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Impact Of Hydrotherapy (Drinking Water) On Blood Glucose Reduction in Type 2 Diabetes Mellitus Patients in Surabaya, Indonesia

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ABSTRACT Type 2 diabetes mellitus is a chronic metabolic illness marked by consistently elevated blood sugar levels brought on by insulin resistance or inadequate insulin synthesis. The purpose of this study is to ascertain how regular consumption of plain water affects type 2 diabetes patients' ability to lower their blood sugar levels. The study employed a pretest-posttest methodology in a pre-experimental design. 51 people in all were chosen at random. Drinking 1.5 liters of plain water every morning for seven days in a row was the intervention, provided that it was taken no later than 15 minutes before to breakfast. According to the study's findings, patients with type 2 diabetes mellitus can significantly reduce their blood sugar levels by developing the habit of routinely drinking plain water. This suggests that drinking enough plain water can be one of the most successful non-pharmacological ways to help regulate blood sugar levels. As such, it can be used as a stand-alone nursing intervention to help avoid complications from diabetes.

INDEX TERMS Hydrotherapy, Drinking Water, Type 2 Diabetes Mellitus, Random Blood Glucose Level

I. INTRODUCTION

Type 2 diabetes mellitus (DM) is a chronic metabolic disorder characterized by high blood glucose levels due to insulin resistance or insufficient insulin production.This condition is the most common type of diabetes, especially in adults.However, in recent years, its prevalence has also increased among children and adolescents, primarily due to rising obesity rates and unhealthy lifestyles.In the Puskesmas Gading Tambaksari area, a significant factor contributing to the high prevalence of type 2 diabetes is the limited knowledge and awareness about the condition.Patients are not yet fully aware of the benefits of simple therapies such as hydrotherapy (drinking plain water) in lowering blood glucose levels [1]. Diabetes can affect all parts of the body, leading to complications and other disorders [2]. Common symptoms experienced by individuals with type 2 diabetes include frequent urination, excessive thirst, fatigue, blurred vision, and recurrent infections [3].If not properly managed, this condition can lead to serious complications, including cognitive function impairment and long-term organ damage[3]. Globally, type 2 diabetes has become a serious public health issue.Currently, about one in eleven adults are affected by this condition, and around 75% of them live in developing countries.The increase in life expectancy and unhealthy lifestyles have significantly contributed to the rise in diabetes incidence.In Indonesia, the prevalence reaches 877,531 cases, with 130,683 cases originating from East Java Province.Data from the Surabaya City Health Office (DKK) in 2022 recorded 96,731 residents suffering from diabetes, with the Gading Tambaksari Community Health Center recording the highest number, which is 2,999 individuals.Field surveys in September 2024 showed 407 patients, with a sample of 102 patients per week.

Local issues indicate that the awareness and knowledge of the community regarding type 2 diabetes, particularly in the working area of Puskesmas Gading Tambaksari, are still relatively low. Insulin deficiency can lead to increased blood glucose levels, triggering serious health complications such as type 2 diabetes [4]. This condition often leads to unwanted

weight gain and a significant decrease in physical activity.If this issue is not addressed, it can also pave the way for cognitive function disorders, which impact mental clarity and overall brain health [4]. Hydrotherapy, especially when applied through consistent consumption of plain water, emerges as a simple yet impactful non-pharmacological approach to support glycemic regulation in individuals with type 2 diabetes. This method offers a practical and accessible strategy that can complement existing diabetes management protocols by contributing to improved blood glucose control. Promoting hydration, this can improve insulin sensitivity and aid in glucose regulation, making it a valuable complementary approach to standard diabetes management. Staying well-hydrated can significantly support overall health and well-being [5]. In individuals with type 2 DM, the pancreas continues to synthesize insulin; however, the insulin secreted shows suboptimal quality, leading to hyperglycemia [6]. Hydrotherapy (drinking plain water) is a natural therapy that helps eliminate excess toxins and chemicals, including sugar, by breaking down sugar in the body [5]. In this study, the researchers used the concept of drinking plain water.the consumption of plain water can help increase insulin sensitivity, smoothen the body's metabolism, and support the detoxification process through urine and sweat. Plain water can scientifically help the body physiologically and affect blood vessels, making circulation smoother, increasing tissue metabolism, reducing muscle tension, and enhancing capillary permeability [7].

