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THE EFFECT OF A COMBINATION OF BRISK WALKING EXERCISE AND HYDROTHERAPY ON BLOOD SUGAR LEVELS IN PATIENTS WITH TYPE 2 DIABETES MELLITUS

Pengaruh Kombinasi Brisk Walking Exercise dan Hidroterapi terhadap Kadar Gula Darah pada Penderita Diabetes Mellitus Tipe 2

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ABSTRAK

Diabetes Melitus merupakan suatu kondisi serius, jangka panjang atau kronis yang tidak dapat disembuhkan yang disebabkan oleh meningkatnya kadar glukosa darah karena tubuh tidak dapat memproduksi hormon insulin dalam jumlah yang tepat. Hal ini menyebabkan penderita DM berisiko mengalami beberapa komplikasi yang dapat melemahkan dan mengancam jiwa sehingga mengakibatkan meningkatnya kebutuhan akan perawatan medis. Terapi nonfarmakologis yang dapat dilakukan sebagai upaya pengendalian kadar gula darah adalah brisk walking exercise dan hidroterapi. Penelitian ini bertujuan untuk mengetahui pengaruh kombinasi brisk walking exercise dan hidroterapi terhadap kadar gula darah pada penderita Diabetes Melitus Tipe 2. Metode penelitian yang digunakan adalah kuasi eksperimen dengan desain pretest-posttest with control group posttest. Pengambilan sampel menggunakan teknik simple random sampling dengan jumlah sampel 28 orang pada setiap kelompok. Uji statistik yang digunakan adalah paired sample t-test dan independent sample t-test dengan taraf signifikansi 0,05. Hasil penelitian menunjukkan adanya perbedaan rata-rata kadar gula darah sebelum dan sesudah latihan pada kelompok intervensi dan kelompok kontrol dengan nilai p sebesar 0,001. Hasil uji statistik menunjukkan adanya perbedaan rata-rata kadar gula darah setelah diberikan latihan fisik antara kelompok intervensi dan kelompok kontrol dengan nilai p sebesar 0,020. Penelitian ini menyimpulkan bahwa kombinasi latihan jalan cepat dan hidroterapi dapat menurunkan kadar gula darah pada penderita diabetes melitus tipe 2.

***Kata kunci**: brisk walking exercise, diabetes melitus, hidroterapi, kadar gula darah*

ABSTRACT

Diabetes mellitus is a serious, long-term, or chronic condition that cannot be cured, caused by increased blood glucose levels because the body cannot produce the hormone insulin in the right amount. This causes DM sufferers to be at risk of experiencing several complications that can be debilitating and life-threatening, resulting in an increased need for medical care. Non-pharmacological therapies that can be done as an effort to control blood sugar levels are brisk walking exercise and hydrotherapy. This study aims to determine the effect of the combination of brisk walking exercise and hydrotherapy on blood sugar levels in type 2 diabetes mellitus sufferers. The research method used was a quasi-experimental pretest-posttest design with a control group posttest. Sampling used a simple random sampling technique with a sample size of 28 people in each group. The statistical tests used were paired sample t-tests and independent sample t-tests with a significance level of 0.05. The results showed a difference in average blood sugar levels before and after exercise in the intervention group and the control group, with a p-value of 0.001. The statistical test results showed a difference in average blood sugar levels after physical exercise between the intervention and control groups, with a p-value of 0.020. This study concluded that the combination of brisk walking and hydrotherapy can reduce blood sugar levels in people with type 2 diabetes mellitus.

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Keywords: blood sugar levels, brisk walking exercise, diabetes mellitus, hydrotherapy

INTRODUCTION

Diabetes mellitus (DM) is a serious, long-term chronic disease characterized by increased blood glucose levels due to the body's inability to produce adequate insulin or because the body is unable to utilize insulin effectively..[1]

Data from the International Diabetes Federation (IDF) (2021) shows that approximately 537 million adults aged 20 to 79 years, or approximately 10.5% of the world's population, are living with diabetes. Indonesia ranks fifth with 19.5 million people out of 10 countries suffering from diabetes. In West Java, the prevalence increased from 1.3% in 2017 to 1.74% in 2018.[1]

