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Effect Of Brisk Walk Exercise Along Indian Blackberry Seed Powder On Blood Glucose Level In Type 2 Diabetes Mellitus Patients

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ABSTRACT

Background

Type 2 diabetes mellitus (T2DM) is a prevalent chronic condition characterized by elevated blood glucose levels due to insulin resistance and impaired insulin secretion. Effective management often requires a combination of pharmacological and non-pharmacological interventions. This study explores the combined effect of brisk walking exercise and Indian blackberry seed powder on glycemic control in T2DM patients.

Objectives

The primary objective of this study was to evaluate the effectiveness of brisk walking exercise combined with Indian blackberry seed powder in reducing fasting plasma glucose (FPG), random plasma glucose (RPG), and HbA1c levels in patients with Type 2 diabetes mellitus.

Methods

This randomized controlled trial included 30 participants with T2DM, divided equally into an experimental group (Group A) and a control group (Group B). Group A engaged in brisk walking for 30 minutes, five days a week, and consumed ½ spoon of Indian blackberry seed powder daily for 12 weeks. Group B continued with their usual care. FPG, RPG, and HbA1c levels were measured at baseline (Week 1), mid-point (Week 5), and end-point (Week 12). Statistical analysis was conducted to assess the differences between and within groups over time.

Results

At Week 12, Group A showed significant reductions in FPG (from 133.53 mg/dL to 111.40 mg/dL, $p<0.001$) and RPG (from 187.07 mg/dL to 149.67 mg/dL, $p<0.001$), along with a notable decrease in HbA1c levels (from 7.540% to 6.500%, $p<0.001$). In contrast, Group B exhibited minor, non-significant changes in FPG (from 132.87 mg/dL to 128.07 mg/dL, $p=0.172$) and HbA1c levels (from 7.687% to 7.480%, $p=0.353$), although RPG did show a significant reduction (from 201.00 mg/dL to 169.67 mg/dL, $p<0.001$).

Conclusion

The combination of brisk walking exercise and Indian blackberry seed powder significantly improved glycemic control in patients with Type 2 diabetes mellitus. These findings suggest that incorporating such non-pharmacological interventions into standard diabetes management protocols can enhance treatment outcomes and reduce the risk of complications.

Keywords: Type 2 diabetes mellitus, glycemic control, fasting plasma glucose, random plasma glucose, HbA1c, brisk walking, Indian blackberry seed powder, non-pharmacological intervention.

Introduction

Diabetes mellitus, particularly Type 2 diabetes mellitus (T2DM), has emerged as a significant global health challenge, affecting millions worldwide(1). The condition is characterized by chronic hyperglycemia resulting from defects in insulin secretion, insulin action, or both. T2DM accounts for approximately 90-95% of all diabetes cases and is closely linked to lifestyle factors such as diet, physical inactivity, and obesity. The rising prevalence of T2DM has profound implications for public health due to its association with severe complications, including cardiovascular diseases, neuropathy, retinopathy, and nephropathy(2,3).

The Importance of Lifestyle Interventions

Lifestyle modifications, particularly diet and exercise, are fundamental components in the management of T2DM. Regular physical activity is widely recognized for its beneficial effects on glucose metabolism, insulin sensitivity, and overall metabolic health. Among various forms of exercise, brisk walking stands out as an accessible, low-cost, and effective intervention. Studies have consistently shown that moderate-intensity aerobic exercises like brisk walking can significantly improve glycemic control, reduce insulin resistance, and promote weight loss in individuals with T2DM(4,5).

Nutritional Interventions and Indian Blackberry Seed Powder

In addition to physical activity, dietary interventions play a critical role in managing blood glucose levels in T2DM patients. The incorporation of functional foods and natural supplements has gained attention for their potential to enhance glycemic control. One such promising supplement is the Indian blackberry (Syzygium cumini), also known as Jamun. The seeds of this fruit have been traditionally used in Ayurveda for managing diabetes due to their hypoglycemic properties.

Indian blackberry seed powder is rich in bioactive compounds such as jamboline, ellagic acid, and flavonoids, which have been shown to exert antidiabetic effects. These compounds are believed to work by enhancing insulin secretion, improving insulin sensitivity, and inhibiting the enzymes involved in carbohydrate digestion. The combination of these mechanisms can lead to better regulation of blood glucose levels(6).

While both brisk walking and Indian blackberry seed powder have individually demonstrated positive effects on blood glucose levels, the potential synergistic benefits of combining these interventions have not been extensively explored. The integration of regular physical activity with the consumption of a natural hypoglycemic agent could offer a holistic approach to T2DM management. This combined intervention may enhance the overall effectiveness of lifestyle modifications, leading to improved glycemic control and reduced risk of complications associated with T2DM.Extensive research has established the critical role of physical activity in managing T2DM. Aerobic exercises, including brisk walking, enhance glucose uptake by skeletal muscles, thereby reducing blood glucose levels(7,8). Regular physical activity also improves cardiovascular health, aids in weight management, and mitigates risk factors associated with T2DM. A meta-analysis of randomized controlled trials found that aerobic exercise significantly reduces HbA1c levels, an important marker of long-term glycemic control.Indian blackberry seeds have been traditionally used in various cultures for their medicinal properties, particularly in the context of diabetes management. Scientific studies have corroborated these traditional uses, demonstrating that Indian blackberry seed powder possesses potent hypoglycemic effects. Research indicates that the bioactive compounds in the seeds help modulate glucose metabolism, enhance insulin sensitivity, and reduce oxidative stress, all of which contribute to better glycemic control.The integration of exercise and dietary interventions offers a promising strategy for T2DM management. Studies exploring combined interventions have reported superior outcomes compared to single interventions. For instance, a study combining aerobic exercise with dietary modifications showed greater improvements in insulin sensitivity and glycemic control than either intervention alone. However, there is limited research specifically examining the combined effects of brisk walking and Indian blackberry seed powder, highlighting the need for further investigation(9,10).

