

MINERAL WATER „DZUGURI” AND TYPE 2 DIABETES MELLITUS: SCREENING RESULTS

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Diabetes mellitus is one of the major global health challenges recognized as a non-communicable pandemic of the 21st century. According to the International Diabetes Federation (IDF), 463 million people were diagnosed with diabetes in 2019, the number of patients will reach 578 million by 2030, and by 2045 it will be 700 million. It is also noteworthy that 75% of adults with diabetes live in low- and middle-income countries [8]. The current situation places a heavy burden on the economies of countries, health systems and society as a whole. Three out of four people with diabetes (352 million people) are of working age (20 to 64 years). This number is expected to increase to 417 million by 2030, which will have a big impact on the overall productivity and economic growth of the society in the coming decades [8].

Patients with diabetes experience various co-morbidities. Approximately 90% of patients with type 2 diabetes mellitus (MDD 2) have at least 2 comorbid conditions. Patients with diabetes have a 6-fold increased risk of ischemic heart disease (IHD); Arterial hypertension is observed: T1D–20%, T2D–75%; The risk of cerebrovascular thromboembolism increases by 4 times; HbA1c increases by 1% - the risk of atherosclerosis and myocardial infarction increases by 15%; Mortality from cardiovascular complications: T1D–35%, T2D–75% [3,10].

The mechanism of hyperglycemia in the case of diabetes mellitus T1 is absolute insulin deficiency, in which insulin therapy is an alternative. In the case of T2D, relative insulin deficiency develops, which is mainly induced by insulin resistance and disruption of the second phase of insulin secretion, which is followed by an increase in pancreatic beta cell dysfunction. Diet and/or tablet therapy are provided at this time, but apoptosis of pancreatic beta cells progresses along with the duration of the disease, which in some cases leads to the need for insulin therapy in diabetes mellitus T2 [2,7].

According to the joint recommendation of the American Diabetes Association (ADA) and the European Diabetes Association (EASD), healthy lifestyle - proper nutrition and adequate physical activity - remains unchanged in the treatment of type 2 diabetes. Proper nutrition allows the body to replenish carbohydrates, proteins, fats and micronutrients with the necessary minimum for the normal functioning of the body (ADA/EASD, 2019).

Of the 92 elements found on Earth, 81 are known in the human body: 4 basic - O, H, C, N; 8 macronutrients - Ca, Cl, F, K, Mg, Na, P, S and 69 micronutrients. Basic and macronutrients make up 99% of the body elements. Zn, Cr, Mg, Mn, V are of special importance along with the main elements in carbohydrate metabolism. They are involved in the synthesis of essential amino acids, and insulin. Cause insulin to be delivered to tissues and organs. Improve insulin sensitivity.

In some cases studies confirm the positive effect of natural mineral waters on the balance of blood glucose levels. In this regard, the results of the meta-analysis conducted by Portuguese researchers are noteworthy. Daniela Costa Vieira and her colleagues studied the results of 20 studies conducted in different countries and available in the Pubmed, Scopus and Google Scholar databases on the effects of mineral waters on metabolic

syndrome. In addition, 10 studies were conducted on the effects of mineral waters on glucose homeostasis in the body. Of these studies, 2 were conducted on rodents and 8 on humans. None of these studies showed adverse outcomes. In particular, five studies showed a positive effect of mineral waters on blood glucose balance, 2 studies indicated positive effects on the body on the other hand (although not related to changes in glucose levels), and 3 studies did not show any significant effects in this regard [6].

It is noteworthy the positive results of studies conducted on this issue in Eastern European countries. In particular, a study of 82 patients with SCD 2 in the Romanian resort of Borsek showed that their blood glucose levels dropped significantly after consuming local mineral water (Spring Water 1 (Main) Borsek) [5]. A similar effect was observed in an experimental study conducted in Serbia. In particular, mice with SCD 2 were randomly divided into 2 groups: one of them received normal tap water for 4 weeks, while the other group of mice had access to only low-mineral water (source: Sneznik-1/79, PH=6.7) during the same period. The results showed that at the end of the study, glucose levels were reduced in the group of mice that received the mineral water. At the same time, mineral water intake did not affect cardiac function and had a significant antioxidant effect. Based on the results obtained, the authors of the study make a recommendation Mineral water “Sneznik-1/79” should be used for the prevention of diabetes as well as for the management of T2Ds [10].

