

Evaluation of Tear Film Stability and Ocular Surface Alterations in Obese Individuals Ayesha Sajid¹, Dr Rubab Naqvi², Sibgha Naseem³, Zaryab Khan⁴, Safira Khalid⁵, Toseef Ul Rahman⁶, Zunira Rasool⁷

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Abstract

To evaluate the tear film stability and ocular health in obese patients. This was a cross-sectional observational study conducted over six months at Farooq Hospital, Lahore. A total of 120 diabetic patients aged 18 to 70 years were selected using purposive sampling. Participants were categorized into three BMI groups: normal (18.5-24.9 kg/m²), overweight (25-29.9 kg/m²), and obese (≥ 30 kg/m²). Tear film quality was assessed through Schirmer's test for tear production and TBUT using fluorescein dye and slit-lamp biomicroscopy. Ocular discomfort was evaluated using the OSDI questionnaire. All procedures were standardized and conducted by trained personnel. P-value < 0.05 was considered significant. Out of 120 diabetic participants, 38.33% were males and 61.67% females; 20% had type 1 and 80% had type 2 diabetes. Based on BMI, 38% had normal weight, 41% were overweight, 41% were obese. Tear film stability (TBUT) mean ranks: 94.39, 64.90, 24.68) and tear production (Schirmer's mean rank 94.50, 65.61, 23.88) declined with increasing BMI. However, the Kruskal-Wallis test showed no statistically significant difference in overall symptom score across BMI categories (*H=0.211, df=2, p=0.900) The differences between BMI groups were not statistically significant, tear film function revealed a decreasing trend with increasing BMI indicating that overweight and obese people may have lower tear stability and production.

Key words: BMI, Overweight, Obesity, Tear Film

Introduction

Diabetes is frequently associated with cataracts and retinopathy, two of the main causes of blindness in persons aged 20 to 70. In diabetes individuals, dry eye has become a serious ocular surface problem in recent years. (1) Complete insulin insufficiency causes type 1 diabetes, which is frequently associated with autoimmune destruction of the pancreatic islets as detected by genetic and serological markers. On the other hand, insulin resistance and insufficient compensatory insulin response are the causes of type 2 diabetes, which is the more prevalent type. (2) one of the hallmarks of diabetes mellitus, a collection of metabolic diseases, is hyperglycemia, which is brought on by compromised insulin secretion or action. (2) Dry mouth, frequent urination, exhaustion, excessive thirst, weight loss, bedwetting, and blurred vision are some of the symptoms of type 1 diabetes. Traditionally seen in elderly persons, type 2 diabetes is now more common in younger people as a result of poor eating habits, sedentary lifestyles, and rising obesity rates. (3) About 3 μm thick, the tear film is essential for lubricating the eyes, protecting them, and preserving the corneas and conjunctiva's health. Additionally, it guarantees a smooth optical surface for refraction. With a total volume of roughly 3-10 μL ,

tear secretion happens at a rate of 1-2 μ L/min. (4) Despite being only 3 microns thick, the tear film is a sophisticated structure that connects the environment and the ocular surface epithelium. Its components are water, electrolytes, mucins, proteins, and lipids, which maintain the health and functionality of the eye surface. (5) Tears have an average pH of approximately 7.45, with seasonal and diurnal variations causing fluctuations between 7.14 and 7.82. (6) A number of tests can be used to assess dry eye syndrome. The Schirmer test, TBUT, and ocular surface staining with fluorescein, Lissamine green, or Rose Bengal are frequently recommended techniques. Interferometry, infrared meibography, MMP-9, lactoferrin levels, tear film osmolarity, and IgE microassays are examples of sophisticated but expensive testing. Evaluation of blink rate is also essential for diagnosis. (7) In diabetics who already have impaired tear function, obesity exacerbates problems with the tear film. This eye problem is made worse by inadequate glycemic management. (8) Obesity is defined by a BMI of ≥ 30 , and overweight is defined by a BMI of 25.0-29.9. with the exception of some regions of Africa and sub-Saharan Asia, overweight and obesity are more common and deadly than underweight worldwide. (9) Global obesity rates nearly doubled (from 7% to 16%) in adults and tripled (from 2% to 8%) in children and adolescents aged 5 to 19 between 1990 and 2022, indicating a significant public health concern. (10) Numerous factors contribute to obesity, such as a bad diet, a lack of physical activity, environmental influences, and genetic susceptibility. (11) Weight gain may result from taking some drugs, such as corticosteroids, antidepressants, and anticonvulsants. Furthermore, hormones that control hunger and energy are disrupted by inadequate sleep, which raises the risk of obesity. (12) Although a person's genetic predisposition to obesity may be increased, environmental variables such as a poor diet and inactivity are frequently required for excessive weight gain to occur. (13) Obesity raises the risk of type 2 diabetes and insulin resistance. Additionally, it is linked to cancers such as breast, colon, and liver cancer, as well as heart disease, stroke, hypertension, osteoarthritis, and sleep apnea. (14) Goblet cell density and tear film volume sharply diminish as a result of diabetes-related hyperglycemia, exacerbating ocular surface injury. (15) Meibomian gland dysfunction (MGD) is frequently linked to type 2 diabetes since studies have shown both structural and functional abnormalities in these glands. (16). Diabetes-related meibomian gland dysfunction destabilizes the tear film and increases evaporation, which exacerbates dry eye symptoms. Inadequate glycemic management makes ocular surface dryness worse by aggravating tear evaporation. (17) The aim of this study is to evaluate the effect of obesity on the tear film and ocular surface.