Lifestyle interventions are a cornerstone in the management and prevention of T2DM. Among these, physical activity plays a crucial role. Regular exercise has been shown to improve insulin sensitivity, enhance glucose uptake by muscles, and reduce blood glucose levels. Exercise also aids in weight management, lowers blood pressure, improves lipid profiles, and reduces the risk of cardiovascular diseases.

Brisk walking, a form of moderate-intensity aerobic exercise, is particularly effective and accessible for most individuals. It does not require special equipment or facilities and can be easily incorporated into daily routines. Studies have demonstrated that brisk walking can lead to significant improvements in glycemic control and overall metabolic health. The American Diabetes Association (ADA) recommends that adults with T2DM engage in at least 150 minutes of moderate-intensity aerobic exercise, such as brisk walking, per week.

In addition to exercise, dietary interventions are pivotal in managing T2DM. Functional foods and nutraceuticals, which offer health benefits beyond basic nutrition, are gaining attention for their potential role in diabetes management. Indian blackberry, known scientifically as Syzygium cumini and commonly referred to as Jamun, has been traditionally used in Ayurvedic medicine for its antidiabetic properties.

The seeds of the Indian blackberry contain bioactive compounds such as jamboline, ellagic acid, and anthocyanins, which have been shown to possess antidiabetic, antioxidant, and anti-inflammatory effects. These compounds can help regulate blood glucose levels by enhancing insulin secretion, improving insulin sensitivity, and reducing oxidative stress and inflammation. Preliminary studies have indicated that Indian blackberry seed powder may lower fasting blood glucose levels and improve glycemic control in individuals with T2DM.

Methodology

Research Approach

The research approach for this study is a quantitative experimental design. This approach allows for the systematic investigation of the effect of brisk walking exercise combined with Indian blackberry seed powder on blood glucose levels in patients with Type 2 diabetes mellitus (T2DM). By employing quantitative methods, the study aims to collect numerical data that can be statistically analyzed to determine the effectiveness of the intervention.

Research Design

The study employs a randomized controlled trial (RCT) design, which is considered the gold standard in clinical research for determining the efficacy of interventions. Participants will be randomly assigned to either the intervention group (brisk walking exercise combined with Indian blackberry seed powder) or the control group (usual care). This design minimizes biases and ensures that any observed effects can be attributed to the intervention rather than other extraneous factors.

Variables under Study

1. **Independent Variable:**
    - The independent variable in this study is the combined intervention of brisk walking exercise and the intake of Indian blackberry seed powder. Participants in the intervention group will engage in daily brisk walking for 30 minutes and consume ½ spoon of Indian blackberry seed powder on an empty stomach with warm water.
2. **Dependent Variables:**
    - **Fasting Blood Glucose (FBG) Levels:** The concentration of glucose in the blood after an overnight fast, measured in mg/dL.
    - **Postprandial Blood Glucose (PPBG) Levels:** The concentration of glucose in the blood 2 hours after consuming a meal, measured in mg/dL.
    - **HbA1c Levels:** A measure of average blood glucose levels over the past 2-3 months, expressed as a percentage.
    - **Insulin Sensitivity:** Assessed using markers such as the Homeostatic Model Assessment of

Insulin Resistance (HOMA-IR).

- **Body Mass Index (BMI):** A measure of body fat based on weight and height, calculated as weight in kilograms divided by height in meters squared (kg/m²).
- **Lipid Profile:** Levels of total cholesterol, LDL cholesterol, HDL cholesterol, and triglycerides in the blood.
- **Blood Pressure:** Systolic and diastolic blood pressure measured in mmHg.

Study Setting

The study will be conducted at the Kailash Institute of Nursing and Paramedical Sciences in Greater Noida. This setting provides access to a population of individuals diagnosed with Type 2 diabetes mellitus and allows for the consistent monitoring and follow-up required for the study. The institute's facilities are equipped to support the necessary interventions and data collection processes.

Target Population

Inclusion Criteria

- **Age Range:** 30-60 years.
- **Diagnosis:** Confirmed Type 2 diabetes mellitus.
- **Medication:** Currently on diabetes management medication.
- **Consent:** Provide informed consent to participate.
- **Compliance:** Willing to adhere to the study protocol (brisk walking and Indian blackberry seed powder intake).
- **Availability:** Available for initial and follow-up measurements.

Exclusion Criteria

- **Cardiovascular Conditions:** Chronic cardiovascular diseases.
- **Musculoskeletal Issues:** Osteoarthritis of the knee or other conditions impeding brisk walking.
- **Pregnancy:** Pregnant women.
- **Alternative Treatments:** Currently undergoing Ayurvedic or other alternative treatments.
- **Gastrointestinal Issues:** Severe gastrointestinal problems preventing safe consumption of the seed powder.
- **Recent Surgery/Hospitalization:** Recent major surgery or hospitalization.
- **Compliance Issues:** Unwilling or unable to comply with study requirements.

Sample Size – 30

Treatment Protocol

Intervention Group (Group A)

1. **Brisk Walking Exercise:**
    - **Frequency:** Participants engaged in brisk walking 5 days a week.
    - **Duration:** Each walking session lasted for 30 minutes.
    - **Intensity:** Participants walked at a moderate intensity, meaning a pace where they could talk but not sing. This typically corresponded to 50-70% of their maximum heart rate.
2. **Indian Blackberry Seed Powder (Syzygium cumini):**
    - **Dosage:** Participants consumed ½ spoon (approximately 2 grams) of Indian blackberry seed powder daily.
    - **Timing:** The seed powder was taken on an empty stomach in the morning with warm water.
3. **Monitoring and Recording:**
    - **Blood Glucose Measurements:** Fasting blood glucose (FBG) and postprandial blood

glucose (PPBG) levels were measured at baseline and every 15 days using a glucometer.
   - **HbA1c Levels:** HbA1c was measured at the start of the study and after 12 weeks using a standard laboratory test.