The authors of another recent study also noted the positive effect of alkaline waters (PH>7) on the blood glucose balance of patients with STDs 2 and recommend the use of similar types of water as a non-pharmacological agent to control blood glucose level [11].

Georgia is known in the world for several unique mineral waters. Among them is mineral water “Dzuguri” located in Tsageri Municipality. The water is extracted in inaccessible places and the supply is small that is why it is not yet known to the masses. “Dzuguri” is recognized as water with healing properties by the order # 310 / N of the Minister of Health of November 5, 2002. Indications: obesity; Diabetes mellitus T2; Gout, uric acid diathesis; Pyelonephritis, nephritis (in the CR phase); Iron deficiency anemia. “Dzuguri” regulates metabolism, has a positive effect on carbohydrate and fat metabolism, bone density, hematopoiesis, has an antioxidant effect, protects the body from the development of metabolic acidosis, which is due to its unique composition. Ca – 58.59%; Mg- 19.04%; Na11.40%; K 0.51% SR- 0.05% Fe- 9.84%; Mn0.46%; Ba-0.06%; Anions: F-0.15% Cl- 1.38%; Hco3-97.51%; So4-0.96%. Conditionally Essential Trace Elements: Permissible Limit Mg / L - Result Zn 3.0- <0.02; Se-0.01- <0.01; Cr- 0.05- <0.02. Important is the fact that “Dzuguri” water has low mineralization, which allows patients to get it instead of drinking water. Its mineralization rate is 1.2 m/dm³, while for other well-known Georgian mineral waters this rate is considerably high. For example, for Borjomi mineral water mineralization rate is 5.6–7.2; Nabeghlavi - 6.2; Lashichala - 6.3; Utsera - 9.2; Sairme - 7.2; Mitarbi - 2.4 (Ministry of Health of Georgia, 2002).

Material and Methods. Despite the information on the composition and healing properties of mineral water “Dzuguri”, there are no evidence-based data obtained from scientific studies on this topic. To investigate the issue, a team composed from endocrinologist, ophthalmologists and public health specialists conducted screening study of patients with diabetes mellitus during October 7-8, 2020, in the village of Orbeli, Tsageri Municipality. The following data were evaluated within the research: Glycemic profile, level of glycosylated hemoglobin and total cholesterol, blood pressure. A complete ophthalmological examination was also performed. The patients were given the mineral water ‘Dzuguri’, after which their blood glucose level was determined again. The research was conducted in the outpatient clinic of the village Orbeli and the population of the neighboring villages also participated in it.

Results and discussion. A total of 84 patients were interviewed within the study. More than half of them - 52 (62%) were female, and the remaining 32 respondents (38%) were male. The mean age of diabetic patients surveyed in the study was 60 years (median 60.5; mode 59). The youngest of the study participants was 25 years old, and the oldest was 81 years old. Half of the respondents belong to the age group of 60 to 81 years. As for education, 42% of respondents had secondary education and 28% had secondary vocational education. The remaining 28% indicated that they had received higher education. The majority of respondents were married (64%), 28% were widowed, and 8% were single. The number of family members in the vast majority ranged from 1 to 5 members (92%) (mean - 3.05, median - 3). Most households had 2 (27%) or 3 (21%) members. Only 8% of respondents mentioned having more than 5 family members.

The study also examined the economic situation of the respondents’ families and their monthly expenditure (including expenses on medical care). The vast majority of respondents indicated that either no one works in their household (41.5%) or only 1 member (37%) is employed. Accordingly, the household income of the majority of respondents (54%) did not exceed GEL 500 per month. The income of 29% of the respondents’ families varied in the range of 500-1000 GEL, and 16% - in the range of 1500-2000 GEL. The monthly income of the family of only 1 respondent exceeded 2000 GEL.

