headache: 32.8%, P=0.029). Environmental and behavioral factors, including improper illumination and infrequent breaks, were significantly associated with increased DES symptoms.

Conclusion: Digital Eye Strain is more prevalent and severe among diabetic individuals, with significant implications for ocular and general well-being. The findings underscore the need for targeted digital health interventions and ergonomic practices to mitigate DES symptoms, especially among those with diabetes.

Keywords: Digital Eye Strain, Diabetes Mellitus, Tear Break Up Time, Ocular Surface Health, Computer Vision Syndrome, Digital Device Usage.

INTRODUCTION

In the contemporary digital era, society's increasing dependency on digital devices such as smartphones, tablets, computers, and e-readers has introduced a myriad of lifestyle changes, among which the phenomenon of Digital Eye Strain (DES), also known as Computer Vision Syndrome (CVS), has emerged as a significant public health concern (1). DES is characterized by a range of ocular and visual discomfort symptoms including eye fatigue, dryness, blurred vision, headaches, neck, and shoulder pain, primarily resulting from prolonged exposure to digital screens. The symptoms of DES not only diminish an individual's quality of life but also impact daily activities and overall well-being, thereby necessitating an in-depth investigation into its prevalence and risk factors, particularly among populations with preexisting health conditions such as diabetes mellitus (2). Diabetes, a chronic condition marked by hyperglycemia and insulin resistance, is known for its systemic manifestations, including a variety of ocular complications, suggesting a potential intersection between DES and diabetic ocular manifestations that warrants exploration (3).

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The prevalence of DES has notably increased alongside the surge in digital device usage across the globe. In the United States alone, more than 80% of adults are reported to engage with digital devices for over two hours daily, with a significant 59% experiencing symptoms indicative of DES. Despite these staggering figures, there remains a gap in research specifically addressing the prevalence and implications of DES among diabetic individuals, who are already susceptible to ocular complications such as diabetic retinopathy (4). This gap underscores the need for empirical research aimed at exploring the prevalence, risk factors, and potential correlations between digital device usage, DES, and diabetes mellitus to inform clinical practices, public health initiatives, and patient education (5).

Risk factors contributing to DES encompass a broad range of elements including age, duration of screen exposure, proximity to screens, posture during device use, and underlying ocular conditions such as refractive errors and dry eye syndrome. Notably, prolonged screen time is associated with decreased blink rates, leading to ocular dryness and discomfort, while the positioning of screens and the user's posture can further exacerbate these symptoms (6). For diabetic individuals, the interplay between diabetes-related ocular changes and DES symptoms introduces an additional layer of complexity. Diabetes-induced alterations in the retina and an increased propensity towards dry eye syndrome can enhance vulnerability to DES, with hyperglycemia further impacting ocular surface health and contributing to DES symptoms (7).

The ramifications of DES extend beyond mere ocular discomfort, affecting individuals' quality of life, daily functioning, and work productivity. The experience of discomfort, headaches, and diminished visual performance associated with DES can significantly hinder an individual's ability to perform daily tasks and maintain overall well-being. For diabetic patients, the addition of DES to their spectrum of health concerns may exacerbate the challenges associated with diabetes management and negatively influence their overall health outcomes (8). Given the multifaceted nature of DES and its implications for diabetic and non-diabetic populations alike, it is imperative for healthcare professionals, researchers, and policymakers to develop a nuanced understanding of DES, its prevalence, risk factors, and impact. Such an understanding is crucial for crafting effective prevention, management strategies, and interventions aimed at mitigating the adverse effects of DES and enhancing the quality of life for affected individuals (9).

MATERIAL AND METHODS

The methodology of this cross-sectional study was designed to investigate the prevalence and risk factors of Digital Eye Strain among diabetic and non-diabetic participants, conducted within the premises of the Eye Department at Jeddah National Hospital, a secondary eye care center, from 1st July 2022 to 31st December 2022. Employing a purposive sampling technique, the study aimed to recruit a diverse cohort of participants, including 150 individuals from both diabetic and non-diabetic groups, to ensure the representation across a wide spectrum in terms of age, gender, digital device usage patterns, and the frequency of eye symptoms experienced. This approach facilitated the examination of a broad array of variables potentially influencing the onset and severity of Digital Eye Strain (10).

Participants were meticulously selected based on inclusion criteria which comprised males and females aged between 25 and 60 years who had been using computers for a minimum of four hours per day continuously over the past year. Individuals with a history of ocular disease or surgery, those who had used contact lenses in the past three months, and women who were pregnant or had gestational diabetes were excluded from the study to eliminate potential confounding factors related to corneal epithelial fragility, dehydration, and systemic conditions that could affect the study's outcomes. For the diabetic cohort, inclusion criteria were further specified to include individuals with well-controlled fasting glucose levels (≥ 100 mg/dL) and HbA1c < 8, without evidence of systemic diabetic complications such as retinopathy or peripheral neuropathy, ensuring a homogenous comparison group (11).