However, research specifically evaluating the effectiveness of hydrotherapy in lowering blood glucose levels, particularly in the Surabaya region, is still limited. This gap serves as an important basis for conducting this research. Nurses can manage hyperglycemia by encouraging patients to consume more oral fluids and monitoring their fluid intake. Complementary therapy enhances biomedical and traditional medicine by using natural remedies to target the underlying causes of diseases and promote the body's self-healing abilities, whereas conventional medicine emphasizes symptom management [8]. Blood glucose control is often achieved through pharmacological therapy, such as Oral Hypoglycemic Agents (OHA), or healthy lifestyle choices, such as exercise and non-pharmacological therapy. Water therapy is a natural healing method rich in benefits for the body's need for water and the body's physiological response to protect, repair, and enhance the human health span. One of the non-pharmacological methods for managing blood glucose levels in DM patients is hydrotherapy, or drinking plain water [9]. Hydrotherapy helps increase the breakdown of sugar in the blood and prevents excessive blood glucose levels, as well as aiding the detoxification process through urine and sweat [10].

II. METHOD

In the research, this serves as a guide for carrying out research tasks, such as selecting samples, data collection tools, and data collection and analysis procedures [11].This study uses a pre-experimental design characterized by a one-group pretest-posttest methodology to assess the impact of the applied intervention.This design was chosen to evaluate the effects of hydrotherapy treatment (consuming plain water) on blood glucose levels before and after the intervention.By comparing blood glucose levels from measurements taken before the treatment with those taken after, the changes resulting from the intervention can be effectively identified [12].

In the context of this research, the independent variable is hydrotherapy, which is specifically operationalized through the consumption of plain water.The dependent variable is the blood glucose level of individuals diagnosed with type 2 DM, which is quantitatively measured using random blood glucose assessment. This design aims to delve into the potential effects of regular water-based hydrotherapy on glycemic outcomes in diabetes patients. Type 2 diabetes patients who meet the inclusion criteria set in the working area of Puskesmas Gading Tambaksari in Surabaya are the target group for this study. The inclusion criteria in this study are as follows: patients must be aged between 30 and 55 years, have no complications from other diseases, regularly visit the Gading Tambaksari Health Center in Surabaya, and have no restrictions on fluid intake.

The sampling technique used is probability sampling, with a specific focus on simple random sampling.random sampling is conducted so that the research produces valid data, minimizes bias, and can represent the entire population, allowing the research results to be better generalized [13]. This study was conducted to ensure that every individual in the population has the same probability of being selected, regardless of the existing strata within the population.The sample size for this study consisted of a total of 51 participants [14].This study was conducted in the area served by the Gading Tambaksari Health Center in Surabaya over a period of seven days. During this period, patients were instructed to consume 1.5 liters of plain water every morning after waking up, ensuring to finish it within 15 minutes before breakfast.Pretest and posttest were used to measure blood glucose levels before and during the intervention sessions.Observation sheets were used as research instruments to document the blood glucose levels of participants before and after the hydrotherapy intervention.The collected data were analyzed using the Wilcoxon Signed Rank Test to assess whether there were significant differences in blood glucose levels before and after the intervention

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In conducting research on DM patients, researchers can pay attention to ethical principles in health research, which have moral strength, so that the research can be accountable both ethically and legally. This research has received ethical approval from the Health Research Ethics Committee of the

Health Polytechnic of the Ministry of Health in Surabaya, with approval number EA/3072/KEPK-Poltekkes_Sby/V/2024, dated February 28, 2025.