According to the World Health Organization (WHO) in 2016, of the various types of diabetes mellitus, type 2 is the most common, accounting for approximately 90–95% of all cases. Approximately 80% of people with type 2 diabetes live in low- and middle-income countries, with the majority being between 40 and 59 years old.[2]

In 2021, the West Java Provincial Health Office recorded 644,704 people suffering from diabetes mellitus.In Tasikmalaya City, the number of DM patients increased by 16% in 2021, from 9,279 to 10,996 in 2022. The results of a preliminary study on December 22, 2023, Indihiang Community Health Center were a community health center with a total of 628 people served with diabetes mellitus

Diabetes mellitus is a disease that requires long-term therapy and can cause complications in various organs, and can also become chronic when the pancreas is unable to produce enough insulin. The body's inability to use insulin effectively is one of the main causes of diabetes mellitus.[3] Of the various types, type 2 diabetes mellitus is the most common, while cases of type 1 diabetes mellitus are relatively rare in Indonesia. Type 2 diabetes is generally caused by progressive impairment of pancreatic beta cell function, which results in a decreased ability of the body to produce adequate insulin.[4]

DM is a serious challenge and places a significant burden on sufferers and their families. Diabetes is a chronic condition that carries the risk of various serious complications that can weaken body functions and threaten the patient's survival. These complications include cardiovascular disorders, kidney damage, nerve disorders, and vision problems, significantly increasing the need for intensive medical intervention. As a result, patients experience a drastically reduced quality of life and face a higher risk of premature death compared to the general population. So globally, diabetes is ranked among the top 10 causes of death.[1]

Low levels of physical activity contribute to an increased risk of developing type 2 diabetes mellitus compared to high levels of physical activity.[5] A study in Brazil showed that patients with type 2 diabetes mellitus experienced a reduction in blood glucose levels of up to 16% after undergoing a regular and structured program of aerobic physical exercise and resistance training.[6] These results are in line with the results of a cross-sectional study conducted in Saudi Arabia, namely that type 2 DM patients who have low physical activity have significantly lower blood glucose control compared to those who do regular physical activity.[7]

According to PERKENI (2021), efforts to prevent the occurrence of complications of type 2 diabetes mellitus can be treated in various ways. Consists of 5 pillars, namely education, diet, physical exercise, pharmacological therapy, and blood sugar checks.[8] One type of physical exercise called brisk walking exercise is fast walking done for a specified time.This physical exercise can increase the heart rate and stimulate muscle contractions, thereby increasing the breakdown of glycogen into glucose for energy, as well as increasing tissue

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oxygenation through increased blood flow. Muscle contractions during exercise also increase insulin receptor sensitivity, helping the body use glucose more efficiently.

Furthermore, this exercise plays a role in reducing plaque formation in blood vessels by increasing the utilization of fat as an energy source and significantly lowering blood sugar levels. This mechanism is crucial in diabetes management, as it helps control blood glucose, prevents insulin resistance, and reduces the risk of cardiovascular complications common in people with diabetes mellitus. Non-pharmacological hydrotherapy therapy, which means drinking water regularly and consistently, is very helpful in maintaining the fluid and electrolyte balance that the body needs to treat diabetes mellitus.[8]

As research conducted by Damanik (2019) regarding Influence of brisk walking exercises in reducing blood glucose levels in type 2 diabetes mellitus patients undergoing outpatient treatment at a general hospital with the results that there is an effect of fast walking on the decline of blood glucose levels in diabetes mellitus patients showed an average decrease of 2.63 mg/dL with a significance value of p = 0.002.[9]

Brisk Walking is useful to help reduce excess fat in the body. Muscle-strengthening exercises can increase the body's cell sensitivity to insulin by stimulating muscle contractions, which trigger increased activity of the type 4 glucose transporter (GLUT4) in cell membranes. This allows glucose to enter cells more effectively without relying entirely on insulin. Furthermore, these exercises also help increase muscle mass, which serves as a primary site for glycogen storage and glucose utilization, thus improving blood sugar control and reducing insulin resistance, which are key factors in the management of type 2 diabetes mellitus. This sensitivity will persist over time and cause more capillaries to open, allowing more insulin receptors to be accessed. Eventually, these activated receptors can convert glucose in the bloodstream into energy.[10]

