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Brisk walking exercise as an effort to reduce blood glucose levels in diabetes mellitus

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ABSTRACT

Background: Non-communicable diseases (NCDs) are a health problem that is currently the focus of global and national attention. One of the NCDs that can be found is Diabetes Mellitus (DM). The chronic metabolic disease called diabetes mellitus is caused by an insufficient amount of insulin produced by the pancreas or the body being unable to adequately use the insulin it produces. Diabetes cannot be cured, but blood sugar can be controlled to prevent complications. Physical exercise or exercise is the third and very important aspect in controlling diabetes. One physical exercise that can be done is brisk walking exercise for 30 minutes. Objective: To find out whether the implementation of brisk walking exercise can reduce blood glucose levels in diabetes mellitus sufferers in Wall Village, Tejakula District, Buleleng Regency in 2023. The type of research used is quasi-experimental with a nonequivalent control group design. The sampling technique used was non-probability sampling, namely purposive sampling, namely 30 respondents (15 intervention groups and 15 control groups). The Wilcoxon test results obtained ρ-value 0.001 < alpha (0.05), which means there is a difference in blood glucose levels before and after brisk walking exercise in diabetes mellitus sufferers. Based on this research, it is recommended that brisk walking can be used as a non-pharmacological therapy to reduce blood glucose levels.

INTRODUCTION

Non-communicable diseases are one of the health problems that is currently the focus of global and national attention. One of the non-communicable diseases that can be found is Diabetes Mellitus (Khariri and Andriani, 2020). Diabetes, as is commonly known throughout the world, is a condition that requires special attention. So that Diabetes Mellitus sufferers can live a normal and healthy life, they must receive appropriate treatment and management (Parman and Nyompa, 2018). The chronic metabolic disease called diabetes mellitus is caused by an insufficient amount of insulin produced by the pancreas or the body being unable to use the insulin produced adequately (Tandra, 2018).

The number of cases and prevalence of diabetes mellitus has continued to increase over the last few years. The International Diabetes Federation (IDF) (2021) states that in 2021 the number of DM cases in the world will reach 537 million cases, it is estimated that in 2030 this number will increase to 643 million cases. The number is expected to jump to 783 million cases in 2045. The World Health Organization (WHO) (2021) states that the largest number of DM sufferers live in low and middle income countries. In 2019, the Southeast Asia region, namely Indonesia, was ranked third with a prevalence of diabetes mellitus of 11.3% (Kemenkes, 2020).

Diabetes mellitus cases in Indonesia in 2021 reached 19.47 million cases and it is predicted that in 2045 it will increase to 28.57 million cases (International Diabetes Federation, 2021). According to the Bali Provincial Health Service (2021), the number of diabetes mellitus cases in Bali is 53,726 cases. Buleleng Regency reached 7,359 cases in 2020 to 81,674 cases in 2021 and to 129,815 in 2022.

Factors that can influence blood glucose are closely related to lifestyle in terms of diet and physical activity (Murtiningsih et al., 2021). An improper diet will result in an unbalanced intake of carbohydrates and other nutrients. As a result, the body's blood sugar levels rise above the threshold for pancreatic function, which leads to diabetes mellitus. (Hariawan et al., 2019). Physical exercise is another element that causes diabetes mellitus, apart from bad eating habits. People who rarely engage in physical activity are 2,455 times more likely to develop diabetes than those who participate in regular physical activity (Pangestika et al., 2022).

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The impact of death caused by diabetes mellitus sufferers is double when compared to those who do not suffer from diabetes mellitus. Every year 1.5 million cases of death are directly attributed to diabetes mellitus (WHO, 2021). The number of cases of death due to diabetes mellitus in Indonesia in 2021 will increase by 58%. In 2011 there were 149,872 deaths, while in 2021 there were 236,711 deaths (International Diabetes Federation, 2021). Diabetes is the leading cause of blindness, stroke, foot ulcers, heart disease, neuropathy, and kidney failure, in addition to premature death worldwide (Abdurrahim Senuk and Wenny Supit, 2017).