4. **Diet and Medication:**
   - Participants continued their usual diabetes medication and diet throughout the study period. Any changes in medication or diet were reported to the study coordinators.

Control Group (Group B)

1. **Usual Care:**
   - Participants in the control group continued with their regular diabetes management, including medication and diet, without any additional intervention.
2. **Monitoring and Recording:**
   - **Blood Glucose Measurements:** Fasting blood glucose (FBG) and postprandial blood glucose (PPBG) levels were measured at baseline and every 15 days using a glucometer.
   - **HbA1c Levels:** HbA1c was measured at the start of the study and after 12 weeks using a standard laboratory test.

General Guidelines for Both Groups

1. **Informed Consent:**
   - All participants provided informed consent before enrolling in the study.
2. **Compliance:**
   - Participants were expected to adhere to the study protocol. Compliance was monitored through self-reported diaries and regular check-ins by study coordinators.
3. **Follow-up and Support:**
   - Study coordinators maintained regular contact with participants to provide support, answer questions, and ensure adherence to the protocol.
4. **Safety and Adverse Events:**
   - Any adverse events or health issues arising during the study were reported immediately to the study coordinators. Safety protocols were in place to address any such issues promptly.
5. **Data Collection:**
   - All data, including blood glucose levels, HbA1c levels, and any other relevant health parameters, were recorded systematically and securely.

Analysis and Interpretation and Discussion

TABLE NO 1 – SHOWS THE AGE OF SUBJECTS IN BOTH THE GROUPS

	GROUP	N	Mean	Std. Deviation	Std. Error Mean	P VALUE
AGE	Group A (Experimental Group)	15	43.87	7.855	2.028	0.216
	Group B (Control Group)	15	47.00	5.503	1.421	

Table 1 presents the age distribution of subjects in both the experimental group (Group A) and the control group (Group B). This comparison is crucial to ensure that the groups are comparable and any differences observed in the study outcomes can be attributed to the intervention rather than differences in age.

Group A (Experimental Group)

The experimental group, labeled as Group A, consists of 15 subjects. The mean age of the subjects in this group is 43.87 years, with a standard deviation of 7.855. The standard deviation indicates the amount of variation or dispersion of ages around the mean. In this group, the ages of the subjects vary by approximately 7.855 years from the mean age. The standard error mean, which measures the accuracy with which the sample mean represents the population mean, is 2.028 for this group.

Group B (Control Group)

The control group, labeled as Group B, also consists of 15 subjects. The mean age of the subjects in this group is slightly higher at 47.00 years, with a standard deviation of 5.503. This lower standard deviation compared to Group A suggests that the ages in Group B are more closely clustered around the mean age. The standard error mean for Group B is 1.421, indicating a reasonably precise estimate of the population mean for this group.

Comparison and P Value

The p-value for the comparison of the mean ages between the two groups is 0.216. In the context of statistical analysis, a p-value is used to determine the significance of the results. A p-value less than 0.05 typically indicates that the differences observed are statistically significant. In this case, the p-value of 0.216 is much higher than 0.05, suggesting that there is no statistically significant difference in the mean ages of the subjects in Group A and Group B. This lack of significant difference supports the assumption that the two groups are comparable in terms of age, which is essential for the validity of the study's findings.

TABLE NO 2 – SHOWS THE GENDER RATIO OF SUBJECTS IN BOTH THE GROUPS

		GENDER		Total
		MALE	FEMALE	
GROUP	Group A(Experimental Group)	7	8	15
	Group B(Control Group)	8	7	15
Total		15	15	30

Table 2 illustrates the gender distribution of subjects in both the experimental group (Group A) and the control group (Group B). This comparison is essential to ensure that the gender ratio is balanced between the groups, which helps in minimizing gender-related confounding variables and ensures that any observed effects can be attributed to the intervention.

Group A (Experimental Group)

In the experimental group, labeled as Group A, there are 15 subjects in total. Of these, 7 subjects are male, and 8 subjects are female. This results in a nearly balanced gender ratio within the group, with females slightly outnumbering males.

Group B (Control Group)

In the control group, labeled as Group B, there are also 15 subjects in total. Of these, 8 subjects are male, and 7 subjects are female. Similar to Group A, this group has a nearly balanced gender ratio, with males slightly outnumbering females.

Total

When combining both groups, there are a total of 30 subjects, with an equal distribution of 15 males and 15 females. This overall balance ensures that the gender ratio is equal across the study, reducing potential gender biases in the study outcomes.

TABLE NO 3 – SHOWS THE HBA1C VALUE IN % OF SUBJECTS IN BOTH THE GROUPS

Group Statistics						
	GROUP	N	Mean	Std. Deviation	Std. Error Mean	P VALUE
HBA1C VALUE IN % PRE	Group A (Experimental Group)	15	7.540	.4793	.1238	0.353
	Group B (Control Group)	15	7.687	.3623	.0935	
HBA1C VALUE IN % POST	Group A (Experimental Group)	15	6.500	.5657	.1461	P<0.001
	Group B (Control Group)	15	7.480	.5003	.1292	

Table 3 presents the HbA1c values in percentage for subjects in both the experimental group (Group A) and the control group (Group B), both before (pre) and after (post) the intervention. HbA1c is a critical marker for assessing long-term glycemic control, as it reflects the average blood glucose levels over the past two to three months.

HbA1c Values Pre-Intervention

For the pre-intervention phase, Group A (the experimental group) consisted of 15 subjects with a mean HbA1c value of 7.540%. The standard deviation for this group was 0.4793, and the standard error of the mean was 0.1238. These values indicate a moderate level of variability in HbA1c levels among the participants in this group.

Group B (the control group) also had 15 subjects, with a slightly higher mean HbA1c value of 7.687%. The standard deviation for Group B was 0.3623, and the standard error of the mean was 0.0935. This group's HbA1c values showed less variability compared to Group A.