In addition, hydrotherapy or drinking water regularly and routinely really helps maintain the balance of fluids and electrolytes that the body needs to treat diabetes mellitus.[11] This is proven by research conducted by Ahid Jahidin (2019) regarding the Influence of drinking water therapy showed a significant effect on reducing random blood sugar levels (GDS) in type 2 diabetes mellitus patients, with an average decrease of 93.9 mg/dL and a significance value of p = 0.000. [12]

Drinking water first thing in the morning upon waking can help lower blood glucose levels. This is because drinking water increases hydration, which plays a crucial role in glucose metabolism and helps the kidneys excrete excess sugar through urine. Furthermore, good hydration can also improve insulin sensitivity, allowing blood glucose to be more effectively absorbed by the body's cells. Therefore, drinking water in the morning can be a simple yet effective way to manage blood sugar levels, especially in patients with type 2 diabetes mellitus. This phenomenon occurs due to the absence of food in the stomach, allowing the stomach wall to rapidly absorb air. The air then enters the bloodstream, passes through the kidneys, and circulates throughout the body. This mechanism stimulates the body's metabolism, speeding up digestion and eliminating concentrated chemicals such as excess glucose through urine, feces, sweat, and respiratory vapors. As a result, blood glucose levels decrease.[13]

Brisk walking and hydrotherapy have similar benefits in lowering blood sugar levels in people with diabetes mellitus through different but complementary mechanisms. Brisk walking increases cardiovascular activity and muscle contractions, which stimulates increased

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insulin sensitivity and glucose utilization by active muscles, thereby helping to significantly lower blood sugar levels. Meanwhile, hydrotherapy, which typically involves water exercise, reduces joint stress and allows for more comfortable physical activity, especially for people with limited mobility. Aquatic exercise also stimulates blood circulation and metabolism, and helps reduce oxidative stress that contributes to insulin resistance.

Based on the background of the results of the preliminary study, diabetes sufferers who received treatment still had high blood sugar levels. Researchers are interested in conducting this research to determine the effect of a combination of brisk walking exercise and hydrotherapy (drinking water)on changes in blood glucose levels in patients with type 2 diabetes mellitus in the Indihiang Health Center Working Area. This is important considering the high prevalence of diabetes and the need for effective management methods to control the disease and prevent further complications.

METHODS

This research method used a quasi-experimental design with a control group (pretest–posttest with control group). The study was conducted from May 23, 2024, to May 29, 2024, in the Indihiang Community Health Center (Puskesmas) working area. The study population consisted of 628 individuals diagnosed with diabetes mellitus, both type 1 and type 2.

This study involved an enumerator who assisted the researcher during blood sugar checks, namely a student and a cadre who helped monitor clients in carrying out the interventions provided.

The sampling technique used was probability sampling with a simple random sampling approach. Researchers first screened the population to select only those who met the inclusion criteria. Afterward, simple random sampling was performed on this group. Following screening, the sample was selected using a random sampling technique, where each individual in the population had an equal chance of being selected as part of the research sample. This method aims to ensure sample representativeness so that research results can be generalized to the entire population with minimal bias. Using the hypothesis test formula for the average difference of 2 means, the minimum sample size for the study was 32 respondents. To anticipate dropout, the sample size was reduced to 28-35 respondents, resulting in a total of 56 subjects.

The inclusion criteria in this study were patients diagnosed with diabetes mellitus type 2 and willing to be a respondent and sign the informed consent, adults (38–60 years), with blood sugar levels of 200–300 mg/dl, taking oral antidiabetic medication, and not experiencing physical/movement limitations, swhile exclusion criteriarespondents who are unwilling to participate in the research or withdraw during the research.

Data collection was conducted by selecting respondents according to predetermined criteria. The researcher used a spin lottery method for sampling. The researcher entered all the names of respondents who met the inclusion criteria to be selected as respondents, then spun using Google Spin. After obtaining the required number of respondents, the respondents were divided into two groups: the intervention group and the control group. Furthermore, participants were given informed consent as a form of agreement after receiving an explanation of the purpose and objectives of the study, the expected benefits, and the procedures to be undertaken during the study, namely brisk walking exercise and hydrotherapy drinking water. The intervention group was encouraged to do brisk walking exercise and hydrotherapy with drinking

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water therapy every day for 7 consecutive days, while the control group was encouraged to participate in Prolanis activities for 7 days. The researcher will measure blood sugar levels comparatively on the first day before the intervention (pre-test) and on the seventh day after the intervention (post-test) in both groups, namely the intervention group and the control group.