Diabetes cannot be cured, but blood sugar can be controlled to avoid complications. Preventive behavior is very important for diabetes mellitus sufferers because it can reduce the risk of acute complications in diabetes mellitus sufferers. Nurses must play an active role in caring for diabetes mellitus sufferers, namely through four aspects of self-management of diabetes mellitus. The four aspects of self-management of diabetes mellitus are diet compliance, monitoring blood sugar levels, physical exercise, and medication compliance (Suardana et al., 2019). Physical exercise or exercise is the third and very important aspect in controlling diabetes. Physical activity is good for general health and helps control blood sugar and body weight (Simamora et al., 2021).

Physical exercise is an activity carried out regularly and in a planned manner, such as walking, jogging, push-ups, stretching, aerobics, cycling, etc. (Indonesian Ministry of Health, 2018). Brisk walking is one of the physical activities that can be done. For diabetes sufferers, brisk walking exercise is a type of moderate intensity aerobic exercise that is carried out by diabetes sufferers using brisk walking techniques for 20-30 minutes which is done 2-3 times per week using an average speed of 4-6 km per hour (Niuflapu and Agustina, 2022). Brisk walking exercise will trigger the production of endorphins which help a person feel happy and can relieve stress and depression. Exercise such as brisk walking exercise does not result in an increase in insulin but rather increases glucose absorption by active muscles. This is caused by increased sensitivity of muscle insulin receptors and from increased insulin receptors during exercise. (Tandra, 2018). Niuflapu and Agustina (2022) argue that brisk walking is a method for regulating or controlling blood sugar in the body. Brisk walking will help diabetes sufferers lower blood sugar levels if done regularly.

Research conducted by Rehmaitamalem and Rahmisyah (2021) on the effect of walking on reducing blood sugar levels in DM sufferers at the Nibong Community Health Center, North Aceh showed that after walking six times for 30 minutes in two weeks, there was a decrease in blood sugar levels in diabetes sufferers. mellitus. Similar research was also conducted by Kasmad et al. (2022) regarding The impact of using brisk walking exercise in lower blood sugar of patients with type two diabetes, namely that after doing brisk walking three times a week for 20 minutes in the intervention group, 11 respondents experienced a significant decrease in blood glucose, which means there was The effect of brisk walking exercise on blood glucose levels in people with type 2 diabetes mellitus.

Based on the results of a preliminary study on February 16 2023 in the village of Bawah Tejakula, Buleleng Regency, the results of interviews with 100% of diabetes mellitus sufferers who visited the community health center, 40% of them said they regularly did sports such as walking and taking part in gymnastics and 60% of them said they never do exercise because they are busy working and feel old, however regarding brisk walking (brisk walking exercise) these ten diabetes mellitus patients have never heard of this physical exercise. The efforts made by the Tejakula Community Health Center to treat DM are by providing health education about diabetes mellitus, carrying out health checks and treatment, nutritional consultations, and carrying out physical activity (prolanis gymnastics) which is held every two weeks on Saturdays. Physical exercise such as brisk walking has never been implemented in the Adiwerna Community Health Center work area. Apart from that, diabetes mellitus patients can do brisk walking without cost or equipment.

METHOD

The independent variable in this study is brisk walking exercise, while the dependent variable in this study is blood glucose levels in diabetes mellitus sufferers. The data collection method is by providing direct intervention to diabetes mellitus sufferers and using the method of checking blood glucose levels before and after the intervention is given using a glucometer measuring instrument.

The instruments used by the research in this study were an easy touch glucometer, stopwatch and standard operational procedures for brisk walking exercise. A glucometer was used to measure respondents' blood glucose levels before and after brisk walking exercise. The glucometer in this study was used from the beginning to the end of the study so that the blood glucose level results obtained were valid. The following are the procedures used to carry out data collection steps:

1. At the implementation stage, in the first meeting before being given the brisk walking exercise, 30 respondents will have their blood sugar levels checked during this time. For two weeks, 15 respondents

will be given brisk walking exercise treatment three times a week for 30 minutes with a distance of 2 km in accordance with standard operating procedures and the other 15 respondents will not be given treatment. The activity will be carried out in an open room and will be directly observed by researchers while doing the brisk walking exercise.