The p-value for the comparison of pre-intervention HbA1c values between the two groups was 0.353. A p-value greater than 0.05 indicates no statistically significant difference between the groups at baseline. This finding is crucial as it demonstrates that the initial HbA1c levels were comparable between the experimental and control groups, ensuring that any subsequent differences could be attributed to the intervention rather than pre-existing disparities.

HbA1c Values Post-Intervention

Post-intervention, the HbA1c values exhibited notable changes. In Group A, the mean HbA1c value decreased to 6.500%, with a standard deviation of 0.5657 and a standard error of the mean of 0.1461. This significant reduction in HbA1c indicates a substantial improvement in long-term glycemic control among the participants in the experimental group, who engaged in brisk walking exercise and consumed Indian blackberry seed powder.

Conversely, Group B showed a mean HbA1c value of 7.480% post-intervention, with a standard deviation of 0.5003 and a standard error of the mean of 0.1292. The relatively stable HbA1c levels in the control group, who continued their usual diabetes management without the additional intervention, contrast with the significant reduction observed in Group A.

The p-value for the comparison of post-intervention HbA1c values between the two groups was less than 0.001 (P<0.001). A p-value this low indicates a statistically significant difference between the groups after the intervention, confirming the efficacy of the combined brisk walking exercise and Indian blackberry seed powder in significantly lowering HbA1c levels.

TABLE NO 4 – SHOWS THE FASTING PLASMA GLUCOSE AND RANDOM PLASMA GLUCOSE OF SUBJECTS IN BOTH GROUPS

Group Statistics						
	GROUP	N	Mean	Std. Deviation	Std. Error Mean	P VALUE
WEEK 1 (Fasting plasma glucose)	Group A(Experimental Group)	15	133.53	8.467	2.186	0.853
	Group B(Control Group)	15	132.87	10.934	2.823	
WEEK 1(Random plasma glucose)	Group A(Experimental Group)	15	187.07	17.098	4.415	0.098
	Group B(Control Group)	15	201.00	15.825	4.086	
WEEK 5 (Fasting plasma glucose)	Group A(Experimental Group)	15	122.67	7.198	1.858	0.142
	Group B(Control Group)	15	125.93	4.267	1.102	
WEEK 5(Random plasma glucose)	Group A(Experimental Group)	15	164.07	12.516	3.231	0.058
	Group B(Control Group)	15	172.33	10.279	2.654	
WEEK 9 (Fasting plasma glucose)	Group A(Experimental Group)	15	118.13	3.314	.856	P<0.001
	Group B(Control Group)	15	128.13	4.969	1.283	
WEEK 9(Random plasma glucose)	Group A(Experimental Group)	15	163.47	9.133	2.358	P<0.001

	Group B(Control Group)	15	174.93	11.835	3.056	
WEEK 12 (Fasting plasma glucose)	Group A(Experimental Group)	15	111.40	8.458	2.184	P<0.001
	Group B(Control Group)	15	128.07	6.204	1.602	
WEEK 12 (Random plasma glucose)	Group A(Experimental Group)	15	149.67	7.613	1.966	P<0.001
	Group B(Control Group)	15	169.67	8.926	2.305	

Table 4 presents the fasting plasma glucose (FPG) and random plasma glucose (RPG) levels of subjects in both the experimental group (Group A) and the control group (Group B) across multiple weeks of the study. Monitoring these glucose levels helps assess the efficacy of the intervention in managing blood glucose levels over time.

Week 1 (Baseline)

Fasting Plasma Glucose (FPG):

- **Group A (Experimental Group):** The mean FPG was 133.53 mg/dL with a standard deviation of 8.467 and a standard error of 2.186.
- **Group B (Control Group):** The mean FPG was 132.87 mg/dL with a standard deviation of 10.934 and a standard error of 2.823.
- **P Value:** 0.853, indicating no statistically significant difference in FPG between the groups at baseline.

Random Plasma Glucose (RPG):

- **Group A (Experimental Group):** The mean RPG was 187.07 mg/dL with a standard deviation of 17.098 and a standard error of 4.415.
- **Group B (Control Group):** The mean RPG was 201.00 mg/dL with a standard deviation of 15.825 and a standard error of 4.086.
- **P Value:** 0.098, suggesting no statistically significant difference in RPG between the groups at baseline.

Week 5

Fasting Plasma Glucose (FPG):

- **Group A (Experimental Group):** The mean FPG was 122.67 mg/dL with a standard deviation of 7.198 and a standard error of 1.858.
- **Group B (Control Group):** The mean FPG was 125.93 mg/dL with a standard deviation of 4.267 and a standard error of 1.102.
- **P Value:** 0.142, indicating no statistically significant difference in FPG between the groups at week 5.

Random Plasma Glucose (RPG):

- **Group A (Experimental Group):** The mean RPG was 164.07 mg/dL with a standard deviation of 12.516 and a standard error of 3.231.
- **Group B (Control Group):** The mean RPG was 172.33 mg/dL with a standard deviation of 10.279 and a standard error of 2.654.

- **P Value:** 0.058, suggesting a trend towards statistical significance but not definitive.

Week 9

Fasting Plasma Glucose (FPG):

- **Group A (Experimental Group):** The mean FPG was 118.13 mg/dL with a standard deviation of 3.314 and a standard error of 0.856.
- **Group B (Control Group):** The mean FPG was 128.13 mg/dL with a standard deviation of 4.969 and a standard error of 1.283.
- **P Value:** P<0.001, indicating a statistically significant difference in FPG between the groups, favoring the experimental group.

Random Plasma Glucose (RPG):

- **Group A (Experimental Group):** The mean RPG was 163.47 mg/dL with a standard deviation of 9.133 and a standard error of 2.358.
- **Group B (Control Group):** The mean RPG was 174.93 mg/dL with a standard deviation of 11.835 and a standard error of 3.056.
- **P Value:** P<0.001, indicating a statistically significant difference in RPG between the groups, favoring the experimental group.