In the research phase, the intervention group was advised to carry out hydrotherapy independently every day after waking up by consuming 2 glasses of 250 ml of warm water at home for 7 days with a time gap of 10-15 minutes between drinking the first and second glasses.[14]Continued with Brisk Walking Exercise carried out 3x a week with an implementation time of 20-30 minutes adjusted to the respondent's ability.[15]Meanwhile, the control group was advised to carry out activities that are usually carried out in Prolanis, such as dieting, exercising, taking medication, checking blood sugar, socializing and others.

If side effects occur during the study, the study will be stopped and the medication will continue at the original dosage. However, researchers have also conducted studies on the side effects of the interventions, and neither intervention did not caused any adverse effects or harm to the client. Therefore, it is recommended as a simple, inexpensive, and easy non-pharmacological therapy.

The research instrument used is a respondent characteristics questionnaire, daily observation sheets, SOP for brisk walking exercise and hydrotherapy, which are sourced from the research results of several previous researchers [16,17], as well as the Accu-Check brand glucometer, which has undergone validity and reliability tests to measure blood glucose levels.

Univariate data analysis was performed by calculating the mean, median, standard deviation, minimum, and maximum values. Meanwhile, for bivariate analysis, paired sample t-test and independent sample t-test were used to compare the average between groups with the values.p - p-value < 0.05.

This research has received ethical clearance from Jenderal Achmad Yani University, Cimahi, Indonesia, with the number 044/KEPK/FITKes-Unjani/V/2024. Respondents in the research have the right or freedom to express their opinions, which is protected.*Confidentiality*/confidentiality, getting justice, and also getting benefits and avoiding the dangers of intervention.

RESULTS

Table 1. Characteristics of Respondents with Type 2 Diabetes Mellitus Based on Age in the Indihiang Community Health Center Work Area

	Variables	Intervention	Control
Age	Mean	54.00	51.07
	Minimum	38	40
	Maximum	60	60
	Elementary School	6,218	6,782

Based on Table 1, the average age of respondents in this study was 54 years in the intervention group and 51 years in the control group. The youngest respondent was 38 years old, while the oldest was 60 years old.

Based on Table 2, the results show that respondents in the study were dominated by women, with a percentage in the intervention group of 78.6% (22 people) and in the control group 78.6% (22 people). The majority of both groups had suffered from DM for <5 years, with the percentage in the intervention group being 78.6% (22 people) and in the control group 67.9% (19 people).

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In the intervention group, the majority of respondents had a primary school education, namely 50.0% (14 people), while in the control group, the majority of respondents had a high school education, namely 42.9% (12 people).

Table 2. Characteristics of Respondents with Type 2 Diabetes Mellitus

Respondent Characteristics	Group			
	Intervention		Control	
	n	%	n	%
Gender				
Man	6	21.4	6	21.4
Woman	22	78.6	22	78.6
Long Suffering				
≤5 years	22	78.6	19	67.9
>5 years	6	21.4	9	32.1
Education				
No schooling	0	0	0	0
Elementary School	14	50.0	9	32.1
Junior High School	4	14.3	7	25.0
Senior High School	10	35.7	12	42.9

Table 3. Distribution of Average Blood Sugar Levels in the Intervention Group and Control Group Before and After Administration Brisk Walking Exercise and Hydrotherapy

Variables	Mean	Elementary School	Min	Max	95% CI
Intervention Group (n) = 28					
Blood Sugar Levels					
Before	227.46	19,693	203	274	219.83-235.10
After	191.89	17,308	170	236	185.18-198.60
Control Group (n) = 28					
Blood Sugar Levels					
Before	226.25	18,712	202	270	218.99-233.51
After	202.25	15,047	182	239	196.42-208.08

Table 3 shows that the average blood sugar level in the intervention group before brisk walking exercise and hydrotherapy was 227.46 mg/dL. After the intervention, the average blood sugar level decreased to 191.89 mg/dL. Using a 95% confidence interval estimate, the average blood sugar level before the intervention was estimated to be between 219.83 and 235.10 mg/dL, while after the intervention, it was. In the range of 185.18 to 198.60 mg/dL. Meanwhile, in the control group, the average blood sugar level before Prolanis administration was recorded at 226.25 mg/dL. After Prolanis administration, there was a decrease in the average blood sugar level to 202.25 mg/dL. Based on the 95% confidence interval, the average blood sugar level before the intervention was estimated to be in the range of 218.99 to 233.51 mg/dL, while after the intervention, the value was in the range of 196.42 to 208.08 mg/dL.