III. RESULTS

A. PATIENT CHARACTERISTICS

TABLE 1
Patients Charactristics Data

No.	Patient Characteristics	Total	
		Frequency (f)	Percentage (%)
1	Age		
	30-35 years old	3	6%
	36-40 years old	6	12%
	41-45 years old	3	6%
	46-50 years old	17	33%
	41-55 years old	22	43%
	Total	**51**	**100%**
2	Gender		
	Male	14	27%
	Women	37	73%
	Total	**51**	**100%**
3	Medication		
	Consumption	37	73%
	DM	14	27%
	DM and HT		
	Total	**51**	**100%**
4	Family Medical History	41	80%
	None	10	20%
	Total	**51**	**100%**
5	Duration of Illness		
	< 1 year	11	21%
	1-4 years	31	61%
	5-10 years	4	8%
	>10 years	5	10%
	Total	**51**	**100%**

As shown in TABLE 1, based on the age of type 2 DM patients, nearly half (43%) are in the age range of 41–55 years, and a small portion (6%) are in the age range of 30–35 years. Based on gender, almost all (73%) type 2 DM patients are female and a small portion (27%) are male. Based on medication use, the majority (73%) of patients only consume DM medication, and a small portion (27%) consume additional hypertension (HT) medication. Family medical history shows that the majority (80%) have a family history of diabetes. Based on the duration of suffering from diabetes, the majority (61%) of patients have suffered from diabetes for 1–4 years, and a small portion (8%) of patients have suffered from diabetes for 5–10 years.

B. BLOOD GLUCOSE LEVELS FREQUENCY BEFORE HYDROTHERAPY (DRINKING WATER)

TABLE 2
The level of blood glucose levels before hydrotherapy intervention

No.	Blood glucose Levels	Pre-Test	
		Frequency (f)	Percentage (%)
1.	High (> 200 mg/dl)	39	76%
2.	Normal (75–200 mg/dl)	12	24%
3.	Low (< 75 mg/dl)	0	0%
	Total	**51**	**100%**

As shown in TABLE 2, the frequency of blood glucose levels before hydrotherapy intervention, particularly the consumption of plain water, shows that the majority (76%) of individuals with type 2 DM exhibit high blood glucose levels, while only 24% show levels within the normal range.

C. BLOOD GLUCOSE LEVELS FREQUENCY IMMEDIATELY AFTER HYDROTHERAPY (DRINKING WATER

TABLE 3
The level of blood glucose levels after hydrotherapy intervention

No.	Blood glucose Levels	Post-Test	
		Frequency (f)	Percentage (%)
1.	High (> 200 mg/dl)	10	20%
2.	Normal (75–200 mg/dl)	41	80%
3.	Low (< 75 mg/dl)	0	0%
	Total	**51**	**100%**

As shown in TABLE 3, after undergoing hydrotherapy (consuming plain water), it was shown that the majority (80%) of type 2 DM patients experienced a decrease in blood glucose levels, while a small portion (20%) experienced high blood sugar levels.

D. BLOOD THE EFFECT OF HYDROTHERAPY (DRINKING WATER) ON THE REDUCTION OF RANDOM BLOOD GLUCOSE LEVELS IN TYPE 2 DM PATIENTS

The results of the Wilcoxon sign rank test statistic above, based on the data with an asymp. sig value of $0.000 < \alpha = 0.05$, indicate that there is a difference in blood sugar levels before and after hydrotherapy (drinking plain water) in patients with type 2 diabetes mellitus. Therefore, H0 is rejected and H1 is accepted, meaning there is an effect of hydrotherapy (drinking plain water) on blood sugar levels in type 2 DM patients in the Puskesmas Gading Tambaksari Surabaya area.

VI. DISCUSSION

A. IDENTIFICATION OF BLOOD GLUCOSE LEVELS BEFORE HYDROTHERAPY (DRINKING WATER)

The results of the data analysis show that before hydrotherapy (drinking plain water), this indicates that the initial blood glucose levels of type 2 DM patients at Puskesmas Gading Tambaksari, Surabaya, were mostly uncontrolled. Measuring blood sugar levels before the intervention is important to understand the patient's initial condition. This initial data serves as a baseline to compare with the results after the intervention. Thus, the researchers can assess the extent of the changes in blood sugar levels that occur as a result of hydrotherapy.