2. After being given the brisk walking exercise for 6 meetings, the researchers again measured the blood sugar levels of 30 respondents at the end of the meeting to find out whether there were any changes in blood glucose levels before and after being given the brisk walking exercise and then recorded them on the master table.

In this study, variations in blood glucose levels before and after the brisk walking exercise intervention were carried out using bivariate analysis. The Shapiro-Wilk test will be performed to determine the normality of the data before selecting which test to run. This test will determine whether the data collected is normally distributed or not. Data can be said to be normally distributed, if the significance value is >0.05, while data is said to be not normally distributed, if the significance value is <0.05.

The test used to determine the difference in changes in blood glucose levels before and after brisk walking exercise in each group, if the data is not normally distributed, the Wilcoxon test will be carried out, if the data is normally distributed, a parametric statistical test will be carried out, paired t-test analysis. Results are significant if p <0.05. When using this statistical test, if the p-value < α (0.05) then Ho is rejected and Ha fails to be rejected, which means there is a difference in blood glucose levels before and after brisk walking exercise in diabetes mellitus sufferers. The next test is used to compare the differences in blood glucose levels before and after brisk walking exercise between the treatment group and the control group. If the data is normally distributed, the Independent Samples T-test will be carried out, if the data is not normally distributed then the Man Whitney U Test will be carried out. Results are significant if p <0.05. In using this statistical test, if the p-value < α (0.05) then Ho is rejected and Ha fails to be rejected, which means there is a difference in blood glucose levels before and after brisk walking exercise in the control group and the intervention group.

RESULT

Table 1. Blood Glucose Levels before intervention

Group	N	Mean	Median	SD	Min-Max
Kontrol	15	190.87	179.00	41.454	159-331
Intervensi	15	184.47	175.00	30.870	150-239

Based on table 1, from a total of 30 respondents, the average blood glucose level before giving brisk walking exercise in the control group was 190.87 mg/dL with a standard deviation of 41,454, while in the intervention group the average was 184.47 mg/dL with a standard deviation. 30,870. The minimum value for the control group was 159 mg/dL while the intervention group was 150 mg/dL, and the maximum value for the control group was 331 mg/dL while the intervention group was 239 mg/dL. These results show that the average respondent in this study, both from the intervention group and the control group, had blood glucose levels that exceeded the normal value of >139 mg/dL.

Table 2. Blood Glucose Levels after intervention

Group	N	Mean	Median	SD	Min-Max
Kontrol	15	190.53	180.00	33.494	150-289
Intervensi	15	167.20	163.00	23.118	139-210

Based on table 2, from a total of 30 respondents, the average blood glucose level after brisk walking exercise in the control group was 190.53mg/dL with a standard deviation of 33,494, while in the intervention group it was 167.20 mg/dL with a standard deviation of 23,118. The minimum value for blood glucose levels in the control group was 150 mg/dL and in the intervention group was 139. The maximum value for blood glucose levels in the control group was 289 mg/dL and in the intervention group was 210

mg/dL. These results show that on average respondents still have blood glucose levels that exceed normal values.

Table 3. Blood Glucose Level Data Normality Test Results

Blood glucose levels		N	p-value
Pre-test	Control group	15	0.000
	Intervention group	15	0.006
Pos-test	Control group	15	0.058
	Intervention group	15	0.149

Table 3 shows that the results of the normality test showed that the significance value for blood glucose levels before being given brisk walking exercise in the control group and intervention group was 0.000 and 0.006, namely ρ<0.05, which means the data was not normally distributed, while the blood glucose levels after brisk walking exercise in the control group and intervention group were 0.058 and 0.149, namely ρ>0.05, which means the data is normally distributed. Once it is known that there is data that is not normally distributed, then a hypothesis test is carried out using a non-parametric statistical test, namely the Wilcoxon test for each group.

