ISSN: 3005-8449
IRABCS
https://irabcs.com
INNOVATIVE RESEARCH IN APPLIED, BIOLOGICAL AND CHEMICAL SCIENCES

Research Article

IRABCS, vol. 2, issue 2, pp. 248-253, 2024
Received: July 28, 2024
Revised: December 24, 2024
Accepted: December 24, 2024
https://doi.org/10.62497/IRABCS.2024.66

Assessing the Efficacy of Plant-Based Diets in Managing Type 2 Diabetes and Cardiovascular Health

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How to cite: Ahmad A, Anwar S, Altaf U, Batool SM, Abubakar M, Khan T. Assessing the Efficacy of Plant-Based Diets in Managing Type 2 Diabetes and Cardiovascular Health. IRABCS. 2024. vol. 2, issue 2, pp. 248-253. https://doi.org/10.62497/IRABCS.2024.66. Available from: https://irabcs.com/ojs/article/view/66

Abstract

Background: The purpose of this research was to evaluate how well plant-based diets may improve cardiovascular health and manage Type 2 Diabetes Mellitus (T2DM).

Methods: A 12-month randomized controlled experiment with 156 T2DM subjects was carried out at KTH Peshawar. A control group (n=78) and a plant-based diet group (n=78) were randomly allocated to the participants. Changes in HbA1c, fasting blood glucose, blood pressure, lipid profiles, and C-reactive protein (CRP) were among the primary outcomes. The SF-36 questionnaire was used to assess quality of life. Chi-square and t-tests were used in the statistical analysis.

Results: In comparison to the control group, the plant-based diet group demonstrated significant reductions in LDL cholesterol "(-19.2 mg/dL vs. -5.4 mg/dL; $p<0.01$), fasting blood glucose (-22.7 mg/dL vs. -10.3 mg/dL; $p<0.01$), systolic blood pressure (-11.5 mmHg vs. -5.3 mmHg; $p<0.01$), diastolic blood pressure (-7.8 mmHg vs. -2.7 mmHg; $p<0.01$), LDL cholesterol (-19.2 mg/dL vs. -5.4 mg/dL; $p<0.01$), and CRP (-1.4 mg/L vs. -0.4 mg/L; $p<0.01$)" were all significantly lower in the plant-based diet group. The plant-based group had a substantial rise in HDL cholesterol (+6.5 mg/dL vs. +2.3 mg/dL; $p<0.01$). In the categories of vitality, general health, and physical functioning, the plant-based group's quality of life ratings increased considerably ($p<0.05$).

Conclusion: For those with type 2 diabetes, plant-based diets considerably enhance glycemic management, cardiovascular health indicators, inflammatory markers, and quality of life. These results provide credence to the use of plant-based dietary approaches in the treatment of type 2 diabetes and cardiovascular disease.

Keywords: type 2 diabetes mellitus, plant-based diet, cardiovascular health, glycemic control, randomized controlled trial, inflammatory markers, quality of life

Introduction

Two of the most common and crippling chronic illnesses in the world, type 2 diabetes mellitus (T2DM) and cardiovascular disease (CVD), present serious public health issues. Obesity, physical inactivity, and eating habits are among the lifestyle variables that are strongly associated with both illnesses. Effective, long-term management approaches that go beyond traditional pharmaceutical therapies are desperately needed as the prevalence of T2DM and CVD rises [1]. Traditionally, medication and lifestyle changes including increased exercise and weight reduction are used to treat T2DM and CVD. Although these methods may be successful, they may not be enough to manage illnesses over the long term since they do not address the underlying causes of the diseases [2, 3]. The potential involvement of dietary treatments, especially plant-based diets, in the management and prevention of chronic illnesses has garnered increasing attention in recent years [4].

Plant-based diets focus on whole, barely prepared plant foods like fruits, veggies, whole grains, beans, nuts, and seeds, and limit or get rid of animal products. There is little cholesterol and heavy fat in these foods, but they have a lot of fiber, vitamins, minerals, and phytochemicals. A lot of research has shown that plant-based meals are linked to better digestive health, better general health, and a lower chance of getting chronic illnesses [5-7]. More specifically, plant-based meals have been shown to help people with type 2 diabetes better control their blood sugar by making insulin work better and lowering blood sugar levels. These foods also lower the chance of CVD because they make blood pressure, inflammation, and cholesterol levels better. Even though these results are good, more study is still needed to find

out how well and how often plant-based meals can help treat type 2 diabetes and heart disease in the long run [8-10].