Methodology

This observational cross-sectional study was conducted over six months at Farooq Hospital, with purposive sampling of 120 obese patients aged 18 years or older, classified into normal weight, overweight, and obese groups based on BMI. Inclusion criteria included confirmed, hypothyroid patients, and no recent ocular surgeries or other ocular surface diseases. Tear film stability and production were assessed using Tear Break-Up Time (TBUT) and Schirmer's test, respectively. The ocular surface disease index OSDI questionnaire and slit lamp biomicroscopy were used to evaluate ocular surface health. Demographic and clinical data, including BMI, were recorded. All assessments were done under standardized conditions by trained personnel. Data were analyzed using SPSS, applying non-parametric tests due to non-normal data distribution. Kruskal-Wallis were used, with a significance level set at $p < 0.05$.

Results

In this study, the normality of data was assessed through the Shapiro-Wilk test. Results indicated that data were not normally distributed ($P < 0.05$). The present study was conducted on 120 patients, of whom 46(38.33%) were males and 74(61.67%) were females, as shown in Figure 1.

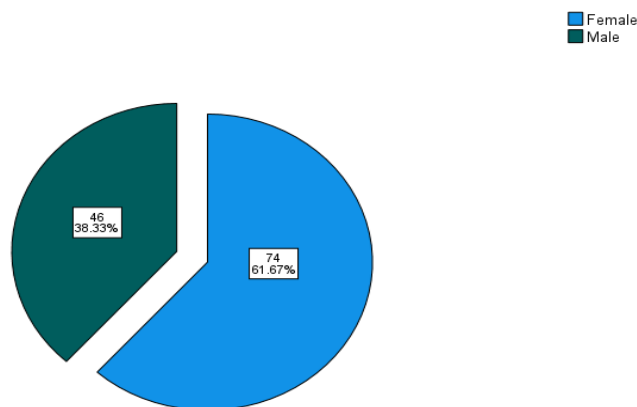


Figure No. 1: Gender Distribution Among Study Participants

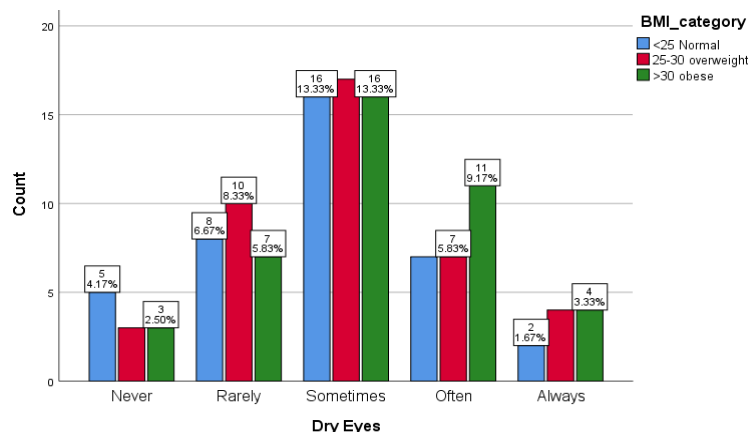


Figure No. 2: Distribution of BMI

Table No. 1: Descriptive Profile of Study Participants

	N	Minimum	Maximum	Mean	Std. Deviation
Age	120	45	70	55.71	5.927
BMI	120	21.70	36.50	28.8033	4.50490

In the present study, the mean age was 55.3 ± 5.6 years, ranging from 45-70 years. Regarding body mass index (BMI), participants demonstrated an average BMI of 28.6 ± 4.6 kg/m², with values ranging from 21.70 to 36.50 kg/m², indicating that the majority were overweight or obese.

Table No. 2: comparisons of mean ranks of tear function tests and dry eye symptoms across BMI categories

	BMI_category	N	Mean Rank
TBUT	<25 Normal	38	94.39
	25-30 overweight	41	64.90
	>30 obese	41	24.68
	Total	120	
Schirmer	<25 Normal	38	94.50
	25-30 overweight	41	65.61
	>30 obese	41	23.88
	Total	120	
Dry_Eyes	<25 Normal	38	55.66
	25-30 overweight	41	59.59
	>30 obese	41	65.90