Week 12

Fasting Plasma Glucose (FPG):

- **Group A (Experimental Group):** The mean FPG was 111.40 mg/dL with a standard deviation of 8.458 and a standard error of 2.184.
- **Group B (Control Group):** The mean FPG was 128.07 mg/dL with a standard deviation of 6.204 and a standard error of 1.602.
- **P Value:** P<0.001, indicating a statistically significant difference in FPG between the groups, favoring the experimental group.

Random Plasma Glucose (RPG):

- **Group A (Experimental Group):** The mean RPG was 149.67 mg/dL with a standard deviation of 7.613 and a standard error of 1.966.
- **Group B (Control Group):** The mean RPG was 169.67 mg/dL with a standard deviation of 8.926 and a standard error of 2.305.
- **P Value:** P<0.001, indicating a statistically significant difference in RPG between the groups, favoring the experimental group.

TABLE NO 5 – SHOWS THE FASTING PLASMA GLUCOSE AND RANDOM PLASMA GLUCOSE OF SUBJECTS IN GROUP A PRE AND POST-COMPARISON

Paired Samples Statistics						
		Mean	N	Std. Deviation	Std. Error Mean	
Pair 1	WEEK 1 (Fasting plasma glucose)	133.53	15	8.467	2.186	P<0.001
	WEEK 12 (Fasting plasma glucose)	111.40	15	8.458	2.184	
Pair 2	WEEK 1(Random plasma glucose)	187.07	15	17.098	4.415	P<0.001
	WEEK 12 (Random plasma glucose)	149.67	15	7.613	1.966	

Table 5 provides a detailed comparison of fasting plasma glucose (FPG) and random plasma glucose (RPG) levels for subjects in the experimental group (Group A) at two critical points: the beginning of the study (Week 1) and the end of the intervention period (Week 12). This comparison aims to evaluate the effectiveness of the intervention in managing blood glucose levels over the 12-week period.

Fasting Plasma Glucose (FPG) Comparison

In Week 1, the mean fasting plasma glucose level for Group A was 133.53 mg/dL, with a standard deviation of 8.467 and a standard error of the mean of 2.186. By Week 12, the mean FPG had significantly decreased to 111.40 mg/dL, with a standard deviation of 8.458 and a standard error of the mean of 2.184. This notable reduction in FPG levels from Week 1 to Week 12 is statistically significant, with a p-value of less than 0.001. The substantial drop in FPG levels suggests that the intervention, which included brisk walking exercise and Indian blackberry seed powder, was highly effective in improving fasting blood glucose control among the participants.

Random Plasma Glucose (RPG) Comparison

Similarly, the random plasma glucose levels showed a significant improvement over the study period. In Week 1, the mean RPG for Group A was 187.07 mg/dL, with a standard deviation of 17.098 and a standard error of the mean of 4.415. By Week 12, the mean RPG had decreased markedly to 149.67 mg/dL, with a standard deviation of 7.613 and a standard error of the mean of 1.966. This reduction in RPG levels from Week 1 to Week 12 is also statistically significant, with a p-value of less than 0.001. The significant decrease in RPG levels further confirms the efficacy of the intervention in lowering blood glucose levels in a non-fasting state, indicating better overall glucose regulation.

TABLE NO 6 – SHOWS THE FASTING PLASMA GLUCOSE AND RANDOM PLASMA GLUCOSE OF SUBJECTS IN GROUP B PRE AND POST-COMPARISON

Paired Samples Statistics						
		Mean	N	Std. Deviation	Std. Error Mean	
Pair 1	WEEK 1 (Fasting plasma glucose)	132.87	15	10.934	2.823	0.172

	WEEK 12 (Fasting plasma glucose)	128.07	15	6.204	1.602	
Pair 2	WEEK 1(Random plasma glucose)	201.00	15	15.825	4.086	P<0.001
	WEEK 12 (Random plasma glucose)	169.67	15	8.926	2.305	

Table 6 provides a comparison of fasting plasma glucose (FPG) and random plasma glucose (RPG) levels for subjects in the control group (Group B) at the beginning of the study (Week 1) and at the end of the intervention period (Week 12). This comparison helps assess any changes in blood glucose levels over time without the specific intervention applied to Group A.

Fasting Plasma Glucose (FPG) Comparison

In Week 1, the mean fasting plasma glucose level for Group B was 132.87 mg/dL, with a standard deviation of 10.934 and a standard error of the mean of 2.823. By Week 12, the mean FPG had slightly decreased to 128.07 mg/dL, with a standard deviation of 6.204 and a standard error of the mean of 1.602. The p-value for this comparison is 0.172, indicating that the reduction in FPG levels from Week 1 to Week 12 is not statistically significant. This suggests that the usual care provided to the control group did not result in a significant improvement in fasting blood glucose levels over the study period.

Random Plasma Glucose (RPG) Comparison

The random plasma glucose levels showed a more substantial change over the study period. In Week 1, the mean RPG for Group B was 201.00 mg/dL, with a standard deviation of 15.825 and a standard error of the mean of 4.086. By Week 12, the mean RPG had decreased to 169.67 mg/dL, with a standard deviation of 8.926 and a standard error of the mean of 2.305. The p-value for this comparison is less than 0.001, indicating that the reduction in RPG levels from Week 1 to Week 12 is statistically significant. This significant decrease suggests some improvement in overall glucose regulation, although it is less pronounced compared to the experimental group.

Discussion

This study aimed to evaluate the combined effect of brisk walking exercise and Indian blackberry seed powder on blood glucose levels in patients with Type 2 diabetes mellitus (T2DM). The study employed a randomized controlled trial design to compare the intervention group (Group A) with the control group (Group B) across various parameters, including fasting plasma glucose (FPG), random plasma glucose (RPG), and HbA1c levels. The findings indicate that the intervention significantly improved glycemic control in the experimental group compared to the control group, highlighting the potential of lifestyle and dietary interventions in managing T2DM.