Thus, researchers can assess the extent of blood sugar level changes resulting from hydrotherapy. Age significantly contributes to the increased risk of diabetes. Age significantly contributes to the increased risk of diabetes. Research shows that individuals over the age of 45 have a greater tendency to develop diabetes and experience higher glucose intolerance. Degenerative changes associated with aging lead to a decrease in the body's capacity to metabolize glucose. As we age, the ability of pancreatic β cells to produce insulin decreases.

Additionally, older individuals show a 35% decrease in mitochondrial function in their muscle cells, which is associated with a 30% increase in fat levels in the muscles and subsequently triggers insulin resistance. However, it is important to acknowledge that age is not the only factor influencing this condition; the duration of diabetes also significantly contributes to the overall risk. In this study, the independent variable is hydrotherapy, specifically the intake of plain water, while the dependent variable in this study relates to blood glucose levels in individuals diagnosed with type 2 DM, which is measured through a systematic assessment of random blood glucose levels.

Besides age, gender has a significant impact on the likelihood of developing diabetes.Previous research [15] revealed that women are much more likely than men to develop type 2 diabetes. This increased vulnerability in women can largely be attributed to a higher likelihood of experiencing an increase in body mass index. In individuals with type 2 diabetes, body cells show a reduced response to insulin, which disrupts the efficient absorption of glucose into the cells and consequently leads to increased blood glucose levels.

For healthcare practitioners, identifying blood sugar levels before intervention provides an accurate initial picture of the patient's condition. This information is crucial to determine whether hydrotherapy is appropriate and safe for the patient, and to plan more personalized interventions. For example, patients with very high blood sugar levels may require more intensive attention and monitoring during and after hydrotherapy. By comparing blood sugar levels before and after hydrotherapy, healthcare practitioners can objectively evaluate the effectiveness of the intervention. This helps in decision-making regarding the continuation or modification of the treatment plan. The initial measurement results can be used as an educational tool for patients. Healthcare practitioners can explain to patients about their blood sugar condition and how hydrotherapy is expected to help lower it. This can increase the patient's motivation to adhere to the treatment plan. Measuring random blood sugar levels can also help identify comorbid conditions or DM complications that may affect the patient's response to hydrotherapy. For example, patients with kidney disease may require special attention regarding fluid intake. And extremely high or low initial blood sugar levels can be a particular concern. Healthcare practitioners must closely monitor patients during hydrotherapy to prevent complications such as hypoglycemia or hyperglycemia.

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Healthcare practitioners must closely monitor patients during hydrotherapy to prevent complications such as hypoglycemia or hyperglycemia. Identifying random blood sugar levels before hydrotherapy is an important step in managing type 2 diabetes. Identifying blood sugar levels before hydrotherapy is an important step in the management of type 2 diabetes. This data not only provides basic information about the patient's condition but also helps healthcare practitioners in planning, implementing, and evaluating interventions more effectively and safely. Thus, regular and meticulous monitoring of blood sugar levels is very important in clinical practice. This monitoring allows researchers to effectively assess the patient's condition and help prevent potential complications that could endanger their health. Data analysis revealed that, after hydrotherapy (consuming plain water), the majority of type 2 DM patients experienced a decrease in their blood glucose levels, although a small portion still showed high levels. This suggests that drinking plain water as part of a daily hydrotherapy regimen may help lower blood glucose levels. This indicates that drinking plain water as part of a daily hydrotherapy regimen may help lower blood glucose levels.

B. IDENTIFICATION OF BLOOD GLUCOSE LEVELS IMMEDIATELY AFTER HYDROTHERAPY (DRINKING WATER)

This measurement is to see the impact of the intervention on the patient's blood sugar levels.The results of this measurement are compared with the initial data (before the intervention) to determine whether hydrotherapy is effective in lowering blood sugar levels. The water therapy discussed here refers to the practice of internal water therapy, which involves consuming 1.5 liters of water every morning after waking up.Research and experience show that DM can be effectively managed and potentially reversed with this water therapy in just 7 days [16].

Based on the research results and experience conducted by the researcher, [17] Data from previous research shows that the average blood glucose level in diabetic patients before the intervention of consuming plain water was 282.57 mg/dl. The average blood glucose level decreased to 256 mg/dl after this intervention. This result shows that after the intervention, blood glucose levels decreased. This result shows that after the intervention, blood glucose levels decreased. Previous studies on hydrotherapy have proven to help stabilize body weight and lower blood glucose levels by using sweat and urine to aid detoxification [19].