Table 4. Difference in Average Blood Sugar Levels Before Intervention Between the Intervention Group and the Control Group

Variables		Mean	Elementary School	SE	p-value	N
Blood Sugar Levels	Intervention	227.46	19,693	3,722	0.814	28
	Control	226.25	18,712	3,536		28

**Independent sample t-test*

Table 4 presents the results of the independent sample t-test, which shows a p-value of 0.814 for pre-intervention blood sugar levels in the intervention

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and control groups. Since the p-value is greater than 0.05 (p > 0.05), it can be concluded that there is no statistically significant difference between the two groups in terms of pre-intervention blood sugar levels. Thus, the average initial blood sugar levels (starting point) in the intervention and control groups were relatively similar.

Table 5. Difference in Average Blood Sugar Levels in the Control Group Before and After Prolanis Activities

Variables		Mean	Difference	Elementary School	SE	p-value	N
Blood Sugar Levels	Before	226.25	24,000	18,712	3,536	0.001	28
	After	202.25		15,047	2,844		

**Paired sample t-test*

Based on Table 5, the results of the paired sample t-test show a p-value of 0.001, which is below the significance level (α = 0.05). This finding indicates a statistically significant difference between the average blood sugar levels before and after the intervention in the control group.

Table 6. Differences in Average Blood Sugar Levels in the Intervention Group Before and After Exercise Brisk Walking Exercise and Hydrotherapy

Variables		Mean	Difference	Elementary School	SE	p-value	N
Blood Sugar Levels	Before	227.46	35,571	19,693	3,722	0.001	28
	After	191.89		17,308	3,271		

**Paired sample t-test*

Based on Table 6, the results of the paired sample t-test show a p-value of 0.001, which is smaller than the significance level of α = 0.05. This finding indicates a statistically significant difference between the average blood sugar levels before and after the implementation of brisk walking exercise and hydrotherapy in the intervention group at the Indihiang Community Health Center.

Table 7. Difference in Average Blood Sugar Levels Between Intervention Groups After Administration Brisk Walking Exercise and Hydrotherapy with the Control Group After Being Given Prolanis Activities.

Variables		Mean	Elementary School	SE	p-value	N
Blood Sugar Levels	Intervention	191.89	17,308	3,271	0020	28
	Control	202.25	15,047	2,844		28

**Independent sample t-test*

Referring to Table 7, it can be seen that the intervention group experienced a more pronounced decrease in blood sugar levels, with a post-intervention average recorded at 191.89 mg/dL compared to the control group, which only reached 202.25 mg/dL. The analysis results using an independent samples t-test yielded a p-value of 0.020, which is below the 0.05 significance threshold. This indicates a significant difference between the two groups being compared. This indicates a statistically significant difference between the average blood sugar levels of the intervention and control groups in the Indihiang Community Health Center area in 2024.

DISCUSSION

A. Average Blood Sugar Levels in the Intervention Group Before and After Being Given a Combination of Brisk Walking Exercise and Hydrotherapy

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In the intervention group, the average blood sugar level decreased from 227.46 mg/dL before the brisk walking exercise and hydrotherapy to 191.9 mg/dL after the intervention. This finding is in line with the research resultsDamanik (2019) which shows that brisk walking exercise has a significant impact on reducing blood glucose levels in diabetes mellitus patients, with an average decrease of 2.63 mg/dL and a significance value of p = 0.002.10Additional support comes from studies conducted byHati & Muchsin, (2022) who reported a decrease in blood sugar levels from an average of 222.67 mg/dL to 199.33 mg/dL after a brisk walking intervention, where the initial levels were still in the high category.[14]

The treatment given to respondents was the same as the Damanik study, namely carrying out Brisk Walking Exercise 3 times a week with an implementation time of 20-30 minutes adjusted to the respondent's ability and drinking water.2 glasses of 250 ml at home for 7 days with a gap of 10-15 minutes between drinking the first and second glass.

