Research Article

Effect of 0.5% and 1% glucose intake on tear production in euglycemic

Amna Afridi[1]*, Ayesha kiran[2], Sara Sonum[3], Saadullah[1], Matiullah[4], Farwa Gul[5]

ABSTRACT

Background: Tear production increases ocular surface health and improves visual clarity. Which facilitates the physical activity comfortably. Different dosages of glucose intake had a significantly varying impact on tear production in euglycemic, initially decreasing followed by an increase.

Objective: to compare the effect of 0.5% and 1% glucose intake on tear production in euglycemic.

Methodology: A quasi-experimental study was conducted with n=200 participants at Irfan Eye Care Hospital Peshawar, from September 2022 to May 2023. The participants were euglycemic without any ocular and systemic pathology and determined its effect on tear production. The participants were divided into two groups equally for 0.5% and 1% glucose intake. Tear production was measured at baseline, after 60 minutes, 90 minutes, 120 minutes, and 150 minutes with the Schirmer test.

Results: There was a significant reduction of tear production from baseline to 120 minutes ($p<0.05$) than rise in both groups. While when compared, no significant ($p\geq0.05$) difference at each assessment level.

Conclusion: there was similar effect of 0.5% and 1% glucose concentration intake on tear production

Keywords: fasting blood sugar; glucose; hyperglycaemia; tear production; dry eye disease

Designation & Affiliation

1. MPhil Student, Department of Optometry, The University of Faisalabad, Pakistan. Assistant Professor, Department of Health, Rehabilitation C Sports Sciences Abdul Wali Khan University Mardan, Pakistan.
2. Coordinator, Department of Optometry, The University Of Faisalabad, Pakistan.
3. Optometrist, Optometrist at Life Hospital Bahria Lahore, Pakistan.
4. Lecturer, PIRS Isra University Islamabad, Pakistan.
5. Lecturer, Avicenna Medical And Dental College Lahore, Pakistan.

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Correspondence*

Amna Afridi MPhil Student of Optometry, Department of Optometry, The University of Faisalabad, Pakistan.
E-mail: kamna1166@gmail.com

INTRODUCTION

Glucose, a monosaccharide sugar, serves as the initial substrate for a variety of processes. When the level of glucose in the blood is too high or too less, can be brought on by hyperglycemia. Which, when poorly controlled over time, causes severe morbidity Including tear production [1-3]. The human body carefully regulates glucose levels to keep a stable equilibrium. When a person is healthy, they filter the glucose through their kidneys, which then reabsorb most of it into the blood. More than 0.25 mg/ml of glucose in a random urine test is glycosuria. Blood glucose levels that are too high, are an issue with your kidney filters and may be the cause of it[4].

A continuous tear film covers the ocular surface of the eye and adjusts to different environmental conditions produced by stimulation of the Cholinergic and adrenergic fibers of the lacrimal gland to secrete the aqueous layer. Such as low humidity, light, and diseases. It forms a protective film across the cornea and conjunctiva and keeps the cornea transparent [5]. It's important to balance the drainage and tear generation; a typical tear produces 10 mm every five minutes. Any deviations between 5 and 30 millimeters are deemed abnormal[6].

Glucose concentration has a significant impact on tear production. Various studies have been conducted to evaluate the short-term effects of glucose intake on tear production [1-3]. In a study, 0.5% glucose intake showed a significant reduction initial 60 minutes, but at the 90th and 120th minute significant increase in tear production[1]. In hyperglycaemic patients, tear production may be adversely affected and cause damage to the ocular surface and tear film volume reduction [2]. Hyperglycaemia may also influence the lacrimal gland which raises norepinephrine levels can impair tear production mechanisms[3]. While the specific effects of 1% glucose were not directly studied, the findings suggest that both concentrations of glucose can have significant, albeit varying, impacts on tear production and ocular health in euglycemic individuals[7, 8].