As for expenses, respondents noted that despite the need they are forced to adjust their income and spend entirely on the income received during the month (they also have to take debts). In terms of revenue, costs are also high. On medical services, the major share of expenditure comes from medicines. In particular, 34% of respondents spend 100-250 GEL per month on medical services, and 22% - 251-500 GEL. 42% of the monthly medical expenses are less than 100 GEL, while 2% spend from 501 to 1000 GEL.

The body mass and height of the respondents were determined during the survey and the body mass index (BMI) was calculated based on these data. It should be noted that only 14% of respondents had a body mass index within the norm (BMI = 18.5-24.9), 1% had thinness (BMI = 17.7), 43% had excess weight (BMI = 20.0-29.9), and 42% are obese (BMI > 30). Thus, the vast majority of respondents (85%) were obese or overweight.

Respondents were asked about the year in which they were diagnosed with diabetes. It turned out that only a small proportion of respondents were newly diagnosed. The great majority (77%) were diagnosed with diabetes before 2015. There were very few cases of type 1 diabetes mellitus (T1DM), the vast majority (98%) were found to have T2DM. The proportion of patients who reported various complications of diabetes was also

high (64%). In most of these cases, the complication was related to diabetic eye (44%), 25% reported the presence of a diabetes foot, and the remaining 31% had other complications. Despite the presence of eye complications, more than half (52%) of the patients with diabetes are unable to consult an ophthalmologist at least once a year, only 34% of respondents reported annual consultations, and 14% - 2 times per year. Financial problems were named as the main barrier for the preventive examinations. At the same time, few respondents heard about diabetic retinopathy and certainly knew their own status (28%). 96 people underwent a complete ophthalmological examination during the screening. Detected diseases are presented in Fig. 1.

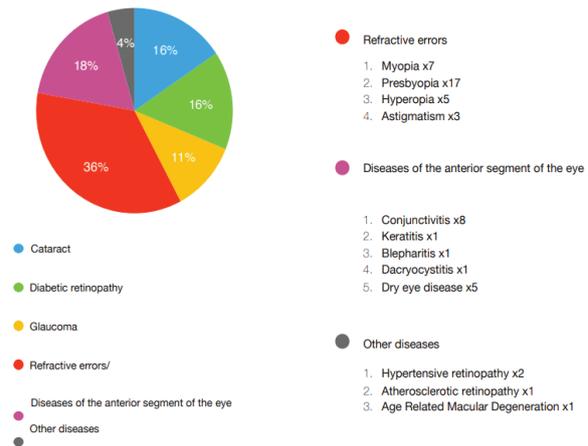


Fig. 1. Diseases detected during ophthalmological examination

It is remarkable that in such small number of examined patients revealed a high proportion of eye diseases, the existence of which they did not even know. This applies to diabetic retinopathy, refractive errors, glaucoma, diseases of the anterior segment of the eye. A survey of patients with diabetes indicated that they were not informed about ocular complications caused by diabetes and were not consulted by an ophthalmologist. The study once again reassured the examination team in importance of conducting screening studies to prevent eye diseases.

During the survey, the behavior of diabetic patients and their attitudes towards a healthy lifestyle were also studied. Relatively positive trends in tobacco and alcohol consumption have been observed in this regard. It turned out that 69% of respondents had never smoked a cigarette, 22% of them used to smoke before but stopped smoking. Only 9% were active smokers at the time of the survey. The share of female smokers was particularly low (only 4% of women surveyed were smokers, of whom only one is currently active). Similarly, 61% of respondents do not consume alcohol at all, 16.5% drink 2 to 7 standard glasses, 11% - 8 to 14 standard glasses, and 11% - more than 15 standard glasses per week. In this case, alcohol consumption is low among women as well - 88% of them indicate that they do not drink alcohol at all.

As for nutrition - only a small part of the respondents (7%) follow to the recommended diet, 81% are unable to fully or partially follow a proper diet, and the remaining 12% have not heard about healthy eating at all and have not got information about the recommended diet. Compared to food, the number of respondents who are physically active and are able to follow the recommended regimen is high (27%). 17% have difficulty with

physical activity and are generally unable to follow the regimen in this regard, while 49% partially follow the recommendations. 7% of respondents have little information about physical activities and importance of active lifestyle.