B. Average Blood Sugar Levels in the Control Group Before and After Prolanis Activity

In the control group, there was a decrease in average blood sugar levels from 226.25 mg/dL before the intervention to 202.25 mg/dL after participating in regular exercise, which is part of the Prolanis program. Nastiti & Achmad Hanif (2018) stated that one of the prolanis activities, namely gymnastics, can affect reducing blood sugar levels with a p-value of 0.001. In this caseImplementing Prolanis activities only once a month is considered ineffective in significantly lowering blood sugar levels in people with diabetes mellitus. This is due to the limited frequency of intervention, which means it is unable to provide optimal impact on blood glucose control. Because it is not routinely carried out by respondents every day, only a few respondents are obedient in implementing the activities that are usually carried out in the prolanis at home.[19]

This finding is consistent with the research results of Kristianto et al. (2021), which revealed a significant difference in blood sugar control in type 2 diabetes mellitus patients who participated in the Prolanis program compared to those who did not participate (p = 0.019). Furthermore, based on a risk ratio analysis, Prolanis participants had a 0.53-fold lower risk of blood sugar control failure, confirming the program's effectiveness in managing type 2 diabetes. [20]

C. Difference in Average Blood Sugar Levels in the Control Group Before and After Prolanis Activity

The results of the study revealed that the average blood sugar level of participants before the implementation of the Prolanis activity was 226.25 mg/dL, which decreased to 202.25 mg/dL after the intervention, with an average difference of 24.00 mg/dL. The paired sample t-test showed a p-value of 0.001, indicating a statistically significant decrease in blood sugar levels after the intervention. This finding is in line with research by Nastiti & Achmad Hanif (2018), which states that one of the activities in the Prolanis program, namely exercise, plays an effective role in reducing blood sugar levels in diabetes mellitus sufferers, with a p-value of 0.00.[18]

In addition, the decrease in blood sugar levels in the control group in this study was influenced by a number of multifactorial factors, including the level of physical activity and compliance in taking medication. In addition to participating in prolanis activities, which are carried out once a month, respondents in the study carried out physical activities in their daily activities, including cleaning the house and doing other work, accompanied by regularly taking medication provided by the Community Health Center.

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D. Difference in Average Blood Sugar Levels in the Intervention Group Before and After Being Given a Combination of Brisk Walking Exercise and Hydrotherapy

The results of the study indicated a significant decrease in average blood sugar levels in the intervention group after receiving a combination of brisk walking exercise and hydrotherapy, from 227.46 mg/dL to 191.89 mg/dL, with an average difference of 35.57 mg/dL. This decrease was supported by statistical test results which showed a p-value of 0.001, indicating statistical significance.

This research is in line with Ahid Jahidin (2019) also shows that there was a mean difference in blood sugar levels of 64.1 mg/dL between the conditions before the water therapy and on day 7 of therapy. Furthermore, the mean difference in blood sugar levels between before therapy and day 14 reached 93.9 mg/dL, while the mean difference between days 7 and 14 of therapy was recorded at 29.9 mg/dL.[12]

This research is also supported by Putra et al. (2022). In their research, the pretest mean of 336.80 mg/dL decreased to 212.13 mg/dL in the posttest.[14] These findings indicate a decrease in average random blood sugar levels in respondents before and after hydrotherapy. These findings suggest that regular hydrotherapy plays a positive role in controlling blood sugar levels in people with diabetes. This therapy can also be part of a healthy lifestyle, for both people with and without diabetes, as it aids the body's detoxification process by removing chemicals.[22]

The findings of this study are in line with the results of previous studies. Niuflapu & Agustina (2022), A literature review of 9 journals found that increasing blood sugar levels in patients with diabetes mellitus is not sufficient with just the Prolanis program from the community health center.[23]

It can be seen that brisk walking exercise has significant benefits for people with diabetes mellitus. Regular brisk walking combined with hydrotherapy has been shown to effectively lower blood sugar levels. The primary mechanism is increased insulin sensitivity, which, in turn, improves glucose metabolism and stimulates muscles to use glucose as an energy source. Furthermore, this exercise increases blood flow and cardiovascular function, helping glucose transport into cells more efficiently. Hydrotherapy also provides muscle relaxation and increased blood circulation, which supports metabolic processes.

