International Journal of Science and Healthcare Research
Vol. 8; Issue: 1; Jan.-March 2023
Website: ijshr.com
Original Research Article *ISSN: 2455-7587*

Correlation of Blood Glucose Level and Tear Production Among Young Adult Women

Azuamah, Y.C.[1], Njoku, C.E.[2], Esenwah, E.C.[3], Ikoro, N.C.[4], Megwas, A.U.[5]

[1,2,3,4,5]Department of Optometry, Federal University of Technology, Owerri, Nigeria

Corresponding Author: Azuamah, Y.C.

DOI: https://doi.org/10.52403/ijshr.20230112

ABSTRACT

Blood glucose monitoring is a way of testing the concentration of glucose in the blood. Tears are clear, salty, slightly alkaline and watery substance which helps in seeing clearly and maintaining the health of the eyes. This study was carried out to determine the correlation of blood glucose level and tear production among young adult women. A total of 108 subjects were part of this study. The Accu Chek glucometer was used to measure the blood glucose level and the Schirmer test strips were used to measure the tear production of the subjects. Results showed that the mean FBG level was 98.86±12.21; the mean RBG was 114±39.39, and the mean tear production was 18.37±11.63. SPSS version 23 data analysis using the Pearson Product Moment Correlation Coefficient at 0.05 level of significance and 95% confidence interval revealed that there were no significant correlations of both fasting and random blood glucose levels (P>0.05) with tear production among young adult women. It was therefore concluded from the study that there was no correlation between blood glucose level and tear production among adult women. Further research in a wider geographical area was recommended.

Keywords: Fasting Blood Glucose, Random Blood Glucose, Tear production, Schirmer Test, Dry Eye Syndrome, Diabetes Mellitus

INTRODUCTION

Tear secretion is a complex process with the involvement of the main and accessory lacrimal glands, corneal and conjunctival epithelial cells, and the meibomian glands. [1] Corneal sensory nerves stimulate the lacrimal gland by a trigeminal-parasympathetic reflex. The lacrimal gland secretes a complex aqueous milieu rich in antibodies, cytotoxic agents and growth factors onto the ocular surface to protect the cornea from desiccation, infection and vascularization while promoting wound healing and transparency. [2] The bulk of the tear volume and flow is via secretion from the lacrimal gland with a smaller portion secreted by the conjunctiva. The lacrimal gland is the main source of fluid, electrolytes and proteins in tear fluid. Tears lubricate the eye and help keep it clear of dust, prevent infection, provide nourishment and keep the cornea healthy, and provides clear vision. [3] Tears contain water, mucin, lipids, lysozyme, lactoferrin, lipocalin, lacritin, immunoglobulins, glucose, urea, sodium, and potassium. [3] Similar to other exocrine tubuloacinar glands, the lacrimal gland is mainly composed of three types of cells: acinar, duct and myoepithelial cells out of which 80% is made of acinar cells and are the site for synthesis, storage and secretion of proteins. Generally, in case of tubuloacinar glands, the contribution of acinar and duct cells to the final glandular product varies on a wide scale. Although the morphology can possess considerable similarities among various glands, the functional role of acinar and duct cells differs greatly. [4]

Poor glycemic control affects both the anterior and the posterior segments of the

eye. [5] Keratoconjunctivitis sicca, more commonly referred to as dry eye syndrome (DES), is a frequently encountered condition and hyperglycemia has been identified as one of the leading causes of DES. [6] The reported prevalence of Dry Eye Syndrome in diabetics is 15–33% in those over 65 years of age and increases with age and is 50% more common in women than in men. The incidence of dry eye is correlated with the level of glycated hemoglobin: the higher the level of glycated hemoglobin, the higher the incidence of dry eye. [6] Lacrimal function unit (LFU) which is composed of "the cornea, conjunctiva, lacrimal gland, meibomian gland, lids, and the sensory and motor nerves that connect them" plays a regulatory role in tear secretion and tear film formation and maintains the normal physiology of the ocular surface. Damage to any component of LFU leads to tear-deficiency or evaporative DES. Tear hyperosmolarity and tear film instability caused by Lacrimal Function Unit and ocular surface dysfunction are the key factors in DES. [7] Effects of hyperglycemia on any component of the LFU may be transferred to the entire system via neural connections, leading to insufficient tear production or excess tear loss, abnormalities in blinking, and changes in tear film composition. All these cause Dry Eye Syndrome. Hyperglycemic patients with dry eye may have the same symptoms as DES without hyperglycemia. Tear hyperosmolarity and tear film instability caused by Lacrimal Function Unit and ocular surface dysfunction are the key factors in DES. [8] Dry eye syndrome is noted in patients with damaged main lacrimal gland. They are typically severe in patients whose glycemic control is poor.