After the survey, the patients visited the endocrinologist, during which their anamnesis were collected as well as glucose levels and cholesterol were determined. At the same time, patients were recommended to take mineral water "Dzuguri", drink it and return to the endocrinologist after 2 hours to check the blood glucose level again. During the screening process, it was found that part of the patients had already eaten breakfast. Such patients were diagnosed with low blood glucose, recommended to drink mineral water "Dzuguri" and returned to the endocrinologist to re-determine the level of glucose. The results indicated that in 80% of the patients, the blood glucose level decreased after receiving the mineral water, while in the remaining part it remained the same or slightly increased. The mean glucose level during the first test was 165 mg%, while after taking mineral water it became 154 mg%. The maximum rate at the first testing was 394 mg%, which decreased to 356 mg% after water intake.

The presented screening study had two purposes: the first purpose was to study how diabetic patients are informed about their disease, what is their demographic, socio-economic profile and behavior; and the second purpose - to study the effects of "Dzuguri" mineral water on patients with DM.

The results indicated that the majority of the surveyed contingent was women with secondary education over 60 years of age. Their incomes are meager and their expenditures on medical needs are quite high in relation to their incomes. The study found a high proportion of catastrophic spending on health care. A high number of complications of diabetes were also noted, the major part of which was related to eye diseases caused by diabetes. Despite the existing problems, only a small part of the respondents are able to visit the ophthalmologist regularly, which in most cases are explained by financial barriers.

Relatively reliable results were observed in the process of studying the respondents' behavior and attitude towards a healthy lifestyle. It was found that the number of smokers among the respondents was very low as well as a very small proportion consumed alcohol excessively. Adherence to the recommended diet and physical activity regimen was relatively problematic. More information needs to be provided to the patients with DM to raise their awareness on importance of healthy diet and physical activities and ensure changes in their behavior.

An important result of the study is the positive effect of mineral water "Dzuguri" on the glucose level of patients with diabetes. However, in this respect, the study had some limitations - it consisted mainly of residents of one village, who were a very homogeneous group in terms of socio-economic indicators, diet or general lifestyle. Therefore, it is important to expand this research and involve a wider segment of the population in different regions.

Conclusion. Thus, for the early detection and prevention of diabetes and eye diseases as well as for cost-effective planning of future interventions, it is important to conduct regular screening studies in the regions of Georgia and make a detailed analysis of the study results. Given the socioeconomic status of patients with diabetes, it is especially important to implement interventions that will help managing diabetes effectively and will not be associated with high costs. In this case natural mineral springs have significant potential, which is clearly confirmed by the presented research.

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SUMMARY

MINERAL WATER „DZUGURI” AND TYPE 2 DIABETES MELLITUS: SCREENING RESULTS

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Diabetes Mellitus (DM) is one of the major public health issues worldwide causing a heavy burden on health systems and

economies of many countries. In this regard, it is crucial to develop and implement low-cost interventions aimed to early prevention and effective management of DM (particularly T2DM). Various studies worldwide indicated positive effect of natural mineral waters on regulating blood glucose level. The present screening study aimed to: 1) learn how T2DM patients are aware about their disease, study their demographic, social-economic profile and behavior; and 2) explore the impact of Georgian spring mineral water "Dzuguri" on blood glucose level among T2DM patients. The study results indicated that a considerable large amount of T2DM patients suffer from various social-economic problems and experience limited access to healthcare services. More encouraging was their attitude toward healthy life-style and related behavior. Considering this context, another finding of the study was particularly significant: mineral water from spring "Dzuguri" demonstrated positive initial effect on regulating glucose level among T2DM patients. Consequently, similar studies should be continued in a larger scale with more robust methodology and covering more population from various regions of Georgia.

Keywords: Diabetes mellitus type 2, Mineral water, Screening, Glycemia.