E. Difference in Average Blood Sugar Levels Between the Intervention Group and the Control Group

An independent sample t-test showed a significant difference in mean blood sugar levels between the intervention and control groups after the intervention, with a p-value of 0.020. The decrease in blood sugar levels was more significant in the intervention group (191.89 mg/dL) compared to the control group (202.25 mg/dL).

Brisk walking exercises play a role in reducing body fat accumulation and strengthening muscles, thereby increasing cell sensitivity to insulin. Conversely, excess fat accumulation can decrease cell response to insulin, contributing to insulin resistance. Increased insulin sensitivity widens capillary openings, making more insulin receptors available to convert blood glucose into energy. [10]

Research conducted by Puspitasari (2017) in Prasaja (2021) found that drinking water twice a day, 160 ml each time upon waking for one week, successfully reduced blood glucose levels, with a more significant decrease compared to the group that consumed 250 ml of water twice a day. This finding indicates that both the frequency and volume of water consumption play a crucial role in maintaining balanced blood glucose levels. Physiologically, drinking water helps the body in the process of excreting excess glucose

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through the kidneys in the form of urine. In addition, increased fluid intake can also increase blood osmotic pressure, which contributes to the dilution of glucose in the plasma, thereby helping to reduce glucose concentration in the blood circulation.[22]

This was the first experience for the researcher, so there is still much to learn as the research progresses. Furthermore, several limitations in the implementation of daily monitoring of respondents during the intervention should have been addressed directly by the researcher. Due to time and manpower constraints, the researcher couldn't conduct direct monitoring every day. Therefore, the researcher requested assistance from cadres as enumerators to accompany and monitor respondents during the intervention and to send documentation as evidence of respondents' participation in the intervention activities in the WhatsApp group.

Based on the research findings, it can be concluded that the combination of brisk walking exercise and hydrotherapy provides a more significant effect in lowering blood sugar levels than either intervention alone. Brisk walking exercise works by stimulating muscle contractions, increasing glycogen breakdown, and increasing oxygen supply to body tissues, which directly increases the use of glucose by muscle cells as an energy source. Meanwhile, hydrotherapy through regular water consumption helps the body excrete excess glucose through the kidneys in the form of urine. The combination of these two therapies provides a synergistic effect in lowering blood glucose levels, while strengthening non-pharmacological approaches in managing diabetes mellitus.

These findings align with Kristianto et al. (2021), who showed a significant difference in blood sugar control in type 2 diabetes mellitus patients participating in the Chronic Disease Management Program (Prolanis) compared to patients who did not participate in the program (p = 0.019). Furthermore, type 2 diabetes mellitus patients participating in the Prolanis program had a 0.53-fold lower risk of blood sugar control failure compared to those who did not participate in the program, with a 95% confidence interval (CI). This indicates that Prolanis can play a significant role in improving blood glucose management in diabetes patients [20]

Supported by research, Saputra et al. (2023) showed that brisk walking activity significantly reduced blood sugar levels, with an average of 241.70 mg/dL in the intervention group and 275.05 mg/dL in the control group (p = 0.01), confirming the benefits of physical activity for people with diabetes mellitus.[24]

CONCLUSION

There was a significant difference in average blood sugar levels before and after the brisk walking exercise and hydrotherapy intervention in the intervention group, and before and after the Prolanis activity in the control group, indicating that both interventions were effective in supporting pharmacological therapy. Brisk Walking Exercise and hydrotherapy can be implemented as nursing interventions to lower blood sugar levels in patients with diabetes mellitus. This therapy also has the potential to reduce treatment costs by enabling patients to perform it independently, while minimizing drug side effects and accelerating the healing process. Therefore, these two therapies are worthy of further research and used as an evidence-based basis in nursing practice for controlling blood sugar levels and preventing complications.

The results of this study can be a reference for further studies in optimizing the combination of brisk walking exercise and hydrotherapy as a non-pharmacological strategy to lower blood sugar levels and prevent complications in type 2 diabetes.

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