Effect of 0.5% Oral Intake of Glucose on Tear Production

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ABSTRACT

Purpose: To determine, how 0.5% oral glucose consumption affects the formation of tears.

Methodology: After ethical approval, this cross-sectional study involved 176 non-glycemic individuals (103 males and 73 females) with an average age of 23.7±2.70 years. Participants with normal body mass index (BMI) were included in the study, with an average BMI of 22.42kg/m2. After informed consent, tear production was measured at fasting and thirty, ninety and two hours minutes after intake of 0.5% glucose. Data was entered and analyzed in SPSS.

Results: The mean tear production at fasting was found to be 13.88±5.18mm. After 30 minutes of oral intake of 0.5% glucose, the mean tear production remained at 13.88±5.18mm. However, after 60 minutes of oral intake of 0.5%glucose, the mean tear production decreased to 12.96±5.196mm. After 90 minutes of glucose intake, the mean tear production increased to 13.58±5.03mm, and after 120 minutes, it further increased to 15.54±5.09mm. Statistical analysis revealed significant differences in tear production after 30, 60, and 90 minutes of oral intake of 0.5%glucose. However, after 90 minutes, the difference in tear production became insignificant.

Conclusion: The results underscore importance of timing in evaluating tear production dynamics and suggests that glucose's effects might not be uniform across all time intervals.

Key Words: Glucose, Tears, Dry eyes

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INTRODUCTION

One of the most prevalent organic substances in the natural world is glucose. Glucose is a component of all main dietary carbohydrates; it can be found alone or in combination with other monosaccharides, such as lactose and sucrose.[1] It is also a significant component of numerous glycosides and oligosaccharides, most notably sucrose. Naturally occurring sources of glucose include ripe fruits, flowers' nectar, leaves, sap, blood, mammal milk, and the liver and muscles' glycogen.[2,3]

It can be found in refined foods, drinks, sweets, canned juice, intravenous fluids, oral medications (such as glucose supplements), and antibodies.[4] Glucose in the human body can go through three main processes: it

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can be stored as sucrose or polysaccharide, oxidized to pyruvate, a three-carbon molecule, through glycolysis, or oxidized to pentose through the pentose phosphate (phosphoglycerate) pathway. Glucose serves primarily as a fuel to produce energy that is carried by ATP.[5,6]

Glucose is the energy source for certain cells, such as red blood cells and those in the brain, central nervous system (CNS), and muscles. Following an overnight fast, the usual range for a person's blood glucose level is 80–100 mg/ml; following meals, a normal evaluation of 120–130 mg/ml is anticipated.[7,8] This is the blood glucose level that's referred to as fasting. The lacrimal gland secretes the aqueous layer, which makes up the majority of the tear film's volume, out of its three layers.[9] The lacrimal gland is innervated by both cholinergic and adrenergic fibers; unstimulated tearing is regulated by the parasympathetic nervous system.[10,11]

Other factors that affect the lacrimal function include aging, menopause, some medications, and pathologic diseases.[12] The patient will experience issues if the rate of production and drainage are not similar. It is assumed that the typical rate of tear formation is 10 mm or more per 5 minutes.[13] Thirty millimeters or more of wetness was deemed excessive, whereas five millimeters or less was deemed inadequately abnormal. The primary goal of this study is to determine how glucose intake affects the rate at which tears are produced, as glucose enters the bloodstream by absorption from the small intestine and is primarily used for energy production.

METHODOLOGY

Young undergraduate students at University of Lahore were approached to be potential study volunteers. The average age of the research participants, who were of both genders, was 23.7±2.70 years. Subjects were informed and granted verbal consent after receiving a thorough description of the goals and methods of the study.

Participants were chosen based on inclusion and exclusion criteria, and those whose case histories and physical examinations revealed the following conditions were not allowed to continue in the research. We used only patients whose blood glucose levels fell between 70 and 120 mg/dl. The purpose of these screening criteria was to weed out any potential invalidators of the results. Because their baseline values were obtained prior to the administration of the glucose solution, the individuals functioned as their own control. The weighing scale was used to determine their weight. Their blood levels were measured after they had fasted for eight to ten hours.

The Schirmer tear strip test was used to measure the actual amount of tears produced. The strips were put at the intersection of the lower lid's middle outer third after being folded 5 mm from one end. After five minutes, the strip was taken off and the quantity of soaking was measured. The participant was instructed to keep their eyes open and to blink as needed. This served as the subjects' baseline measurement of tear production, which was noted and documented. Thirty, sixty, and ninety minutes after ingesting the 0.5% glucose solution, the tear production levels were reevaluated. Using the Z-test, the peak drop in tear production at 90 minutes after consumption was statistically significant ($P>0.05$) at the 0.05 level of significance.

RESULTS

After consuming a 0.5% glucose solution, there was a modest drop in tear production between 30 minutes (14.08%) and 60 minutes (19.7%), peaking at 90 minutes (15.9%), and a steady increase towards the baseline at 120 minutes (3.77%). It was noted that there was a minor decrease in the amount of tears produced by both male and female participants. There are 73 cases (subjects) identified as female, accounting for 41.5%of the total sample. There are 103 cases (subjects) identified as male, constituting 58.5% of the total sample. The total number of cases in the dataset is 176, which represents 100% of the sample.