РЕЗЮМЕ

МИНЕРАЛЬНАЯ ВОДА «ДЗУГУРИ» И САХАРНЫЙ ДИАБЕТ ТИПА 2: РЕЗУЛЬТАТЫ СКРИНИНГА

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Сахарный диабет (СД) - одна из основных проблем общественного здравоохранения во всем мире, которая ложится тяжелым бременем на систему здравоохранения и экономику многих стран. В этой ситуации крайне важно разработать и внедрить недорогие вмешательства, направленные на раннюю профилактику и эффективное ведение СД (особенно СД2). Различные исследования во всем мире показали положительное влияние природных минеральных вод на регулирование уровня глюкозы в крови.

Целью скринингового исследования явилось: 1) определить насколько пациенты с СД2 осведомлены о своем заболевании, изучить их демографический, социально-экономический профиль и поведение; 2) установить влияние грузинской родниковой минеральной воды «Дзугури» на уровень глюкозы в крови у пациентов с СД2.

Результаты исследования показали, что значительное количество пациентов с СД2 страдают от различных социально-экономических проблем и имеют ограниченный доступ к медицинским услугам. Более обнадеживающим было их отношение к здоровому образу жизни и соответствующему поведению. Принимая во внимание этот контекст, еще

один вывод исследования был особенно значимым: минеральная вода из источника «Дзугури» продемонстрировала положительный исходный эффект на регулирование уровня глюкозы у пациентов с СД2. Следовательно, аналогичные исследования необходимо продолжить в более широком масштабе и с более надежной методологией, охватив большое количество населения из различных регионов Грузии.

რეზიუმე

მინერალური წყალი „ძუღური“ და შაქრიანი დიაბეტი ტიპი 2: სკრინინგის შედეგები

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შაქრიანი დიაბეტი მსოფლიოს მასშტაბით წარმოადგენს საზოგადოებრივი ჯანმრთელობის ერთ-ერთ უმთავრეს პრობლემას, რაც მძიმე ტვირთად აწევა ბა ქვეყნების ჯანდაცვის სისტემას და ეკონომიკას. ამ მხრივ მნიშვნელოვანია ისეთი დაბალხარჯიანი ინტერვენციების განხორციელება, რომლებიც ხელს შეუწყობს დაავადების დროულ პრევენციასა და განაპირობებს მის ეფექტურ მართვას. სხვადასხვა ქვეყნებში ჩატარებული კვლევები ადასტურებენ ბუნებრივი მინერალური წყლების დადებით ზეგავლენას სისხლში გლუკოზის დონის ბალანსზე.

წინამდებარე სკრინინგული კვლევა ისახავდა ორ მიზანს: 1) დადგენა თუ რამდენად ინფორმირებულნი არიან დიაბეტით ავადმყოფი პაციენტები თავიანთი დაავადების შესახებ, როგორია მათი დემოგრაფიული, სოციალურ-ეკონომიკური პროფილი და ქცევა; 2) მინერალური წყალი „ძუღურის“ ზეგავლენის შესწავლა დიაბეტის მქონე პაციენტების სისხლში გლუკოზის დონეზე.

შედეგებმა აჩვენა, რომ გამოკვლეულ პაციენტთა დიდი ნაწილი განიცდის მნიშვნელოვან სოციალურ-ეკონომიკურ და ჯანდაცვის სერვისებზე ხელმისაწვდომობის პრობლემებს. შედარებით საიმედო მდგომარეობა დაფიქსირდა გამოკითხულთა ქცევისა და ცხოვრების ჯანსაღი წესის მიმართ მათი დამოკიდებულების შესწავლის პროცესში. ასეთ პირობებში განსაკუთრებით აღსანიშნავია კვლევის მეორე მიზანთან დაკავშირებული შედეგი: მინერალური წყლის „ძუღურის“ დადებითი ზეგავლენის დემონსტრირება დიაბეტის მქონე პაციენტების სისხლში გლუკოზის მაჩვენებელზე. აქედან გამომდინარე, მნიშვნელოვანია აღნიშნული საკითხის მეტი აქტუალიზაცია - ანალოგიური კვლევების შემდგომი მეთოდოლოგიური დახვეწა, გაფართოება და მასში სხვადასხვა რეგიონის მოსახლეობის უფრო ფართო ფენების ჩართვა.