Tear production increases ocular surface health and improves visual clarity. Which facilitates the physical activity comfortably. Different dosages of Glucose intake may have a significantly varying impact on tear production in euglycemic. There is limited data on the effects of 1%, and most literature was found on 0.5% glucose concentration. This study aims to determine whether increasing glucose concentration leads to more significant or different effects on tear production by comparing the dose-dependent effects of 0.5% and 1% glucose intake on tear production It tackles possible clinical implications for managing eye health in individuals without blood sugar abnormalities by exploring the dynamics of tear production and investigating nutritional therapies or preventive measures that may support optimal tear production.

METHODOLOGY

A quasi-experimental study was conducted on subjects with normal blood glucose levels at Irfan Eye Care Hospital Peshawar from September 2022 to May 2023. The study was approved by the ethical review board (ERB) of the University of Faisalabad (TUF/IRB/240/23). The study was performed by the Declaration of Helsinki, which regulates scientific research of human participants.

A total of n=200 euglycemic. With a best corrected visual acuity (BCVA) of 6/6 who were between the ages of 18 and 35 and of both genders were eligible to participate in this study. Those with systemic or ocular pathology, a history of ocular surgery, high blood glucose levels above 140 mg/dL, low blood glucose levels below 60 mg/dL, and diabetes diagnoses were all excluded. Subjects with less than 5mm were also excluded from the study.

Determine the effect of glucose on tear production. The participants were divided into two groups equally for 0.5% glucose and 1% glucose intake by non-probability purposive sampling technique. The Participants were divided into two groups equally for glucose intake. Group A (n=100) was given 0.5% glucose dose and group B (n=100) was given 1% glucose dose orally. The concentrations were prepared by a pharmacist, who made the two different concentrations the 0.5% glucose solution was prepared by taking a 5% dextrose solution and diluting it 10 times, while similarly for 1%, 5% dextrose solution was diluted 5 times.

After taking permission from the participants of the study all patients underwent a detailed history and the Visual acuity of the subjects was recorded with the help of a LogMAR chart. Then RBS (random blood sugar) test of the subject was performed for recorded glucose level with the help of a glucometer for the exclusion of hyperglycemia and hypoglycaemia.

The Participants were divided into two groups equally for glucose intake. Group A (n=100) was given 0.5% glucose dose and group B (n=100) was given 1% glucose dose orally.

Schirmer test was performed, and Measurements of tear production were recorded. The baseline values were obtained before the administration of glucose solution and then obtained after 60 minutes, 90 minutes, 120 minutes, and 150 minutes. When the time was complete after administration of glucose intake The Schirmer strips were folded 5mm and were instilled in the lower temporal fornix conjunctiva for five minutes and

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asked the subject to gently close the eye for five minutes. The strip was removed after five minutes and the wetting of the Schirmer strip. The normal rate of tear production in the Schirmer strip was taken 10mm and above in five minutes. The values below 5mm were taken as abnormal[9].

The descriptive statistics were presented by the mean, standard deviation (SD), frequencies, and percentages. As the data fulfilled the assumption of parametric testing, the RMANOVA with pairwise comparison was applied for within-group changes. While for between the group analysis, Independent t-test was applied. The Statistical Package for social sciences (SPSS) version 22.0 was used to analyze the data. To determine statistical significance level of significance was set at p<00.5.

RESULTS

The study's participants were 16–35 years old including n=200 were females and n=200 males. A total of n=62(31.0%) participants were between the age of 16 to 20 years, n=67(33.5%) were between 21 to 25 years, n=41 (20.0%) were between 26 to 30 years and n=30 (15.0%) participants were between 31 to 35 years respectively.