Androgens and oestrogens which are female sex hormones, regulate the lacrimal and meibomian glands. It has been theorized that androgen levels play an important role in dry eye by regulating secretory functions of lacrimal glands. [9] Lack of androgens is responsible for reversible degenerative changes of the lacrimal gland, decreased volume of the tears and decreased level of proteins in tears. [10] Adequate insulin level is important for lacrimal gland and ocular surface stability and function, because it is necessary for acinar cell and cornea epithelial cell proliferation. The objective of this study is to investigate the correlation between blood glucose levels and tear production among young adult women.

MATERIALS AND METHODS

This study was a clinical study carried out at the Department of Optometry Teaching Clinic, Federal University of Technology, Owerri, Imo state, Nigeria. An informed consent was gotten from all the subjects who were part of the study. Ethical approval for the study was obtained from the Ethics Committee, School of Health Technology, Federal University of Technology Owerri, Imo State, Nigeria. Data was obtained through the measurement of tear production using the Schirmer test strips and measurement of blood glucose level was using the Accu Chek glucometer.

Statistical Methods

The data obtained from the study was uploaded into the Statistical Package for Social Sciences (SPSS) version 23 software. The Pearson Product Moment Correlation Coefficient was used to test the correlation of tear production and blood glucose levels at 0.05 level of significance and 95% confidence interval.

RESULTS

A total of 108 young adult women ranging from the age of 18 to 38 with a mean age of 26.91±5.64 were used for this study. Table 1 showed the frequency distribution of the age of the subjects. Subjects within the age group of 18 – 23 years were 24 with a percentage frequency of 22.22%. Subjects within the age group of 24 – 28 years were 54 with the highest percentage frequency of 50.00%. Subjects within the age group of 29 - 23 years were 6 with the lowest percentage frequency of 5.56% and subjects within the age group of 34 – 38 were 24 with a

percentage frequency of 22.22%. Table 2 showed the fasting blood glucose distribution of subjects. The 81 – 90 blood glucose range were 4 with a mean value of 84. The 91 – 100 blood glucose range were 6 with a mean value of 94. The 111 – 120 range were 4 with a mean value of 114. Table 3 showed the random blood glucose distribution of subjects. The 81 – 140 blood glucose range were 86 with a mean value of 104.40. The 141 – 200 blood glucose range were 4 with a mean value of 168. The 201 – 260 were 2 with a mean value of 223 and the 261 – 320 range were 2 with a mean value of 331. Table 4 showed the tear production distribution of subjects. The 1 – 7 tear production range were 22 with a mean value of 3.82. The 8 – 14 tear production range were 28 with a mean value of 10.57. The 15 – 21 tear production range were 14 with a mean value of 17.71. The 22 – 28 tear production range were 14 with a mean value of 24.14. The 29 – 35 tear production range were 30 with a mean value of 33.93. Table 5 showed the descriptive statistics values for blood glucose and tear production values of subjects. For the subjects FBG values, the subjects were 14 in number with a minimum value of 83, maximum value of 117 showing a range of 34. The mean and standard deviation were 96.86 and 12.21 respectively. The subjects with RBG values were 94 in number, a maximum value of 311, minimum value of 78 showing a range of 233. The mean and standard deviation were 114 and 39.39 respectively. For the tear production, 108 subjects were measured, the minimum value was 1, maximum value was 35, showing a range of 34. The mean and standard deviation were 18.37 and 11.63 respectively. Table 6 showed the SPSS version 23 data analysis using the Pearson Product Moment Correlation Coefficient at 0.05 level of significance and 95% confidence interval. The correlation of FBG and tear production showed a P value of 0.404 and a Pearson Correlation of -0.242. The correlation of RBG and tear production showed a P value 0.708 and a Pearson Correlation of -0.039. In both cases, there was no correlation of blood glucose and tear production (P > 0.05).