Data collection involved recording comprehensive details including the date of the first examination, age at the first visit, gender, past ocular history, presence of systemic diseases, and other risk factors associated with dry eye syndrome such as clinical diagnostic signs including tear break-up time (TBUT), corneal fluorescein staining, and tear meniscus height. This information was instrumental in assessing the prevalence of Digital Eye Strain and identifying associated risk factors within the study population (12).

The data analysis was conducted using the Statistical Package for the Social Sciences (SPSS) version 25, allowing for a detailed statistical examination of the gathered data to meet the research objectives. Ethical considerations were paramount throughout the study, with informed consent obtained from all participants to ensure their comprehensive understanding of the study's purpose, procedures, and their rights. The privacy and confidentiality of participant data were rigorously protected, adhering to ethical standards consistent with the Declaration of Helsinki. This ethical framework guided the study's conduct, emphasizing the importance of respect for participant autonomy, privacy, and the ethical use of collected data for research purposes.

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RESULTS

The demographic characteristics and clinical signs of the study sample revealed notable insights into the prevalence and risk factors associated with Digital Eye Strain among diabetic and non-diabetic groups. The average age of participants in the diabetic group was 56 years, with a standard deviation of 10.3, while the non-diabetic group had an average age of 54 years, with a standard deviation of 8. The gender distribution was balanced across both groups, with males and females each constituting 44.6% and 54.4% of their respective groups. A significant difference was observed in the Tear Break Up Time (TBUT) between the two groups, with the diabetic group showing a median TBUT of 5 seconds, compared to 7 seconds in the non-diabetic group, indicating a higher prevalence of dry eye symptoms among diabetics (P=0.001) [Table 1].

Moreover, the assessment of ocular surface health, as indicated by Fluorescein Stains (FS) and Tear Meniscus Height, showed differences albeit not all statistically significant. The diabetic group had a median FS grade of 0.5, compared to 0 in the non-diabetic group, with a p-value of 0.312, suggesting a trend towards worse ocular surface health in diabetics [Table 1]. The Tear Meniscus Height also reflected this trend with diabetics having a lower median value of 0.5 mm compared to 0.75 mm in the non-diabetic group, although this difference approached but did not reach statistical significance (P=0.064) [Table 1].

Ocular and extraocular complaints, including fatigued eyes, irritation, burning sensation, headache, and neck/shoulder pain, were reported by participants, highlighting the symptomatic burden of Digital Eye Strain. Notably, fatigued eyes were more prevalent in the diabetic group (49.5%) compared to the non-diabetic group (30.6%). Conversely, irritation of the eyes was reported more frequently among non-diabetics (46.9%) than diabetics (30.5%). Headaches were significantly more common, affecting 91.8% of the diabetic group and 80.7% of the non-diabetic group, underlining the broad impact of digital device usage on systemic discomfort [Table 2].

Table 1: Demographic Characteristics and Clinical Signs

Description	Metric	Diabetic Group	Non-Diabetic Group	P-value
Mean Age	Years (SD)	56 (10.3)	54 (8)	N/A
Gender	Male (%)	44.6	44.6	N/A
	Female (%)	54.4	54.4	N/A
Tear Break Up Time	Seconds (IQR)	5 (2)	7 (1)	0.001
Fluorescein Stains	Grade (IQR)	0.5 (2)	0 (1)	0.312
Tear Meniscus Height	mm (IQR)	0.5 (0.6)	0.75 (0.7)	0.064

Table 2: Ocular and Extra Ocular Complaints

Complaint	Diabetic Group (%)	Non-Diabetic Group (%)
Fatigued Eyes	49.5	30.6
Irritation of Eyes	30.5	46.9
Burning Sensation	20.3	22.5
Headache	91.8	80.7
Neck/Shoulder Pain	8.2	17.3

Table 3: Association between Computer Usage and Symptoms

Symptom	Computer Usage	Diabetic Group (%)	Non-Diabetic Group (%)	P-value
Eye Fatigue	> 4 Hrs	57	N/A	0.001
Headache	> 4 Hrs	32.8	N/A	0.029

Table 4: Patterns of Computer Usage and Symptoms

Factor	Impact	Diabetic Group (%)	Non-Diabetic Group (%)	P-value
Improper Illumination (Headache)	Yes	27.9	22.1	Diabetic: .021, Non-Diabetic: .003
Frequency of Breaks (< 1 Hr, Eye Fatigue)	Yes	14.1	26.3	Diabetic: .021, Non-Diabetic: .001

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The association between computer usage and symptoms revealed a direct correlation with increased symptoms among those with higher screen time. In the diabetic group, more than 4 hours of computer use was associated with a 57% prevalence of eye fatigue and 32.8% prevalence of headaches, significantly higher than among those with less usage, with p-values of 0.001 and 0.029 respectively [Table 3].