Table -1: Gender Distribution

Gender	Frequency	Percentage
Female	73	41.5
Male	103	58.5
Total	176	100

Figure -1: Fasting Tear Production

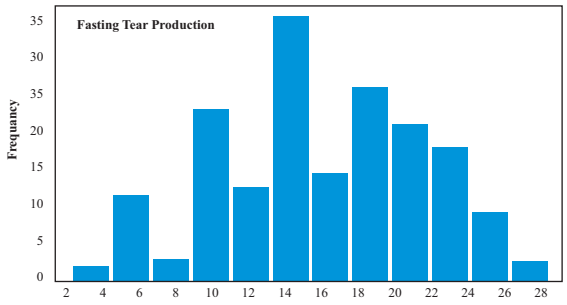


Figure -2: Tear Production After 60 Minutes of Glucose Intake

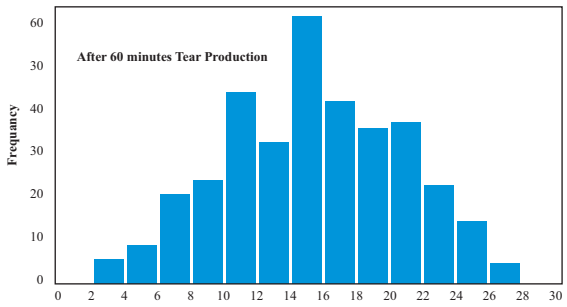


Figure -3: Tear Production After 90 Minutes of Glucose Intake

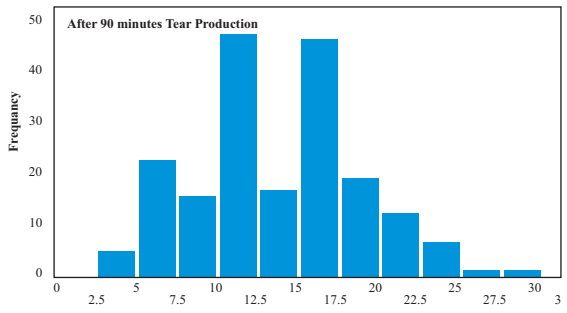
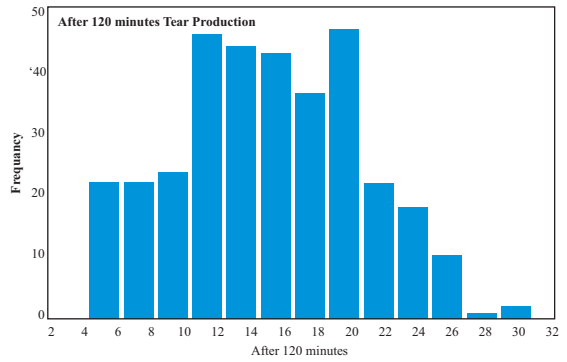


Figure -4: Tear Production After 120 Minutes of Glucose Intake



DISCUSSION

Dry eye syndrome is a common ocular ailment that can have profound effects on an individual's well-being and quality of life. The intricate interplay of tear production and ocular surface health is a critical aspect of ocular physiology. In this study, our aim was to delve into the relatively unexplored territory of glucose intake and its potential impact on tear production rate. This investigation carries significance for both clinical practice and understanding the broader implications of diet on ocular health. Our study population consisted of 176 individuals who were free from glycemic conditions, reflecting a diverse group of 103 males and 73 females. The age distribution, with a mean of 23.7 ± 2.70 years, captured the young adult demographic. The meticulous inclusion of participants with normal BMI further ensured that our findings would be representative of a specific subset of the population.

The baseline measurement of tear production rate during fasting was established at 16.15 ± 5.14 mm, offering a solid foundation for assessing the effects of glucose intake. , However, the dynamic nature of tear production was highlighted by the subsequent time points after glucose ingestion. After 30 minutes, tear production remained relatively stable at 13.88 ± 5.18 mm, indicating an immediate effect or perhaps the lack of an acute impact. This finding could suggest that glucose might not have an instantaneous influence on tear production.

Interestingly, the subsequent time intervals revealed intriguing trends. After 60 minutes of oral intake of 0.5% glucose, a reduction in tear production was noted, with the mean decreasing to 12.96 ± 5.196 mm. , This observation is noteworthy as it suggests a transient decline in tear production post-glucose intake. This decline might be attributed to several factors, including potential shifts in blood glucose levels affecting tear composition or altered ocular surface dynamics. What followed after the initial decline was an unexpected yet intriguing pattern. At the 90-minute mark post-glucose ingestion, we observed a rebound effect, with tear production increasing to 13.58 ± 5.03 mm.

This surge in tear production hints at the adaptive capabilities of the ocular system in response to glucose variations. The ocular surface might be modulating its response to maintain tear film stability and overall ocular health. Building upon this, the 120-minute mark brought forth another elevation in tear production, with the mean reaching 15.54 ± 5.09 mm. This sustained increase implies that the effects of glucose intake on tear production can persist beyond the immediate post-ingestion phase. These observations collectively emphasize the intricate and dynamic nature of glucose's impact on tear dynamics.

Single centre study with sample consisting of only undergraduate students constitute major limitation.

CONCLUSION

The fluctuations in tear production may have implications for managing dry eye conditions and optimizing tear film stability. Health-care professionals should consider monitoring tear production rate following glucose intake to better understand and address dry eye issues in individuals.

Conflict of Interest: None to declare

Ethical Approval: The study was approved by the Institutional Review Board / Ethical Review Board No. REC-UOL-206-02-2024.

Author Contributions: Muhammad Abdal: Concept, Drafting, Literature Search.

Muhammad Aish: Literature Search, Data Collection.

Qamar ur Rehman: Literature Search, Data Collection.

Ayesha Tasneem: Data Collection and Analysis.

Faiza Tasneem: Literature and Critical Review.

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