Table 1: Age distribution of subjects

Age (Years)	n	%
18-23	24	22.22
24-28	54	50.00
29-33	6	5.56
34-38	24	22.22
Total	108	100

Table 2: Fasting Blood Glucose (FBG) distribution of subjects

FBG (mg/dl)	n	Mean value
81-90	4	84
91-100	6	94
101-110	0	0
111-120	4	114
Total	14	

Table 3: Random blood glucose (RBG) distribution of subjects

RBG (mg/dl)	n	Mean value
81-140	86	104.40
141-200	4	168.00
201-260	2	223.00
261-320	2	331.00
Total	94	

Table 4: Tear production distribution of subjects

Tear Production(mm)	n	Mean value
1-7	22	3.82
8-14	28	10.57
15-21	14	17.71
22-28	14	24.14
29-35	30	33.93
Total	108	

Table 5: Descriptive statistics of blood glucose and tear production values

Variable	n	Range	Min	Max	Mean	S.D
FBG	14	34	83	117	96.86	12.21
RBG	94	233	78	311	114.00	39.39
Tear Prod	108	34	1	35	18.37	11.63

FBG = Fasting Blood Glucose, RBG = Random Blood Glucose, n = number, Min = Minimum, Max = Maximum, S.D. = Standard Deviation

Table 6: SPSS data analysis result showing P values for testing of correlation between Blood Glucose levels and Tear Production

Variables	Pearson Correlation	P-value
FBG – Tear Production	-0.242	0.404
RBG – Tear Production	-0.039	0.708

DISCUSSION

This study showed that there was no correlation between blood glucose levels and tear production among young adult women between the ages of 18 and 38 in Owerri West, Imo State, Nigeria. Waris et al. [11] found an association between diabetic duration and dry eye. Naik, et al. [12]

observed from their study that the incidence of dry eyes was higher in patients who had uncontrolled diabetes and in patients who has had diabetes for a longer period. The difference in their findings from our study could be due to the fact that most of the subjects in our study had normal blood glucose levels. A study by Onoriode [13] showed that dry eye disease was also common among diabetics with longer duration of disease and elevated fasting blood sugar though this was not statistically significant (P = 0.123) and (P = 0.332) respectively. It was therefore concluded that dry eye disease occurred in patients with diabetes mellitus with an increase in frequency as they get older. The tear film irregularity associated with extended duration of diabetes was caused by the retinopathy. Thus, the damage to the microvasculature and denervation of the lacrimal gland contributed to impaired lacrimation in diabetes mellitus. In a similar study[14], it was observed that oestrogen and progesterone suppressed sebaceous function and thus, reduced lipid production. Therefore, a hormonal change, commonly seen among menopausal women relates to reduced level of androgens produced by the ovaries, causing dry eye. Thus, hormones have been implicated in the seemingly increasing incidence of dry eyes in females compared with their male counterparts.

Our study was supported by the findings of Ihesuilor et al. [15] who found that gender significantly influence tear production after the administration of bromfenac. According to Sharma, et al. [16], this could be as a result of a decrease in androgen levels in women taking oral contraceptives. It was concluded from the study that the use of oral contraceptives is an important etiological factor in pathogenesis of dry eye disease in women of reproductive age. Reduced tear production is associated with lactation, pregnancy, post menopause, oral contraceptive and supplemental oestrogens. Post-menopausal women and lactating women have decreased level of oestrogens. Women taking oral contraceptives and women who are pregnant have increased levels. The common feature of this group is the low bioavailability of androgens. Also, the findings were in line with Zeng et al. [17] whose study on Schirmer I test, corneal sensitivity, and SPEED score negatively correlated with diabetic duration. The decreased corneal sensitivity was caused by the compromised innervation of the cornea in patients with Diabetes Mellitus. Tear film dysfunction, characterized by impairment in tear quantity and quality, occurs in association with abnormal corneal innervation due to the intimate, functional relationship between the cornea and the preocular tear film.

In another study [18] that aimed to investigate whether diabetes mellitus was correlated with reduced tear production, it was observed that diabetic patients demonstrated a significantly reduced Schirmer test result (P <001). This therefore supports previous reports of reduced basal tear production, lending more support to the theory of a peripheral neuropathy affecting lacrimal gland function in diabetes.

CONCLUSION

In conclusion, this study revealed that there was a no significant correlation between tear production and blood glucose level among young adult women. It was recommended that further research be carried out in a larger geographical area.