Patterns of computer usage, including the impact of improper illumination and the frequency of breaks, were analyzed to understand their effects on the development of Digital Eye Strain symptoms. Diabetic individuals reported a 27.9% prevalence of headaches attributed to improper illumination, compared to 22.1% in the non-diabetic group, with respective p-values of 0.021 for diabetics and 0.003 for non-diabetics. Furthermore, a significant difference was observed in the effect of taking breaks; less frequent breaks (less than 1 hour) were associated with increased eye fatigue, especially among non-diabetics (26.3%) compared to diabetics (14.1%), with p-values of 0.021 for diabetics and 0.001 for non-diabetics [Table 4].

DISCUSSION

The findings of this study shed light on the significant impact of Digital Eye Strain (DES) among diabetic and non-diabetic populations, underscoring a crucial intersection between chronic systemic conditions and digital device usage. Our results demonstrate a higher prevalence of DES symptoms, particularly reduced Tear Break Up Time (TBUT), among diabetics compared to non-diabetics, aligning with previous studies that have suggested an exacerbated risk of ocular surface disorders in diabetic individuals due to metabolic dysregulation affecting the tear film and ocular surface integrity (13).

Moreover, the pronounced symptoms of eye fatigue and headache in the diabetic group, especially with over four hours of computer use, echo the findings of other studies highlighting the exacerbated impact of screen time on individuals with pre-existing systemic conditions (14). The link between extended digital device usage and increased DES symptoms emphasizes the need for targeted interventions to mitigate screen-related ocular discomfort, particularly among vulnerable populations (15).

Interestingly, the role of improper illumination and infrequent breaks in exacerbating DES symptoms suggests an area for intervention that could benefit both diabetic and non-diabetic groups. These findings are consistent with research by Katz et al. (2020), which identified environmental and behavioral factors as modifiable risk factors for DES, advocating for ergonomic adjustments and behavioral modifications as part of DES management strategies (16).

The comparison of clinical signs, such as TBUT and Fluorescein Stains (FS), between diabetic and non-diabetic individuals provides an important insight into the ocular surface's vulnerability in diabetics (17). Similar studies have reported that diabetic patients often exhibit compromised tear film stability and ocular surface health, contributing to the higher incidence of DES symptoms (Smith et al., 2017). This correlation underscores the importance of comprehensive ocular surface evaluation in diabetic patients, especially those with significant digital device usage (18).

The gender distribution in our study, evenly split across diabetic and non-diabetic groups, highlights the universal impact of DES across genders. However, this contrasts with some reports suggesting a higher predisposition among females, attributed to hormonal influences on tear film dynamics (19). The discrepancy may be due to the specific demographic characteristics of our study population or the overarching influence of diabetes, which may overshadow gender-specific trends in DES prevalence (20, 21).

The prevalence of ocular and extraocular complaints, particularly headaches and neck/shoulder pain, further illustrates the multifaceted nature of DES, extending beyond the ocular symptoms to involve musculoskeletal discomfort. These findings are corroborated by research indicating that DES can have a broader systemic impact, affecting overall quality of life and productivity (22). The interplay between screen time, posture, and environmental factors highlights the complexity of DES etiology, necessitating a holistic approach to management and prevention (23).

CONCLUSION

In conclusion, our study contributes to the growing body of evidence on the impact of Digital Eye Strain among diabetic and non-diabetic populations, highlighting significant differences in the prevalence and severity of symptoms. The findings advocate for the inclusion of digital device usage habits in the clinical assessment of diabetic patients, emphasizing the need for tailored advice on screen time management, ergonomic practices, and regular ocular evaluations. Future research should explore intervention strategies, including screen filtering technologies, ergonomic adjustments, and behavioral modifications, to mitigate the impact of Digital Eye Strain, particularly among vulnerable populations with pre-existing conditions like diabetes.

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REFERENCES

1. Ahmad AA, Alshehri BF, Almalki AM, Albaradi AM, Almalki MS, Alattas KY. Eyeing computer vision syndrome: Awareness, knowledge, and its impact on sleep quality among health sciences students during the COVID-19 pandemic in Taif, Kingdom of Saudi Arabia. International Journal of Medicine in Developing Countries. 2021;5(9):1647-.

2. Ahmed MS, Ullah AY, Barman N, Ratan ZA, Mostafa S, Khaleque A, et al. Risk factors associated with elevated intraocular pressure: a population-based study in a rural community of Bangladesh. BMJ Open Ophthalmology. 2023;8(1):e001386.