The repeated measure ANOVA test with pairwise comparison showed that both groups were initially significant (p<0.001) reduced tear production till 120 minutes but after that significant increase in tear production was observed after 150 minutes. (table 1)

Table 1: Within group assessment of Schirmer Test (mm) measurement

	Group A (0.5%)			Group B (1%)		
	Mean	SD	p-value	Mean	SD	p-value
Baseline	12.08	1.70	0.000***	12.45	1.96	0.000***
After 60 min.	10.00	2.10	0.000***	9.91	2.20	0.000***
After 90min.	7.37	2.82	0.000***	7.43	2.61	0.000***
After 120min.	5.68	2.84	0.000***	5.52	2.53	0.000***
After 150min.	10.75	2.57	0.000***	11.72	10.49	0.000***

Baseline to 60 minutes, 60 minutes to 90 minutes, 90 minutes to 120 minutes & 120 minutes to 150 minutes; Level of significance: p<0.05, p<0.01** & p<0.001****

The result of independent t-test showed that there was no significant difference (p≥0.05) between 0.5% and 1% glucose intake on tear production at each level of assessment from baseline to after 150 minutes. (table 2)

Table 2: Comparison between group on Schirmer Test (mm) measurement

	Group A (0.5%)		Group B (1%)		MD	p-value
	Mean	SD	Mean	SD		
Baseline	12.08	1.70	12.45	1.96	.37	.15
After 60 min.	10.00	2.10	9.91	2.20	-.09	.76
After 90 min.	7.37	2.82	7.43	2.61	-.06	.876
After 120 min.	5.68	2.84	5.52	2.53	.16	.675
After 150 min.	10.75	2.57	11.72	10.49	-.97	.371

Level of significance: p<0.05, p<0.01** & p<0.001****

DISCUSSION

The study's finding of significant reductions in tear production following glucose intake, particularly at 90 and 120 minutes, may be attributed to the physiological effects of glucose on the ocular surface and tear film dynamics [10]. Elevated glucose levels can influence osmotic balance and tear film stability, potentially leading to reduced tear production in euglycemic individuals, as diabetes is known to affect tear film parameters negatively due to neuropathy and poor metabolic control[11].

Additionally, the lack of significant differences between the 0.5% and 1% glucose groups suggests a threshold effect, where both concentrations may elicit similar physiological responses in tear production[12]. This aligns with findings that indicate diabetes impacts tear film stability and volume, emphasizing the need for careful monitoring of tear film parameters in diabetic patients, even in the absence of overt symptoms[11,12].

The absence of a significant difference between the two glucose intake groups, despite a significant reduction in tear production from baseline to follow-up, can be attributed to the methodology used in the analysis may not have adequately captured the nuances of treatment effects, as highlighted in discussions about no-difference findings[13].

The comparison of 0.5% and 1% glucose intake on tear production is significant, as glucose levels in tears can vary widely among individuals, with reported concentrations ranging from 3.4 to 12.7 mg/dl in healthy subjects [14]. While some studies indicate that glucose can influence tear composition, the exact impact of varying glucose concentrations on tear production remains unclear.

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For instance, research has shown that diabetic patients exhibit impaired tear functions, which may be linked to altered glucose metabolism[15]. Additionally, the presence of O-glycans in tears, which are crucial for maintaining tear stability, does not significantly differ between normal and dry eye patients, suggesting that glucose levels alone may not dictate tear production [16].

Overall, the results highlight the complex interplay between glucose levels and ocular health, warranting further investigation into optimal glucose management for preserving tear production.

CONCLUSION

There was similar effect of 0.5% and 1% glucose concentration intake on tear production. Therefore, their comparative efficacy requires further investigation to establish a definitive relationship.

DECLARATIONS & STATEMENTS

Author's Contribution

AA and SS: substantial contributions to the conception and design of the study.
AA and AK: acquisition of data for the study.
SU and MU: analysis of the data for the study.
AA and SA: interpretation of data for the study.
AA: drafted the work.
AA, AK, SS, SU, MU and SA: revised it critically for important intellectual content.
AA, AK, SS, SU, MU and SA: final approval of the version to be published and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors contributed to the article and approved the submitted version.

Ethical Statement

The study was approved by the ethical review board (ERB) of the University Faisalabad (TUF/IRB/240/23) and conducted at Irfan Eye Care Hospital Peshawar.

Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Acknowledgments

None to declare.

Conflicts of Interest

The authors declare no conflict of interest.

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