Declaration by Authors

Ethical Approval: Approved
Acknowledgement: None
Source of Funding: None
Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

1. Conrady DC, Joos PZ, Bheupendra CK. The Lacrimal Gland and Its Role in Dry Eye: Review. J Ophthalmol. 2016; 16(75): 1-11.
2. Cousen P, Bennett H, Swa K, Dhillon B. Tear Production and Corneal Sensitivity in Diabetes. J Diabetes Comp. 2007; 21(6): 371–373.

3. Freitas GR, Ferraz GM, Gehlen M, Skare TL. Dry Eyes in Patients with Diabetes Mellitus. Prim Care Diabetes. 2021; 15(1): 184-186.
4. Tóth-Molnára E, Dingb C. New Insight into Lacrimal Gland Function: Role of the Duct Epithelium in Tear Secretion. Ocul Surf. 2020; 18: 595–603.
5. Zhang X, Zhao L, Deng S, Sun X, Wang N. Dry Eye Syndrome in Patients with Diabetes Mellitus: Prevalence, Etiology and Clinical Characteristics. J Ophthalmol. 2016; 20(10): 53-55.
6. Manaviat MR, Rashidi M, Afkhami-Ardekani M, Shoja MR. Prevalence of Dry Eye syndrome and Diabetic Retinopathy in Type 2 Diabetic patients. BMC Ophthalmol. 2008; 10: 1186-1471.
7. Olaniyan SI, Fasina O, Bekibele CO, Ogundipe AO. Relationship between Dry Eye and Glycosylated Haemoglobin among Diabetics in Ibadan Nigeria. Pan Afr Med J. 2019; 33(14): 67-73.
8. Naik K, Magdum R, Ahuja A. Ocular Surface Diseases in Patients with Diabetes. Cureus. 2022; 14(3): 393-401.
9. Gupta PD. Hormonal Regulation of the Dry Eye. JSM Ophthalmol. 2020; 7(1): 106-109.
10. Idu FK, Osita ME, Oyem CU. Tear Secretion and Tear Stability of Women on Hormonal Contraceptives. J Optom. 2013; 6(1): 45–50.
11. Waris NS, Balaji RS, Huda R. Prevalence of Dry Eyes in Diabetic Patients. Indian J Clin Exp Ophthalmol. 2022; 5(1): 40-43.
12. Pimentel LG, Carolina PB, Leticia SA, Souza AK, Prata ST. Association between Glucose Levels and Intraocular Pressure: Pre- and Postprandial Analysis in Diabetic and Non-diabetic Patients. J Ophthalmol. 2015; 8(3): 20-58.
13. Onoriode UC. Dry Eye Disease among Diabetes Mellitus Patients Seen in University Of Benin Teaching Hospital, Benin City, Nigeria. 2017. Available at: https://www. Dissertation.npmcn.edu.ng. [Retrieved 24 November 2022].
14. Burda N, Mema V, Mahmudi E, Selimi B, Zhugli S, Lenajni B, Bunjaku I. Prevalence of Dry Eye Syndrome in Patients with Diabetes Mellitus Type 2. J Acute Disease. 2013; 2(1): 48-51.
15. Ihesiulor CG, Uka MC, Offorha BC, Nwokike CC, Udo UA, Anonaba CA, Ebere AO. A Prospective Study of the Effect of Bromfenac on Tear Production. Matrix Sci Medica. 2019; 3(1): 1-5.
16. Sharma A, Porwal S, Tyagi M. Effect of Oral Contraceptives on Tear Film in Reproductive Age Group Women. Int J of Reprod, Contrac Obstetrics Gynecol. 2018; 7(3): 860-863.
17. Zeng X, Lv Y, Gu Z, Jia Z, Zhang C, Lu Z, Chu C, Nie Y, Wang Y, Zhang Y, Zhao S. The Effects of Diabetic Duration on Lacrimal Functional Unit in Patients with Type II Diabetes. J Ophthalmol. 2019; 8(12):75-115.
18. Cousen P, Bennett H, Swa K, Dhillon B. Tear Production and Corneal Sensitivity in Diabetes. J Diabetes Complic. 2007; 21(6): 371–373.

How to cite this article: Azuamah, Y.C., Njoku, C.E., Esenwah, E.C. et.al. Correlation of blood glucose level and tear production among young adult women. *International Journal of Science & Healthcare Research.* 2023; 8(1): 104-108. DOI: *https://doi.org/10.52403/ ijshr.20230112*

******