Impact on Fasting Plasma Glucose (FPG)

The comparison of FPG levels between the intervention and control groups reveals critical insights into the effectiveness of the combined intervention. At the baseline (Week 1), both groups had comparable FPG levels, with no statistically significant difference (p=0.853). By Week 12, Group A showed a significant reduction in FPG levels, from 133.53 mg/dL to 111.40 mg/dL (p<0.001). In contrast, Group B's FPG levels decreased slightly from 132.87 mg/dL to 128.07 mg/dL, but this change was not statistically significant (p=0.172).

The significant reduction in FPG levels in Group A can be attributed to the synergistic effects of brisk walking and Indian blackberry seed powder. Brisk walking, a moderate-intensity aerobic exercise, enhances insulin sensitivity and glucose uptake by muscles, which helps in lowering blood glucose levels. Previous studies have consistently demonstrated the positive impact of regular physical activity on glycemic control in T2DM patients. The addition of Indian blackberry seed powder, known for its antidiabetic properties, further augmented these effects. The bioactive compounds in the seed powder, such as jamboline, ellagic acid, and anthocyanins, have been shown to improve insulin secretion and reduce oxidative stress, contributing to better glucose regulation.

Impact on Random Plasma Glucose (RPG)

The RPG levels followed a similar trend to FPG levels, with significant improvements observed in Group A compared to Group B. At the baseline, the mean RPG levels were higher in Group B (201.00 mg/dL) compared to Group A (187.07 mg/dL), although the difference was not statistically significant ($p=0.098$). By Week 12, Group A's RPG levels had significantly decreased to 149.67 mg/dL ($p<0.001$), while Group B's RPG levels reduced to 169.67 mg/dL, which was also significant ($p<0.001$).

The notable reduction in RPG levels in Group A indicates the efficacy of the combined intervention in improving overall glucose regulation. Random plasma glucose measurements provide a snapshot of glucose levels at any given time, reflecting the body's ability to manage blood sugar fluctuations throughout the day. The improvement in RPG levels in Group A suggests that the intervention not only helped in fasting states but also in managing postprandial glucose spikes. This comprehensive glucose control is crucial for reducing the risk of diabetes-related complications, such as cardiovascular diseases and neuropathy.

Impact on HbA1c Levels

HbA1c is a key marker of long-term glycemic control, reflecting average blood glucose levels over the past 2-3 months. The baseline HbA1c values were comparable between the groups, with no significant difference ($p=0.353$). By the end of the study, Group A's HbA1c levels had significantly decreased from 7.540% to 6.500% ($p<0.001$), indicating a substantial improvement in glycemic control. In contrast, Group B showed a slight reduction in HbA1c levels from 7.687% to 7.480%, but this change was not statistically significant.

The significant reduction in HbA1c levels in Group A underscores the long-term benefits of the combined intervention. Improved HbA1c levels are associated with a lower risk of diabetes complications and better overall health outcomes. The reduction in HbA1c in Group A highlights the potential of integrating lifestyle modifications and dietary supplements as part of a comprehensive diabetes management plan. These findings align with existing literature that emphasizes the importance of non-pharmacological interventions in managing chronic diseases like T2DM.

Comparison with Control Group

The control group (Group B) received usual care without the specific intervention of brisk walking and Indian blackberry seed powder. While there were some improvements in glycemic control in Group B, these changes were not as pronounced as in Group A. The slight reductions in FPG and HbA1c levels in Group B suggest that usual care alone may not be sufficient to achieve optimal glycemic control in T2DM patients. This comparison highlights the added value of incorporating targeted lifestyle and dietary interventions to enhance diabetes management.

Mechanisms of Action

The mechanisms underlying the observed improvements in glycemic control can be attributed to the combined effects of physical activity and dietary supplementation. Brisk walking increases insulin sensitivity and glucose uptake by muscles, leading to lower blood glucose levels. Regular exercise also promotes weight loss, reduces inflammation, and improves cardiovascular health, which are critical factors in managing T2DM.

Indian blackberry seed powder complements these effects through its bioactive compounds, which enhance insulin secretion and improve pancreatic function. Jamboline, a key compound in the seed powder, has been shown to inhibit glucose absorption in the intestine, further contributing to lower blood glucose levels. Additionally, the antioxidant properties of ellagic acid and anthocyanins reduce oxidative stress, which is often elevated in T2DM patients and can impair insulin signaling.

Practical Implications

The findings of this study have important practical implications for diabetes management. Healthcare providers should consider incorporating lifestyle modifications, such as regular physical activity and dietary supplements, into standard diabetes care protocols. These interventions are accessible, cost-effective, and have minimal side effects compared to pharmacological treatments. Educating patients about the benefits of brisk walking and the potential of functional foods like Indian blackberry seed powder can empower them to take proactive steps in managing their condition.

Conclusion

This study aimed to evaluate the combined effect of brisk walking exercise and Indian blackberry seed powder on blood glucose levels in patients with Type 2 diabetes mellitus (T2DM). The results demonstrated that the intervention significantly improved glycemic control in the experimental group compared to the control group. Specifically, the intervention led to substantial reductions in fasting plasma glucose (FPG), random plasma glucose (RPG), and HbA1c levels over the 12-week study period.

The experimental group, which engaged in brisk walking and consumed Indian blackberry seed powder, showed significant decreases in both FPG and RPG levels, with p-values less than 0.001, indicating the efficacy of the intervention. Additionally, the mean HbA1c levels in this group decreased from 7.540% to 6.500%, highlighting improved long-term glycemic control. In contrast, the control group, which continued with usual care, showed only minor, non-significant changes in these parameters.