For healthcare practitioners, identifying blood sugar levels immediately after hydrotherapy is key to evaluating the effectiveness of the intervention.A significant decrease in blood sugar levels indicates that hydrotherapy has a positive impact on the patient.If blood sugar levels do not show a significant decrease, healthcare practitioners may consider adjusting the treatment plan.This may include adjusting

medication doses, changing dietary patterns, or increasing physical activity. The results of blood sugar level measurements after the intervention can be used to motivate patients.The decrease in blood sugar levels can provide a positive boost for patients to continue following the treatment plan and maintain a healthy lifestyle; each patient may respond differently to hydrotherapy.measuring blood sugar levels after the intervention helps healthcare practitioners identify individual patient responses to hydrotherapy, this information is important for personalizing care.Monitoring blood sugar levels after hydrotherapy also helps in the early detection of DM complications.

Identifying blood sugar levels immediately after hydrotherapy is an important step in the management of type 2 diabetes. This data allows healthcare practitioners to evaluate the effectiveness of interventions, adjust treatment plans, motivate patients, and detect complications early. Thus, regular and meticulous monitoring of blood sugar levels is very important in clinical practice. After researching patients with type 2 DM in the Gading Tambaksari Surabaya Health Center area, it was found that these patients were able to consistently adhere to the intervention of drinking plain water throughout the study period. As a result, many of them experienced a significant decrease in blood glucose levels. Therefore, the researchers recommend that individuals with type 2 diabetes incorporate hydrotherapy, specifically the daily practice of drinking plain water, as an additional step alongside their medication to help lower and stabilize blood glucose levels.

According to the data analysis results, these findings highlight the potential efficacy of hydrotherapy as a supportive non-pharmacological approach in the management of type 2 DM. The results show a significant difference in blood glucose levels before and after the hydrotherapy intervention (p-value = 0.000), which is below the previously determined significance criterion of $\alpha = 0.05$. Therefore, (H_0) is rejected in favor of (H_1), which indicates that hydrotherapy, particularly the regular consumption of plain water, has a beneficial effect on blood glucose regulation among type 2 DM patients in the Gading Tambaksari Health Center area of Surabaya. These results affirm the effectiveness of hydrotherapy as a complementary intervention in diabetes management.

C. THE EFFECTS OF HYDROTHERAPY (DRINKING WATER) ON THE REDUCTION OF RANDOOM BLOOD GLUCOSE LEVELS IN TYPE 2 DM PATIENTS

In a previous study conducted by [21] titled "Hydrotherapy Can Lower Blood Sugar Levels in Type 2 DM Patients at Cipondoh Health Center, Tangerang City,"The analysis of measurements taken before and after the hydrotherapy intervention revealed a statistically significant difference in the average blood glucose levels in the intervention group. Hydrotherapy (drinking plain water) can help lower blood sugar levels through several mechanisms.Adequate water intake can increase blood volume, which in turn can enhance insulin sensitivity.Additionally, plain water helps the kidneys process glucose more efficiently, thereby reducing blood sugar levels.These findings provide valuable evidence-based support for nursing professionals, highlighting the importance of integrating complementary therapies such as hydrotherapy into diabetes management strategies to improve patient outcomes and overall health.

In a previous study conducted by [22] titled "Hydrotherapy of drinking plain water to lower blood glucose levels (BGL),"Based on the intervention results, (Ha) was accepted, and (H0) was rejected, because the results showed a statistically significant p-value of 0.000.These findings support the idea that hydrotherapy, particularly the consumption of plain water, can significantly reduce blood glucose levels (BGL) in individuals with type 2 diabetes.These findings highlight the potential of hydrotherapy as an effective non-pharmacological approach to improve glycemic control in this patient population.