The aim of this study is to evaluate the impact of plant-based diets on the glycemic control and cardiovascular health of individuals with type 2 diabetes. As part of a comprehensive assessment of clinical outcomes, we examined blood pressure, body weight, lipid profiles, HbA1c, blood glucose levels, and inflammatory markers. We also examined changes in quality of life and dietary adherence during the course of the experiment. By providing solid information on the potential benefits of plant-based dietary treatments, this research aims to assist healthcare practitioners in suggesting suitable dietary options for the treatment of T2DM and CVD. As a consequence, dietary suggestions will be informed. The findings of this study imply that plant-based diets could be a useful and effective strategy to treat two of the most significant health concerns of our day, which might have a significant effect on general health. The study contributes to the growing body of evidence that suggests dietary treatments should be a regular part of care for individuals with T2DM and CVD in order to improve patient outcomes and quality of life.

Materials and methods

The research was carried out for a duration of one year, from June 2023 to May 2024, at the Khyber Teaching Hospital in Peshawar. The main objective was to evaluate the effectiveness of plant-based diets in the management of cardiovascular health and type 2 diabetes mellitus (T2DM).

With a 95% confidence level and 80% power, we were able to identify a significant difference in glycemic control and cardiovascular health markers using a sample size of 156 individuals, which was determined by power analysis. This computation took into account a 15% projected dropout rate as well as an expected medium impact magnitude.

The outpatient diabetes and cardiology clinics at KTH were the source of participants. Adults between the ages of 30-65 having a verified diagnosis of type 2 diabetes and at least one cardiovascular risk factor—such as obesity, dyslipidemia, or hypertension—met the inclusion criteria. Significant comorbidities, pregnancy, following a plant-based diet for the previous six months, and being unable to provide informed permission were all grounds for exclusion.

Following the acquisition of written informed permission, individuals were randomized to either the control group, which stuck to their regular diet, or the intervention group, which adopted a plant-based diet. The plant-based diet was explained in detail to the intervention group, including with meal planning, recipes, and frequent check-ins with a nutritionist, to help them stick to it. General dietary recommendations based on recommended care standards for type 2 diabetes and cardiovascular health was given to the control group.

A baseline set of data was gathered, including demographics, medical background, food preferences, and levels of physical activity. A baseline, six months, and twelve months' worth of clinical outcomes were assessed. Changes in glycemic control (as determined by fasting blood glucose levels and HbA1c) and cardiovascular health indicators (as determined by blood pressure, lipid profiles, body weight, and markers of inflammation such C-reactive protein) were the main outcomes. The SF-36 questionnaire was used to evaluate improvements in quality of life, and self-reported dietary records and sporadic 24-hour meal recalls were used to track dietary adherence.

Version 25.0 of SPSS software was used to analyze the data. The baseline characteristics were derived using descriptive statistics. For continuous and “categorical variables, respectively, independent t-tests or chi-square tests” were used to compare groups. In order to evaluate changes over time within and between groups, a repeated measure ANOVA was used. Statistical significance was attained when the p-value was less than 0.05. To control potential confounders, participants were asked to document any significant lifestyle changes (e.g., physical activity, smoking, alcohol consumption) during the study period. These were monitored and adjusted for in the analysis. Additionally, the intervention and control groups were matched for baseline characteristics such as age, sex, and comorbidities, to minimize the influence of these confounders on the outcomes.

Participant Retention and Adherence: High participant retention and adherence to the dietary intervention were prioritized throughout the trial. To promote compliance, there were incentives such as motivational assistance, individualized feedback, and routine follow-ups. Any negative incidents or side effects were kept an eye on and appropriately handled.

Results

The research included 156 individuals in total, of whom 78 were randomly allocated to the plant-based diet intervention group and the other 78 to the regular diet control group. The baseline characteristics of the participants are listed in Table 1. Based on baseline glycemic control, duration of diabetes, age, gender, body mass index (BMI), and cardiovascular health markers.