	Total	120	
Gritty/Sandy_Eyes	<25 Normal	38	60.95
	25-30 overweight	41	64.63
	>30 obese	41	55.95
	Total	120	
Painful_Eyes	<25 Normal	38	62.87
	25-30 overweight	41	53.83
	>30 obese	41	64.98
	Total	120	
Blurred_Vision	<25 Normal	38	55.95
	25-30 overweight	41	64.35
	>30 obese	41	60.87
	Total	120	
Light_Sensitivity	<25 Normal	38	60.61
	25-30 overweight	41	66.54
	>30 obese	41	54.37
	Total	120	
Reading_Difficulty	<25 Normal	38	63.37
	25-30 overweight	41	58.24
	>30 obese	41	60.10
	Total	120	
Driving_at_Night	<25 Normal	38	52.42
	25-30 overweight	41	57.78
	>30 obese	41	70.71
	Total	120	
Computer_Use	<25 Normal	38	65.21
	25-30 overweight	41	53.66
	>30 obese	41	62.98
	Total	120	
Watching_TV	<25 Normal	38	60.47
	25-30 overweight	41	65.43
	>30 obese	41	55.60
	Total	120	
Windy_Conditions	<25 Normal	38	67.76
	25-30 overweight	41	57.99
	>30 obese	41	56.28
	Total	120	
Low_Humidity	<25 Normal	38	60.57
	25-30 overweight	41	59.40
	>30 obese	41	61.54
	Total	120	
Air_Pollution	<25 Normal	38	57.16

	25-30 overweight	41	57.21
	>30 obese	41	66.89
	Total	120	

This table presents mean rank comparisons of tear film stability (TBUT), tear production (Schirmer), and dry eye-related symptoms across three BMI categories (<25 normal, 25-30 overweight, > 30 obese among 120 participants. Lower TBUT and Schirmer mean ranks in obese individuals indicate poorer tear function, while higher mean ranks for dry eye symptoms (e.g., dryness, pain, blurred vision) in overweight and obese groups suggest increased symptoms severity with higher BMI.

Table No. 3: comparison of mean rank of symptom score across BMI categories using Kruskal-Wallis test

BMI category	N	Mean ranks	p-value
<25 Normal	38	61.93	-
25-30 overweight	41	58.54	-
>30 obese	41	61.13	-
total	120		0.900

The overall p-value is 0.900, there is no statistically significant difference in mean ranks among the normal, overweight and obese individuals.

Discussion

The present study evaluated the relationship between BMI and ocular surface parameters aged 18-70 years. Findings demonstrated a significant association between increased BMI and worsening tear film parameters, as evidenced by both subjective symptoms and objective clinical tests. Among the 120 obese patients, 61.67% were females and 38.33% were males. BMI distribution showed that 38% of participants had a normal weight, 41% were overweight, and 41% were obese. The average age was 55.3 year. As the data were non-normally distributed (Shapiro-Wilk test $p < 0.05$), non-parametric tests were applied. Tear film stability (TBUT) and tear production (Schirmer's test) showed a marked decline with increasing BMI. The mean rank for TBUT decreased from 94.39 in the normal group to 64.90 in the overweight and 24.68 in the obese group, while Schirmer mean rank followed a similar pattern (94.50, 65.61, 23.88, respectively) indicating poorer tear function in obese individuals. Symptom's analysis revealed that mean ranks for dry eye symptoms increased progressively with BMI (55.66, 59.59, and 65.90), suggesting higher symptom severity among overweight and obese participants. However, when total symptom scores were compared across BMI groups using the Kruskal-Wallis test, no statistically significant difference was found ($H=0.211$, $df=2$, $p=0.900$) this indicates that although tear function parameters worsened with higher BMI, the overall difference in symptom burden across BMI categories was not statistically significant. Saud A. Alanzi and associates examined the impact of body weight on men's tear film quality in a 2019 study. Two distinct categories were evaluated: one with a high BMI (average 31.8) and the other with a normal weight (average BMI 20.5). There were 20 individuals of the same age in all of them. According to the findings, males with greater BMI had lower-quality tear films. They performed poorly on the tear Ferning test (TF) and NITBUT (a test that evaluates how rapidly tears break apart) than the normal BMI group. Though the individuals with a high BMI group displayed symptoms of dry eye (NITBUT: 8.5 seconds, TF: 2.0), the normal-weight group's eyes were healthy (NITBUT: 14.7 seconds, TF: 0.7). (18) In another study, 59 studies including "7234" eyes were examined in a 2022 meta-analysis review to determine the impact of diabetes on tear function.

According to the findings, tear production and tear film stability were worse in persons with both type 1 and type 2 diabetes. Patients with diabetes had poorer scores on two crucial tests: the invasive TBUT and the Schirmer 1 test. This indicates that they had dry eye, as evidenced by the fact that their eyes generated fewer tears and the tear layer disintegrated more quickly. (8) In contrast to my research, higher BMI is linked to worse tear film function in diabetics. Most of the 120 participants were overweight or obese, and 61.67% were female. About 30-40% reported symptoms like dry eyes and eye pain. TBUT Schirmer's test both showed a strong negative correlation with BMI ($p < 0.001$). The tear function was lowest in obese patients, showing the need for weight control to help manage dry eye in diabetics.

Conclusion

However, the differences between BMI groups were not statistically significant, tear film function revealed a decreasing trend with increasing BMI indicating that overweight and obese people may have lower tear stability and production.

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