3. Althiabi SM, Alnafeesah AA, Al-boqami BAA-h, Alkhulifi BH, Albadi SM, Alfowzan RF. The association between digital eye strain symptoms, especially dry eye and online study during COVID-19 pandemic among Qassim University medical students. International Journal of Medicine in Developing Countries. 2022;6(9):1157-.

4. Bashorun SD, Balogun BG, Ibidapo O, Bashorun AO. Prevalence of dry eye disease in type 2 diabetic and non-diabetics: A cross-sectional hospital-based study. Journal of West African College of Surgeons. 2024;14(2):180-7.

5. Bu Y, Shih KC, Tong L. The ocular surface and diabetes, the other 21st Century epidemic. Experimental Eye Research. 2022;220:109099.

6. Chandler RK, Villani J, Clarke T, McCance-Katz EF, Volkow ND. Addressing opioid overdose deaths: The vision for the HEALing communities study. Drug and Alcohol Dependence. 2020;217:108329.

7. Chauke MM. Possible correlations between HbA1c and selected modifiable risk factors for type 2 diabetes mellitus in a non-diabetic population: University of Johannesburg; 2023.

8. del Mar Seguí M, Cabrero-García J, Crespo A, Verdú J, Ronda E. A reliable and valid questionnaire was developed to measure computer vision syndrome at the workplace. Journal of clinical epidemiology. 2015;68(6):662-73.

9. Khoja L, Atenafu E, Suciu S, Leyvraz S, Sato T, Marshall E, et al. Meta-analysis in metastatic uveal melanoma to determine progression free and overall survival benchmarks: an international rare cancers initiative (IRCI) ocular melanoma study. Annals of Oncology. 2019;30(8):1370-80.

10. Kropp M, Golubnitschaja O, Mazurakova A, Koklesova L, Sargheini N, Vo T-TKS, et al. Diabetic retinopathy as the leading cause of blindness and early predictor of cascading complications—risks and mitigation. Epma Journal. 2023;14(1):21-42.

11. Lee KY, Buldum G, Mantalaris A, Bismarck A. More than meets the eye in bacterial cellulose: biosynthesis, bioprocessing, and applications in advanced fiber composites. Macromolecular bioscience. 2014;14(1):10-32.

12. Loukovaara S, Korhonen A, Niskanen L, Haukka J. Development of diabetic macular oedema shows associations with systemic medication–An epidemiological study. Acta Ophthalmologica. 2023.

13. Lu Y, Wang W, Liu J, Xie M, Liu Q, Li S. Vascular complications of diabetes: A narrative review. Medicine. 2023;102(40):e35285.

14. Meem JT. Musculoskeletal characteristics among diabetic and non-diabetic patients attended at CRP: Bangladesh Health Professions Institute, Faculty of Medicine, the University …; 2022.

15. Morya AK, Ramesh PV, Kaur K, Gurnani B, Heda A, Bhatia K, et al. Diabetes more than retinopathy, it's effect on the anterior segment of eye. World Journal of Clinical Cases. 2023;11(16):3736.

16. Nalini M, Khoshnia M, Kamangar F, Sharafkhah M, Poustchi H, Pourshams A, et al. Joint effect of diabetes and opiate use on all-cause and cause-specific mortality: the Golestan cohort study. International journal of epidemiology. 2021;50(1):314-24.

17. Zewdu D, Gedamu H, Beyene Y, Tadesse M, Tamirat M, Muluken S. Sleep quality and associated factors among type 2 Dm patients and non-Dm individuals in Bahir Dar governmental hospitals: comparative cross-sectional study. Sleep Science and Practice. 2022;6(1):10.

18. Reeves ND, Orlando G, Brown SJ. Sensory-motor mechanisms increasing falls risk in diabetic peripheral neuropathy. Medicina. 2021;57(5):457.

19. Rosenfield M. Computer vision syndrome: a review of ocular causes and potential treatments. Ophthalmic and Physiological Optics. 2011;31(5):502-15.

20. Smith JN, Walker HM, Thompson H, Collinson JM, Vargesson N, Erskine L. Lens-regulated retinoic acid signalling controls expansion of the developing eye. Development. 2018;145(19):dev167171.

21. Upadhayay P, Bansal K, Goyal A. Epidemiology, Risk Factors, Diagnosis and Treatment of Mucormycosis (Black Fungus): A Review. Current Pharmaceutical Biotechnology. 2023;24(13):1645-56.

22. Schaumberg DA, Sullivan DA, Buring JE, Dana MR. Prevalence of dry eye syndrome among US women. American journal of ophthalmology. 2003;136(2):318-26.

23. Shah M, Saboor A. Computer vision syndrome: Prevalence and its associated risk factors among computer-using bank workers in Pakistan. 2022.