Table 4. Differences in Glucose Levels Before and After Brisk Walking Exercise in Diabetes Mellitus Patients

Group		Z	p-value
Intervention	Pre-test Pos-test	-3.235[b]	0.001
Control	Pre-test Pos-test	-1.819[b]	0.776

Table 4 shows that the results of the Wilcoxon signed rank statistical test in the intervention group were that the ρ-value was 0.001 (ρ<0.05), so it can be concluded that the hypothesis was accepted, which means there was a significant difference in blood glucose levels before and after being given brisk walking exercise. intervention group. Meanwhile, in the control group, the ρ-value was 0.776 (ρ>0.05), it can be concluded that the hypothesis was rejected, which means there was no significant difference in blood glucose levels before and after being given brisk walking exercise in the intervention group.

Table 5. Test of Differences in Blood Glucose Levels in the Control Group and Intervention Group

Group		Median (Min-Max)	p-value
Pre-test	Intervention Control	165.00 (120-362) 175.00 (150-278)	0.589
Pos-test	Intervention Control	165.00 (121-353) 164.00 (140-270)	0.036

Based on table 5 pre-test differences between the control group and the intervention group using the Mann-Whitney test. The different results in the blood glucose levels of the control group and the intervention group were ρ=0.589 (ρ>0.05), so that these results can be concluded that there is no significant difference between the control group and the intervention group in the pre-test blood glucose level data. Post test differences between the control group and the intervention group using the Mann-Whitney test. The different results in the blood glucose levels of the control group and the intervention group were ρ=0.036 (ρ <0.05), so that these results can be concluded that there is a significant difference between the control group and the intervention group in the pre-test blood glucose levels.

DISCUSSION

The characteristics of respondents in this study are age, gender and occupation. In research conducted on 30 respondents at West Denpasar Health Center II, it was found that the majority of

respondents were 14 aged 56-59 years. Age is one of the factors that influences blood glucose levels. The older you get, the greater your risk of developing DM. This happens because as you get older, insulin sensitivity will decrease, which can affect blood glucose levels.

As we get older, this will cause a condition of resistance which results in an imbalance in blood sugar levels in the body. Insulin resistance is a cell condition where insulin sends a signal to release glucose from the blood, but muscle cells do not receive this signal (Simon and Batubara, 2020). In accordance with the theory of the aging process which states that during the decade of age 40-70 years, signs and symptoms related to body function will appear (Dinata et al., 2022).

According to research by Petermann Rocha et al. (2018), states that people with the highest risk of developing diabetes mellitus are those aged over 45 years. Among the risk factors that cannot be modified, age is one of the main factors in the development of diabetes mellitus, because the incidence of this disease increases in adulthood. This is in line with the existing theory that increasing age is associated with an increased risk of diabetes mellitus. Older age influences the incidence of glucose intolerance. Glucose intolerance causes a decrease in the body's function to metabolize glucose which is balanced by genetic factors in a person. The risk of glucose intolerance increases with age, starting in the age group over 45 years. Therefore, someone over 45 years of age must immediately undergo diabetes mellitus screening to detect and prevent cases of diabetes mellitus (Gunawan and Rahmawati, 2021).

Research conducted by Isnaini and Ratnasari (2018), states that there is a relationship between age and the incidence of diabetes mellitus. The research conducted in the Puskesmas I Angon area was mostly aged 51-60 years (41.5%). This happens because increasing age will result in changes in carbohydrate metabolism and insulin release due to glucose in the blood and the release of glucose into cells is hampered.

The next factor that influences blood glucose levels is gender. In this research carried out in the West Denpasar Public Health Center II Work Area, it was found that of the 30 respondents studied, 19 people (66.3%) were female, while 11 people (36.7%) were male. The research results show that the percentage of female respondents is greater than male. This is because women have a higher body fat composition compared to men, so they are more susceptible to obesity related to diabetes.

In line with research by Mildawati et al (2019), the majority of respondents were female, namely 59 people (71.1%). Women have a higher body mass index, making them more susceptible to DM. Women are at risk of developing diabetes due to post-menopausal monthly cycle syndrome (premenstrual syndrome), which causes body fat distribution to accumulate due to hormonal processes (Rachman, 2022).

The research results of Arania et al. (2021) stated that there were more female respondents than male, namely 91 people (72.2%). The hormones estrogen and progesterone have the power to increase blood insulin levels in women. The insulin response will decrease due to low estrogen and progesterone hormones during menopause.