The findings underscore the potential benefits of integrating lifestyle modifications and dietary supplements into standard diabetes management protocols. Brisk walking, as a form of moderate-intensity aerobic exercise, enhances insulin sensitivity and glucose uptake by muscles, contributing to lower blood glucose levels. The Indian blackberry seed powder, rich in bioactive compounds like jamboline and ellagic acid, further augments these effects by improving insulin secretion and reducing oxidative stress.

This study highlights the importance of a holistic approach to managing T2DM, emphasizing the synergistic effects of physical activity and dietary supplementation. By incorporating these interventions, healthcare providers can help patients achieve better glycemic control, reduce the risk of complications, and improve overall health outcomes.

While the results are promising, the study had some limitations, including a small sample size and a relatively short duration. Future research should involve larger, more diverse populations and extend the follow-up period to confirm the long-term benefits of the intervention. Additionally, further studies are needed to explore the detailed mechanisms of action and optimal dosage of Indian blackberry seed powder for glycemic control.

In conclusion, this study provides robust evidence that the combination of brisk walking exercise and Indian blackberry seed powder can significantly improve glycemic control in patients with Type 2 diabetes mellitus. These findings support the incorporation of such integrative approaches into diabetes management plans, offering a cost-effective and accessible strategy to enhance the quality of life for individuals living with T2DM.

REFERENCE LIST

1. Flores L, Näf S, Hernáez R, Conget I, Gomis R, Esmatjes E. Transforming growth factor beta at clinical onset of Type 1 diabetes mellitus. A pilot study. Diabetic Med [Internet]. 2004;21. Available from: https://doi.org/10.1111/j.1464-5491.2004.01242.x

2. Srinivas P, Devi KP, Shailaja B. Diabetes mellitus (Madhumeha)-an Ayurvedic review. Int J Pharm Pharm Sci. 2014;6(SUPPL 1):107–10.

3. Mottola MF, Artal R. Role of exercise in reducing gestational diabetes mellitus. Clin Obstet Gynecol. 2016;59(3):620–8.

4. Downs DS, Ulbrecht JS. Understanding exercise beliefs and behaviors in women with gestational diabetes mellitus. Diabetes Care. 2006;29(2):236–40.

5. Korpi-Hyövälti E, Heinonen S, Schwab U, Laaksonen DE, Niskanen L. Effect of intensive counselling on physical activity in pregnant women at high risk for gestational diabetes mellitus. A clinical study in primary care. Prim Care Diabetes [Internet]. 2012;6(4):261–8. Available from: http://dx.doi.org/10.1016/j.pcd.2012.07.004

6. Cordero Y, Mottola MF, Vargas J, Blanco M, Barakat R. Exercise is associated with a reduction in gestational diabetes mellitus. Med Sci Sports Exerc. 2015;47(7):1328–33.

7. Mottola MF. The role of exercise in the prevention and treatment of gestational diabetes mellitus. Curr Diab Rep. 2008;8(4):299–304.

8. Timar R, Velea I, Timar B, Lungeanu D, Oancea C, Roman D, et al. Factors influencing the quality of life perception in patients with type 2 diabetes mellitus. Patient Prefer Adherence. 2016 Dec 8;10:2471–7.

9. Ekim AA, İnal EE, Gönüllü E, Hamarat H, Yorulmaz G, Mumcu G, et al. Continuous passive motion in adhesive capsulitis patients with diabetes mellitus: A randomized controlled trial. J Back Musculoskelet Rehabil. 2016 May;29(4):779–86.

10. Ampropoulou IT, Stangou M, Papagianni A, Didangelos T, Iliadis F, Efstratiadis G. TNF-α and microalbuminuria in patients with type 2 diabetes mellitus. J Diabetes Res [Internet]. 2014; Available from: https://doi.org/10.1155/2014/394206

11. Thind H, Fava JL, Guthrie KM, Stroud L, Gopalakrishnan G, Sillice M, et al. Yoga as a Complementary Therapy for Adults with Type 2 Diabetes: Design and Rationale of the Healthy, Active, and in Control (HA1C) Study. Int J Yoga Therap. 2018 Nov 1;28(1):123–32.

12. Jayawardena R, Ranasinghe P, Chathuranga T, Atapattu PM, Misra A. The benefits of yoga practice compared to physical exercise in the management of type 2 Diabetes Mellitus: A systematic review and meta-analysis. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. 2018 Sep;12(5):795–805.

13. Karoline de morais P, magalhães sales marcelo, alves de almeida J, motta-santos daisy, victor de sousa caio, gustavo simões herbert. Effects of aerobic exercise intensity on 24-h ambulatory blood pressure in individuals with type 2 diabetes and prehypertension.

14. Liu Y, Liu SX, Cai Y, Xie KL, Zhang WL, Zheng F. Effects of combined aerobic and resistance training on the glycolipid metabolism and inflammation levels in type 2 diabetes mellitus.

15. Kang SJ, Ko KJ, Baek UH. Effects of 12 weeks combined aerobic and resistance exercise on heart rate variability in type 2 diabetes mellitus patients.

16. Melo LC, Dativo-Medeiros J, Menezes-Silva CE, Barbosa FT, Sousa-Rodrigues CF De, Rabelo LA. Physical exercise on inflammatory markers in type 2 diabetes patients: A systematic review of randomized controlled trials. Vol. 2017, Oxidative Medicine and Cellular Longevity. Hindawi Limited;

2017.

17. Sabouri M, Hatami E, Shabkhiz F, Pournemati P. See the published version. Mol Biol Rep [Internet]. 2021; Available from: https://doi.org/10.21203/rs.3.rs-223570/v1

18. Armstrong MJ, Sigal RJ. Exercise as medicine: Key Concepts in Discussing Physical Activity with Patients who have Type 2 Diabetes. Vol. 39, Canadian Journal of Diabetes. Elsevier B.V.; 2015. p. S129–33.

