JCHR (2023) 13(4), 747-751

Journal of Chemical Health Risks

jchr.damghan.iau.ir

ORIGINAL ARTICLE

# Evaluation of Blood Components of Glycemic Control in Diabetics with and without Cataract in Comparison with Non-diabetics

Elham Zainalinia[1], Rouhallah Najjar Sadeghi[*2], Mostafa Ebadi [1], Mohammad Faghihi [3]

*[1]Department of Biology, Damghan Branch, Islamic Azad University, Damghan, Iran*

*[2]Department of Clinical Biochemistry, faculty of Medicine, Mazandaran University of Medical Sciences, Sari, Iran*

*[3]Department of Medical Sciences of Shahid Beheshti University, Surgeon and Ophthalmologist of Tehran, Iran*

*(Received: 25 February 2022 Accepted: 29 January 2023)*

**KEYWORDS**

Diabetes;
Cataract;
Fasting Plasma Glucose;
Hemoglobin A1c;
OGTT

**ABSTRACT:** Cataract is a leading cause of vision loss in the world. Several factors are involved in the development of cataracts, of them; diabetes and uncontrolled plasma glucose have great importance. Therefore, controlling glycemic reduces the risk of related to microvascular complications of diabetes diseases such as cataract. This study aimed to compare fasting plasma glucose (FPG), HgbA1c, and oral glucose tolerance test (OGTT) between Diabetic patients with and without cataract in comparison with the healthy group as control. Among 150 subjects, 50 diabetic patients, 50 diabetic cataracts, and 50 healthy individuals without a history of specific disease were compared with each other. Fasting plasma glucose, OGTT, and HgbA1c were measured by colorimetric methods. SPSS23 software was used to analyze data. P-values less than 5% or lower were considered to be statistically significant. In this study, the mean fasting plasma glucose, HgbA1c, and OGTT in the group of diabetic patients, diabetic with cataract, and healthy groups fasting plasma glucose were as follow, 162.46 mg dL$^{-1}$ and 184.76 mg dL$^{-1}$, 92.88 mg dL$^{-1}$ ($P<0.05$), HgbA1c: 7.8, 8.0, 5.8% ($P<0.05$) and OGTT: 228 mg dL$^{-1}$, 246.12 mg dL$^{-1}$ and 114.32 mg dL$^{-1}$ ($P<0.05$) respectively. Our findings showed that in diabetic patients with and without cataract, fasting plasma levels, HgbA1C, and OGTT are higher than the healthy group. There was a significant relationship between the studied factors and cataracts. As a result, high blood glucose has a definitive role in the development of cataracts.

## INTRODUCTION

Cataract is the opacity of the lens of the eye. Lenses are mainly made of water and protein. As a result of aging and some other conditions, the structure of these proteins changes and stick together, causing some areas in the lens to become cloudy. This phenomenon makes these areas larger over time and reduces vision. It is the most common type of cataract. A large percentage of people get it, and its prevalence increases with age. This type of cataract is seen in people who have other specific diseases, including diabetes. Cataract is sometimes associated with the long-term use of certain medications, such as corticosteroids [1]. Diabetes is a major cause of mortality and disability in different societies [2]. It affects about 415 million people in the world, and it is estimated that its prevalence increases to 592 million by 2035[3, 4]. According to some estimates, about 9.2 million Iranian people will have diabetes by the year 2030 [5].

---

*Corresponding author: najjarsadeghi@yahoo.com (R. Najjar Sadeghi)

DOI: 10.22034/jchr.2023.1953604.1514

Diabetes is caused by a complete or partial hypoinsulinemia or a partial or complete increase in glucagon [6]. Diabetes not only leads to early disabilities and increased mortality in many patients, but is also the most important cause of blindness in adults [7]. Due to the growing prevalence and widespread complications of this disease, many efforts have been made worldwide to define the molecular basis of diabetes complications. Hemoglobin A1c is the current gold standard test to estimate glycemic status during 2–3 months ago [8]. Diabetes is associated with late complications such as involvement of the eyes, kidneys, nerves and blood vessels [9]. Cataracts are the most common cause of visual acuity in the world and about 30 to 40 million people in the world are scientifically blind, of which about 45% are cataracts [10]. Cataract is still the leading cause of blindness globally[11]. Known risk factors for cataract include age, genetic factors, inflammation, trauma, metabolic and nutritional diseases, radiotherapy and chemotherapy, ultraviolet radiation and some medications such as steroids[12]. Late cataracts, or age-related cataracts, occur in 90% of all cataracts, and factors such as diabetes and glaucoma may exacerbate the condition [13]. The World Health Organization estimates that 54 million cases of blindness at the age of 60 or older will occur by 2020, about 45% of which will be due to cataracts. In the United States, the cost of cataract treatment is estimated at more than $ 3.4 billion annually. Regarding the risk factors for cataracts, what has been discussed so far is the issue of age. Although the degeneration of lens proteins is a physiological phenomenon, other external factors can accelerate its process %[14]. Some biological factors play an important role in causing damages, metabolic disorders and complications of diabetes. Therefore, we evaluated some glycemic indices of patients suffering from cataracts.