Occupational factors can influence the risk of diabetes. Based on the work of 30 respondents studied in the West Denpasar Public Health Center II Work Area, it shows that the majority of respondents did not work, namely 14 people (46.7%). The results of this research are in line with research conducted by Dinata et al. (2022) which shows that the majority of respondents do not work. Research conducted by Oktavia et al. (2022) also said that in the employment variable the largest number of respondents were 79 respondents who did not work (73.1%). Occupation is a factor that is also proven to have a significant influence on the incidence of type 2 diabetes.

Suiraoka (2012) in Arania et al. (2021) stated that work factors can influence the high risk of developing diabetes mellitus. The body will burn less energy when working with light activities which will result in obesity because the body will store excess energy as body fat. Obesity is a risk factor for diabetes mellitus.

In this study, the majority of respondents did not work, resulting in respondents doing little physical activity. Physical activity is good for controlling blood glucose levels. Normal blood glucose levels will tend to increase gradually after reaching the age of 40 years. To reduce blood glucose levels, it is important to do physical activity such as brisk walking exercise. Brisk walking is a physical exercise that plays an important role in treating diabetes because it can increase the number of receptors on the cell walls where insulin can attach itself and can help burn calories because it can reduce body weight (Manurung, 2018).

The results of research conducted in the West Denpasar Public Health Center II Working Area on 30 respondents showed that the average blood glucose levels of the control group and intervention group before the brisk walking exercise were 190.87mg/dL and 184.47 mg/dL. From these results, it was concluded that the pre-test blood glucose levels in the control group and intervention group exceeded the normal limit (>139 mg/dL). The results of this research are supported by research conducted by Listyarini and Fadilah (2017) in Klumpit Village, Gebog District, Kudus Regency regarding Brisk Walking Can Reduce Blood Glucose Levels in Diabetes Mellitus Patients. It was found that 37 respondents before giving brisk

walking exercise had blood glucose levels exceeding normal limits with The average blood glucose levels of the control group and intervention group were 204.05 mg/dL and 208.28 mg/dL.

Measurement of pre-test blood glucose levels in this study was carried out by looking at the results of measuring blood glucose levels using a glucometer before administering the brisk walking exercise at the first meeting. Factors that influence blood glucose levels are diet, lack of physical activity, obesity and stress levels. High blood glucose levels are very dangerous if left untreated. Blood sugar can be controlled to prevent complications, namely through 4 aspects of DM self-management consisting of diet compliance, blood sugar monitoring, physical exercise, and medication compliance (Suardana et al., 2019).

Based on the results of research and relevant theories, it was found that from 30 respondents in research at West Denpasar Health Center II, the average pre-test blood glucose level exceeded normal blood glucose levels. It is assumed that high blood glucose levels can cause damage to nerves and stiffness in blood vessels, so that blood circulation is disrupted. To avoid this, what can be done is by adopting a healthy lifestyle and routinely controlling blood sugar levels by visiting health services. at Puskesmas II West Denpasar, they have implemented several programs for treating diabetes mellitus, such as providing education regarding diabetes mellitus, POSBINDU, namely early detection and monitoring of the main NCD risk factors carried out in an integrated, routine and periodic manner, PISPK, namely visits to residents' homes to carry out checks. blood sugar levels and if there are residents who have high blood sugar levels they will be referred to the community health center for further treatment. There is a prolanis program which is held twice a month in the second and fourth weeks.

The results of research conducted in the West Denpasar Public Health Center II Working Area on 30 respondents showed that the average blood glucose levels of the control group and intervention group after brisk walking exercise were 190.53 mg/dL and 167.20 mg/dL. The lowest values for the two groups were 150 mg/dL and 139 mg/dL, while the highest values were 289 mg/dL and 210 mg/dL. From these results, it was concluded that the average decrease in blood glucose levels in the brisk walking exercise intervention group was a decrease in the average blood glucose level of 17.27 mg/dL.

Research conducted by Hamonangan and Easter (2019) showed that after taking a brisk walk, the blood glucose levels of DM sufferers were able to decrease by an average of 2.63 mg/dl. The results of this study are in line with Listyarini and Fadilah (2017) obtained from a sample of 19 people, namely that there was an average decrease in blood sugar levels of 19.26 mg/dL.