Table 1: Baseline Characteristics of Participants

Characteristic	Plant-Based Diet Group (n=78)	Control Group (n=78)	p-value
Age (years)	52.3 ± 8.1	51.8 ± 7.9	0.68
Gender (M/F)	40/38	42/36	0.75
BMI (kg/m^2)	29.7 ± 4.5	29.4 ± 4.2	0.67

Duration of Diabetes (years)	8.4 ± 3.7	8.1 ± 3.9	0.62
HbA1c (%)	8.2 ± 1.1	8.1 ± 1.2	0.77
Fasting Blood Glucose (mg/dL)	155.4 ± 32.5	154.1 ± 31.7	0.83
Systolic Blood Pressure (mmHg)	136.2 ± 15.3	135.5 ± 14.8	0.81
Diastolic Blood Pressure (mmHg)	86.7 ± 10.4	86.1 ± 10.1	0.77
LDL Cholesterol (mg/dL)	120.5 ± 28.9	121.2 ± 29.1	0.88
HDL Cholesterol (mg/dL)	45.6 ± 10.2	45.9 ± 10.3	0.84
C-Reactive Protein (mg/L)	3.2 ± 1.7	3.3 ± 1.6	0.76

Comparing the plant-based diet group to the control group throughout the course of the 12-month research, participants in the former had noticeably better glycemic control. The plant-based diet group's mean HbA1c level dropped from 8.2% to 7.4% at 6 months, and then to 6.9% at 12 months. As shown in Figure 1, the control group's mean HbA1c levels decreased more slowly, from 8.1% to 7.9% at six months and 7.7% at twelve months. Figure 1 shows that the difference in HbA1c decrease between the two groups was statistically significant ($p<0.01$).

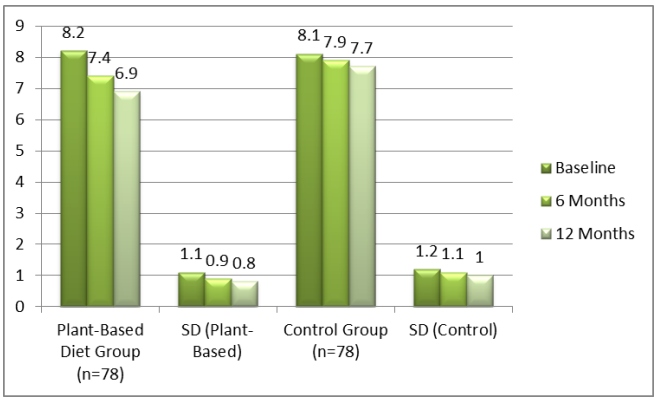

Figure 1: Changes in Glycemic Control

Cardiovascular health parameters significantly improved in the group following a plant-based diet. After a year, the mean diastolic blood pressure dropped from 86.7 mmHg to 78.9 mmHg and the mean systolic blood pressure dropped from 136.2 mmHg to 124.7 mmHg in the plant-based diet group. Table 2 shows that the control group saw less significant drops in blood pressure, with "systolic blood pressure falling from 135.5 mmHg to 130.2 mmHg and diastolic blood pressure falling from 86.1 mmHg to 83.4 mmHg ($p<0.01$)".

Table 2: Changes in Blood Pressure

Time Point	Plant-Based Diet Group (n=78)	Control Group (n=78)	p-value
Baseline (Systolic)	136.2 ± 15.3	135.5 ± 14.8	0.81
6 Months (Systolic)	129.5 ± 13.2	132.1 ± 13.7	0.23
12 Months (Systolic)	124.7 ± 12.8	130.2 ± 13.5	<0.01
Baseline (Diastolic)	86.7 ± 10.4	86.1 ± 10.1	0.77
6 Months (Diastolic)	81.3 ± 9.7	84.2 ± 9.9	0.04
12 Months (Diastolic)	78.9 ± 9.2	83.4 ± 9.6	<0.01

The lipid profiles of the group following a plant-based diet significantly improved. HDL cholesterol levels rose from "45.6 mg/dL to 52.1 mg/dL, while the mean LDL cholesterol levels dropped from 120.5 mg/dL to 101.3 mg/dL". Figure 2 illustrates that in the control group, HDL cholesterol climbed from 45.9 mg/dL to 48.2 mg/dL and LDL cholesterol reduced from 121.2 mg/dL to 115.8 mg/dL ($p<0.01$) for both changes in cholesterol.