## MATERIALS AND METHODS

This study was approved by the ethics committee of Mazandaran University of Medical Sciences (IR.MAZUMS.REC.1398.D114). The study population composed of 150 people, 50 healthy persons (34 men and 16 women) from Imam Hossein Hospital, 50 patients with diabetes (31 men and 19 women) from Tehran Diabetes Center, and 50 diabetic patients with cataract (20 men and 30 women) were selected from Torfeh hospital, Tehran with a mean age of 36.48 years, 57.46 years and 57.74 years, respectively 12 hours of fasting. For all three groups, fasting blood samples were collected at the study site and processed on the same day at the Institute of Tehran, Torfeh hospital. The colorimetric method was used to measure biochemical parameters such as fasting plasma glucose (FPG) and oral glucose tolerance test (OGTT). HgbA1c was measured by high-performance liquid chromatography (HPLC). For qualitative variables, Descriptive tests (Colorimetric method and HPLC) and mean variables and standard deviation for quantitative variables were used. Chi-square tests were also used for analytical analysis. SPSS 23 software was used for data processing and P <0.05 was considered statistically significant.

## RESULTS

Among 150 cases, 50 diabetic patients, 50 diabetic patients with cataracts, and 50 healthy person were included. The frequency, age and gender of each group men and women with and standard deviation is given in the Table 1.

**Table 1.** Demographic data of specimens

| | **Sex** | | **Age** | **P - value** |
|---|---|---|---|---|
| | **Male** | **Female** | **Mean ±SD** | |
| **Diabetes without cataracts** | 31 | 19 | 57.46 ± 4.7 | P<0 |
| **Diabetes with cataracts** | 20 | 30 | 57.74 ± 8.09 | P<0 |
| **Control** | 31 | 19 | 57.46 ±4.7 | P<0 |

The group of diabetic patients with cataracts had the average age with a small difference (57.74 years) among the categories. Therefore, increasing age in the development of diabetes with cataracts is directly related to age. The mean FPG of diabetic patients (162.46 mg $dL^{-1}$) was statistically higher than healthy individuals

(92.88 mg dL$^{-1}$, $P < 0.05$). The mean FPG of diabetic patients with cataract (184.76 mg dL$^{-1}$) was also higher than healthy individuals (92.88 mg dL$^{-1}$) and was a statistically significant ($P < 0.05$) (Figure 1).

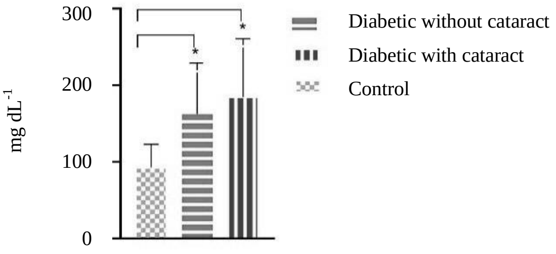

**Figure 1.** Fasting plasma glucose levels. Data are expressed as mean ± SD. The symbol “(*)” means statistically significant ($P < 0.05$) versus the control group.

The mean OGTT- of diabetic patients (228.74 mg dL$^{-1}$) was higher than healthy individuals (114.32 mg dL$^{-1}$) and had a significant relationship ($P < 0.05$). The mean OGTT of diabetic patients with cataracts (246.12 mg dL$^{-1}$) was higher than healthy individuals (114.32 mg dL$^{-1}$) and had a significant relationship ($P < 0.05$) (Figure 2).

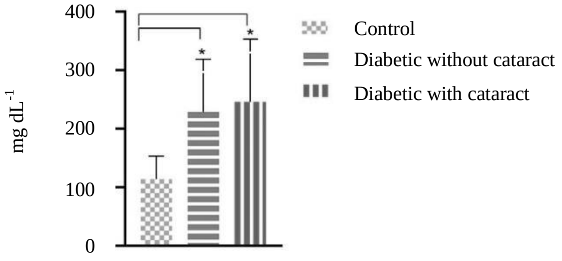

**Figure 2.** Post-prandial blood glucose levels. Data are expressed as mean ± SD. The symbol “(*)” means statistically significant ($P < 0.05$) versus the control group.