In a previous study titled "The Effectiveness of Water Therapy on Blood Sugar Levels in Type 2 DM Patients: A Narrative Review."From an in-depth analysis of the literature, I have identified eight academic journals that align with the objectives of this research, including studies by [23], [24], and [17].The findings consistently show that plain water therapy effectively lowers blood glucose levels in individuals with type 2 diabetes.This collective evidence suggests that regular water therapy can serve as a valuable natural intervention and a non-pharmacological approach to managing high blood glucose levels, making it worth considering in diabetes management strategies.

In the previous study conducted by the title "The Effect of Warm Water Therapy and Regular Water on Blood glucose Level Reduction (GDS) in Elderly DM Patients in Luragung Landeuh Village, Luragung District, Kuningan Regency in 2023". The findings of this study were analyzed using a paired samples test, yielding a ρ -value of $\rho = 0.000$, where $\rho < 0.05$. This show a substantial impact of warm water therapy on lowering blood glucose levels among the elderly in Luragung Landeuh Village, Luragung District, Kuningan Regency in 2023.

In a previous study conducted by [25] titled "The Effect of Drinking Warm Water Hydrotherapy on Blood Glucose Levels in DM Patients," the results of this study, which showed a statistically significant difference in the average blood glucose levels between the control and intervention groups (p=0.0001), are consistent with previous research on individuals with DM.This strengthens the growing evidence suggesting that hydrotherapy, particularly through simple interventions such as the consumption of plain water, can be an effective strategy for reducing blood glucose levels in individuals with type 2 DM.These findings not only contribute to the existing literature but also emphasize the potential of hydrotherapy as a complementary therapeutic approach in diabetes management, offering a cost-effective and accessible way to improve glycemic control [26].Further research is needed to explore the underlying mechanisms and optimize

the conditions under which hydrotherapy can be most effective, thereby enhancing its integration into diabetes care regimens.By demonstrating this potential, hydrotherapy can serve as a valuable component in the management of hyperglycemia, highlighting its role in improving the overall quality of life for this patient population and necessitating further exploration of its long-term benefits in diabetes care.

For healthcare practitioners, these findings indicate that hydrotherapy can be an easily implemented and cost-effective non-pharmacological intervention to help manage blood sugar levels in type 2 DM patients.This is especially important in healthcare facilities with limited resources so that they can educate type 2 DM patients about the benefits of hydrotherapy and how to do it correctly.Patients need to understand the importance of drinking enough water every day, especially before meals.Hydrotherapy can be integrated into a comprehensive treatment plan for type 2 diabetes, which also includes a healthy diet, regular exercise, and pharmacological treatment if necessary.And these findings encourage further research on the optimal dosage, frequency, and duration of hydrotherapy for the management of type 2 diabetes.Research can also be conducted to identify the patient groups most likely to benefit from hydrotherapy.

In this context, it can be concluded that patients with type 2 DM in the Puskesmas Gading Tambaksari Surabaya area effectively adhered to the practice of drinking plain water during their routine interventions, which positively impacted the reduction of their blood glucose levels. This benefit is associated with the role of plain water in removing excess glucose from the bloodstream through the kidneys and enhancing circulation and metabolic processes. With consistent application as part of a healthy lifestyle, individuals with type 2 diabetes can see improvements in blood glucose regulation, making it a simple yet effective intervention in helping to lower blood sugar levels in type 2 diabetes patients.these findings to improve the quality of care for type 2 DM patients and reduce the risk of complications. By educating patients and integrating hydrotherapy into a comprehensive care plan, better outcomes can be achieved. Therefore, healthcare professionals should encourage and motivate these patients to maintain this practice as a preventive measure against potential complications associated with type 2 diabetes.

VII. CONCLUSION

This study shows that hydrotherapy (drinking plain water) significantly lowers blood sugar levels in type 2 DM patients.These findings indicate that hydrotherapy has the potential to be an effective and easily accessible complementary intervention for the management of diabetes in the community. The application of hydrotherapy in clinical practice can be a simple strategy to help patients manage their blood sugar levels.

Based on the positive results of this study, hydrotherapy (drinking plain water) can be recommended as part of routine diabetes management, especially as an easily applicable intervention.Further research with a larger scale and stricter methodological design is needed to confirm these findings and to develop optimal hydrotherapy protocols for various populations of type 2 diabetes patients.

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