Post test blood glucose levels in this study were measured by looking at the results of measuring blood glucose levels using a glucometer after completing the brisk walking exercise at the last meeting. According to Widiasari et al. (2021) non-pharmacological management for DM sufferers consists of education, diet and physical exercise. Physical exercise is the third and very important aspect in controlling DM. Brisk walking is a type of moderate intensity aerobics that can keep blood glucose levels within the normal range. Regular physical exercise helps to control blood sugar (Hati and Muchsin, 2022).

Based on the results of relevant research and theory, it was found that of the 30 respondents in the study, the average post-test blood glucose level showed a significant decrease in blood glucose levels after brisk walking exercise, but still exceeded normal blood glucose levels. The decrease in blood glucose levels in the intervention group may not only be caused by the influence of brisk walking exercise, but the anti-hyperglycemia medication given also plays an important role in reducing blood glucose levels.

Results of research conducted in the West Denpasar Public Health Center II Working Area on 30 respondents in the intervention group and control group. The treatment given to the intervention group was brisk walking exercise for 30 minutes with a distance of 2km/hour for two weeks with a frequency of three times a week. Apart from that, respondents in the intervention group also took diabetes medication, while the control group only took diabetes medication without being given brisk walking exercise treatment.

Based on the results of statistical tests carried out on 30 research respondents, the results of statistical tests on blood glucose levels in the intervention group showed that the ρ-value was 0.001 (ρ<0.05), so it can be concluded that Ha failed to be rejected, which means there was a significant difference in blood glucose levels before and after being given brisk walking exercise to the intervention group. By doing brisk walking exercise regularly you can reduce blood glucose levels.

This research is in line with Damanik et al. (2019) regarding the effect of brisk walking on reducing blood sugar in type 2 DM patients seeking treatment at the Imelda Workers Indonesia Hospital in Medan, the ρ-value was 0.002 <0.05, which indicates the effect of brisk walking on reducing blood glucose levels in type 2 DM sufferers. 2. The same research was also carried out by Hati and Muchsin (2022), and the ρ-value was 0.0001, which means that there is an effect of brisk walking on reducing blood glucose levels in type II DM patients in the Batu Tunggal Community Health Center Working Area, NA IXX District.

Based on the results of relevant research and theory, it was found that there were differences in blood glucose levels before and after brisk walking exercise in diabetes mellitus sufferers in the Puskesmas

II Work Area, West Denpasar. Apart from regularly taking medication, doing physical exercise such as brisk walking exercise regularly can also reduce blood glucose levels in DM patients. When exercising, muscle cells are active and muscle contraction triggers the insertion of GLUT-4 into the plasma membrane of muscle cells even though there is no insulin. Active muscles will absorb and use some of the excess glucose in the blood and reduce the overall need for insulin (Sherwood, 2017).

The difference test between the control group and the intervention group was also carried out to determine the difference in the means of the intervention group and the control group. The pre-test and post-test difference test on blood glucose levels was carried out using the Mann-Whitney test. The results obtained in the pre-test difference test were ρ=0.589 (ρ>0.05), which means there was no significant difference in the pre-test of the control group and the intervention group. The results of the post-test difference in blood glucose levels were ρ=0.036 (ρ <0.05), which means there was a significant difference in the post-test blood glucose levels of the control group and the intervention group. West Denpasar Health Center II has not yet implemented this brisk walking exercise in treating DM. counseling and PISPK programs as a form of treating DM using pharmacological techniques which are carried out once a week. There is a prolanis program as a form of treating DM with non-pharmacological techniques that focus on physical exercise. This program may be able to implement brisk walking exercises as a treatment for diabetes mellitus.

CONCLUSION

Based on the results of the research that has been done, it can be concluded that there is a difference in blood glucose levels before and after brisk walking exercise in diabetes mellitus sufferers with a ρ-value of 0.001 (ρ<0.05). The results of the study also show that there is no difference in blood glucose levels in the control group and the group where brisk walking exercise was given before being given brisk walking exercise. blood glucose between the control group and the intervention group, whereas after brisk walking exercise there were differences in blood glucose levels.

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