The mean HgbA1c of diabetic patients (7.8) was higher than healthy individuals (5.8%), and had a significant relationship ($P < 0.05$). The mean HgbA1c of diabetic patients with cataracts (8.4%) was higher than healthy individuals (5.8%), and had a significant relationship ($P < 0.05$) (Figure 3).

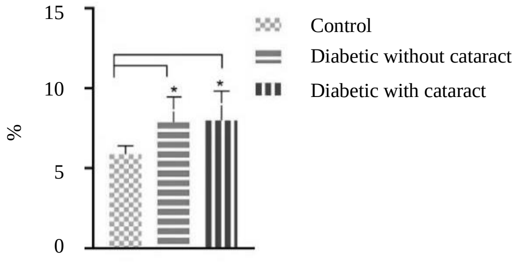

**Figure 3.** Hemoglobin A1$_C$ levels. Data are expressed as mean ± SD. The symbol “(*)” means statistically significant ($P < 0.05$) versus the control group.

The prevalence of FPG is highest in diabetic men (62%), while it is highest in diabetic women with cataracts (60%). The mean hemoglobin A1$_C$ (HbA1c) of diabetic patients (7.8%) was lower than that of diabetic patients with cataracts (0.8) and had no significant relationship ($p>0$). There was a significant relationship between HbA1c and sex in diabetic and diabetic patients with cataracts; the most common were diabetic men (31%) and women with cataract diabetes (30%), respectively, which was not much different. There was a statistically significant relationship between HgbA1c and FPG of diabetics with and without cataracts ($P = 0.00$). As a result, with increasing FPG, HgbA1c increased.

## DISCUSSION

This study was performed to determine the relationship between fasting plasma glucose levels, HgbA1c, and OGTT. For this purpose, the mean fasting plasma glucose, HgbA1c, and OGTT in the group of diabetics, and diabetic with cataracts were compared with that of healthy group. The mean hemoglobin A1C in diabetic patients (7.8), and diabetic patients with cataracts (0.8) compared to the healthy group (5.8) showed a significant increase. Risk factors such as diabetes mellitus, obesity, and the effect of drugs in patients with diabetes with cataracts show an increase in HbA1c. There was no significant in FPG, OGTT, and HgbA1c between diabetic and diabetic patients (P>0.05). In Yi-Jen’s study, FPG was higher in the diabetic group than the control group, but the mean FPG was not significantly different between the two groups, healthy and sick. In some other studies, the association between diabetes and cataract was confirmed, which is consistent with our findings [15, 16].

According to Sharma's study, in determining the irreversible predisposing factors for age-related cataracts, the calculated odds ratio confirmed age-related cataracts in people with a family history of the disease, which is consistent with the present study. Sharma also showed that gender is not a predisposing factor, which is inconsistent with the present results .In a study by McCarthy in Australia [17], only 46% of patients with cataracts were men who agreed with the results of the hacking study but did not agree with the present study [18].

Numerous epidemiological studies, including Chen, have reported an increased incidence of cataracts in women compared to men, which is consistent with the results of the present study [19].

## CONCLUSIONS

According to the present study, high plasma glucose plays a role in the occurrence of cataracts, so it is necessary to carry out programs to control and monitor this factor to control the risk of developing cataracts, even in cases where people in the early stages of cataract are referred. By monitoring and controlling this factor, the progression of the disease can be prevented.

## ACKNOWLEDGEMENTS

The authors of this article consider it necessary to thank all the patients who contributed to this research, the staff involved in sampling Ms. Asghari and Dr. Saeed Karimi, director of Torfeh Hospital, Dr. Hossein Adib, Research Director, Vice Chancellor for Research and Technology, Endocrinology and Metabolism Research Institute, Tehran University of Medical Sciences and Ms. Sedigheh Yektamghadam for statistical analysis.

## ETHICAL CONSIDERATION

This study was approved by the ethics committee of Mazandaran University of Medical Sciences (IR.MAZUMS.REC.1398.D114).

### *Conflict of interests*

The authors declare that they have no conflict of interest.