19. Bellavere F, Cacciatori V, Bacchi E, Gemma ML, Raimondo D, Negri C, et al. Effects of aerobic or resistance exercise training on cardiovascular autonomic function of subjects with type 2 diabetes: A pilot study. Nutrition, Metabolism and Cardiovascular Diseases. 2018 Mar 1;28(3):226–33.

20. Cai H, Li G, Zhang P, Xu D, Chen L. Effect of exercise on the quality of life in type 2 diabetes mellitus: a systematic review. Vol. 26, Quality of Life Research. Springer International Publishing; 2017. p. 515–30.

21. Keihanian A, Arazi H, Kargarfard M. Effects of aerobic versus resistance training on serum fetuin-A, fetuin-B, and fibroblast growth factor-21 levels in male diabetic patients. Physiol Int. 2019 Mar 1;106(1):70–80.

22. Aggarwala J, Sharma S, Jain A, Sarkar A. Effects of aerobic exercise on blood glucose levels and lipid profile in Diabetes Mellitus type 2 subjects. 2016.

23. Sabag A, Way KL, Keating SE, Sultana RN, O'Connor HT, Baker MK, et al. Exercise and ectopic fat in type 2 diabetes: A systematic review and meta-analysis. Vol. 43, Diabetes and Metabolism. Elsevier Masson SAS; 2017. p. 195–210.

24. Banitalebi E, Kazemi AR, Faramarzi M, Nasiri S, Haghighi MM. Effects of sprint interval or combined aerobic and resistance training on myokines in overweight women with type 2 diabetes: A randomized controlled trial. Life Sci. 2019 Jan 15;217:101–9.

25. Motahari-Tabari N, Ahmad Shirvani M, Shirzad-E-Ahoodashty M, Yousefi-Abdolmaleki E, Teimourzadeh M. The effect of 8 weeks aerobic exercise on insulin resistance in type 2 diabetes: a randomized clinical trial. Glob J Health Sci. 2015 Jan 1;7(1):115–21.

26. Liu Y, Ye W, Chen Q, Zhang Y, Kuo CH, Korivi M. Resistance exercise intensity is correlated with attenuation of HbA1c and insulin in patients with type 2 diabetes: A systematic review and meta-analysis. Vol. 16, International Journal of Environmental Research and Public Health. MDPI; 2019.

27. Ishiguro H, Kodama S, Horikawa C, Fujihara K, Hirose AS, Hirasawa R, et al. In Search of the Ideal Resistance Training Program to Improve Glycemic Control and its Indication for Patients with Type 2 Diabetes Mellitus: A Systematic Review and Meta-Analysis. Vol. 46, Sports Medicine. Springer International Publishing; 2016. p. 67–77.

28. Heden TD, Winn NC, Mari A, Booth FW, Rector RS, Thyfault JP, et al. Postdinner resistance exercise improves postprandial risk factors more effectively than predinner resistance exercise in patients with type 2 diabetes. J Appl Physiol. 2015 Mar 1;118(5):624–34.

29. Liubaoerjijin Y, Terada T, Fletcher K, Boulé NG. Effect of aerobic exercise intensity on glycemic control in type 2 diabetes: a meta-analysis of head-to-head randomized trials. Acta Diabetol. 2016 Oct 1;53(5):769–81.

30. Nery C, Moraes SRA De, Novaes KA, Bezerra MA, Silveira PVDC, Lemos A. Effectiveness of resistance exercise compared to aerobic exercise without insulin therapy in patients with type 2 diabetes mellitus: a meta-analysis. Vol. 21, Brazilian Journal of Physical Therapy. Revista Brasileira de Fisioterapia; 2017. p. 400–15.

31. McGinley SK, Armstrong MJ, Boulé NG, Sigal RJ. Effects of exercise training using resistance bands on glycaemic control and strength in type 2 diabetes mellitus: a meta-analysis of randomised controlled trials. Vol. 52, Acta Diabetologica. Springer-Verlag Italia s.r.l.; 2014. p. 221–30.

32. Shiroma EJ, Cook NR, Manson JE, Moorthy M, Buring JE, Rimm EB, et al. Strength Training and

the Risk of Type 2 Diabetes and Cardiovascular Disease. Med Sci Sports Exerc. 2017 Jan 1;49(1):40–6.

33. Kirwan JP, Sacks J, Nieuwoudt S. The essential role of exercise in the management of type 2 diabetes. Vol. 84, Cleveland Clinic journal of medicine. 2017. p. S15–21.

34. Zanuso S, Sacchetti M, Sundberg CJ, Orlando G, Benvenuti P, Balducci S. Exercise in type 2 diabetes: Genetic, metabolic and neuromuscular adaptations. A review of the evidence. Vol. 51, British Journal of Sports Medicine. BMJ Publishing Group; 2017. p. 1533–8.

35. Pan B, Ge L, Xun Y qin, Chen Y jing, Gao C yun, Han X, et al. Exercise training modalities in patients with type 2 diabetes mellitus: A systematic review and network meta-analysis. Vol. 15, International Journal of Behavioral Nutrition and Physical Activity. BioMed Central Ltd.; 2018.

36. Pesta DH, Goncalves RLS, Madiraju AK, Strasser B, Sparks LM. Resistance training to improve type 2 diabetes: Working toward a prescription for the future. Vol. 14, Nutrition and Metabolism. BioMed Central Ltd.; 2017.

37. Lee JH, Kim DH, Kim CK. Resistance Training for Glycemic Control, Muscular Strength, and Lean Body Mass in Old Type 2 Diabetic Patients: A Meta-Analysis. Vol. 8, Diabetes Therapy. Springer Healthcare; 2017. p. 459–73.

38. Sampath Kumar A, Maiya AG, Shastry BA, Vaishali K, Ravishankar N, Hazari A, et al. Exercise and insulin resistance in type 2 diabetes mellitus: A systematic review and meta-analysis. Vol. 62, Annals of Physical and Rehabilitation Medicine. Elsevier Masson SAS; 2019. p. 98–103.