## REFERENCES

1. Ao M., Li X., Qiu W., Hou Z., Su J.,Wang W., 2019. The impact of age-related cataracts on colour perception, postoperative recovery and related spectra derived from test of hue perception. BMC Ophthalmol.19(1), 56.
2. Kitamura A., Taniguchi Y., Seino S., Yokoyama Y., Amano H., Fujiwara Y.,Shinkai S., 2019**.** Combined effect of diabetes and frailty on mortality and incident disability in older Japanese adults. Geriatr Gerontol Int.19(5), 423-428.
3. Al-Lawati J.A., 2017**.** Diabetes Mellitus: A Local and Global Public Health Emergency! Oman Med J. 32(3), 177-179.
4. Guariguata L., Whiting D.R., Hambleton I., Beagley J., Linnenkamp U.,Shaw J.E., 2014**.** Global estimates of diabetes prevalence for 2013 and projections for 2035. Diabetes Res Clin Pract.103(2), 137-149.
5. Javanbakht M., Mashayekhi A., Baradaran H.R., Haghdoost A., Afshin A., 2015. Projection of Diabetes Population Size and Associated Economic Burden through 2030 in Iran: Evidence from Micro-Simulation Markov Model and Bayesian Meta-Analysis. PLoS One.10(7), e0132505.
6. Posner B.I., 2017. Insulin Signalling: The Inside Story. Can J Diabetes.41(1), 108-113.

7. Maseko S.N., van Staden D.,Mhlongo E.M., 2021. The Rising Burden of Diabetes-Related Blindness: A Case for Integration of Primary Eye Care into Primary Health Care in Eswatini. Healthcare. 9(7), 835.

8. Chehregosha H., Khamseh M.E., Malek M., Hosseinpanah F.,Ismail-Beigi F., 2019**.** A View Beyond HbA1c: Role of Continuous Glucose Monitoring. Diabetes Ther. 10(3), 853-863.

9. Deshpande A.D., Harris-Hayes M., Schootman M., 2008. Epidemiology of diabetes and diabetes-related complications. Phys Ther. 88(11), 1254-64.

10. Tanya S.M., Nguyen A.X., Pur D.R., Nguyen M., Kherani F., Costello F., Kohly R., 2022**.** Bridging gaps in access to ophthalmology mentorship with the virtual Canadian Ophthalmology Mentorship Program. Eye (Lond). 36(9):1848-1849. doi: 10.1038/s41433-021-01899-y

11. Lee C.M.,Afshari N.A., 2017. The global state of cataract blindness. Curr Opin Ophthalmol. 28(1), 98-103.

12. Drinkwater J.J., Davis W.A.,Davis T.M., 2019. A systematic review of risk factors for cataract in type 2 diabetes. Diabetes Metab Res Rev. 35(1), e3073.

13. Kiziltoprak H., Tekin K., Inanc M.,Goker Y.S., 2019**.** Cataract in diabetes mellitus. World J Diabetes.10(3), 140-153.

14. Becker C., Schneider C., Aballéa S., Bailey C., Bourne R., Jick S., Meier C., 2018. Cataract in patients with diabetes mellitus—incidence rates in the UK and risk factors. Eye. 32(6), 1028-1035.

15. Singh S., Pardhan S., Kulothungan V., Swaminathan G., Ravichandran J.S., Ganesan S., Sharma T., Raman R., 2019**.** The prevalence and risk factors for cataract in rural and urban India. Indian J Ophthalmol.67(4), 477-483.

16. Tan A. G., Kifley A., Holliday E.G., Klein B.E.K., Iyengar S.K., Lee K.E., Jun G.R., Cumming R.G., Zhao W., Wong T.Y., Cheng C.Y., Mitchell P.,Wang J.J., 2018. Aldose Reductase Polymorphisms, Fasting Blood Glucose, and Age-Related Cortical Cataract. Invest Ophthalmol Vis Sci. 59(11), 4755-4762.

17. Sharma S., Chataway T., Klebe S., Griggs K., Martin S., Chegeni N., Dave A., Zhou T., Ronci M., Voelcker N.H., Mills R.A., Craig J.E., 2018. Novel protein constituents of pathological ocular pseudoexfoliation syndrome deposits identified with mass spectrometry. Mol Vis. 24, 801-817.

18. Ekström C.,Grunditz Ustrup J., 2021. Association between Age-related Cataract and Mortality in Sweden: A Long-term Population-based Follow-up Study. Ophthalmic Epidemiol. 28(4), 301-305.

19. Chen X., Ye G., Zhong Y., Jin L., Liang X., Zeng Y., Zheng Y., Lan M., Liu Y., 2021**.** Prevalence, incidence, and risk factors for myopia among urban and rural children in southern China: protocol for a school-based cohort study. BMJ Open.11(11), e049846.