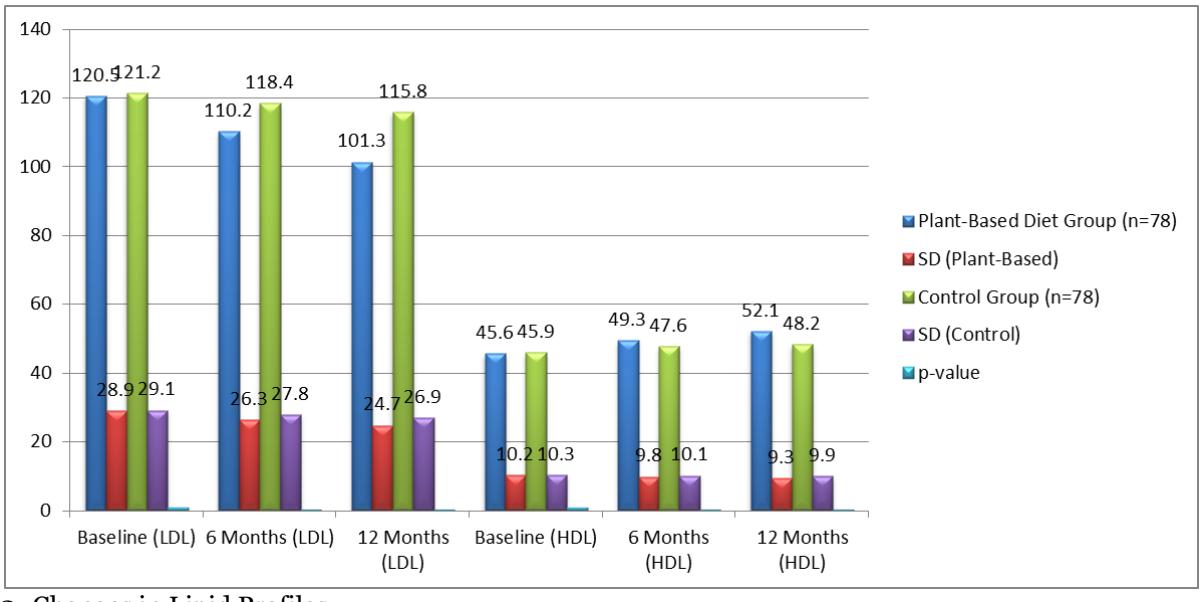

Figure 2: Changes in Lipid Profiles

Indicators of inflammation, including C-reactive protein (CRP), were significantly improved in the group that followed a plant-based diet. Over the course of the trial, the mean CRP levels dropped from 3.2 mg/L to 1.8 mg/L. As Table 3 illustrates, CRP levels in the control group decreased less sharply, from 3.3 mg/L to 2.9 mg/L ($p<0.01$).

Table 3: Changes in Inflammatory Markers

Time Point	Plant-Based Diet Group (n=78)	Control Group (n=78)	p-value
Baseline (CRP)	3.2 ± 1.7	3.3 ± 1.6	0.76
6 Months (CRP)	2.5 ± 1.3	3.1 ± 1.4	<0.01
12 Months (CRP)	1.8 ± 1.1	2.9 ± 1.3	<0.01

In comparison to the control group, the plant-based diet group saw a substantial improvement in quality of life as determined by the SF-36 questionnaire. At both six and twelve months, participants in the plant-based diet group reported superior ratings in the categories of overall health, vitality, and physical functioning. Table 4 shows that the increases in quality of life were statistically significant ($p<0.05$).

Table 4: Changes in Quality of Life Scores (SF-36)

Domain	Plant-Based Diet Group (n=78)	Control Group (n=78)	p-value
Physical Functioning (Baseline)	55.3 ± 12.7	54.8 ± 12.3	0.80
Physical Functioning (6 Months)	65.8 ± 11.5	59.4 ± 11.8	<0.01
Physical Functioning (12 Months)	70.5 ± 10.9	60.6 ± 11.4	<0.01
General Health (Baseline)	48.9 ± 10.8	49.2 ± 10.5	0.87
General Health (6 Months)	59.6 ± 9.7	53.5 ± 10.2	<0.01
General Health (12 Months)	62.6 ± 9.2	54.3 ± 9.8	<0.01
Vitality (Baseline)	51.2 ± 11.9	50.9 ± 11.6	0.85
Vitality (6 Months)	60.3 ± 10.4	54.1 ± 10.8	<0.01
Vitality (12 Months)	64.1 ± 9.9	55.8 ± 10.3	<0.01

Self-reported dietary records and recurring 24-hour food recalls were used to measure dietary adherence. At six months and twelve months, 85% and 82%, respectively, of the individuals in the plant-based diet group were still following the diet, indicating good adherence rates. Figure 3 illustrates how the control group consistently followed their regular diet.

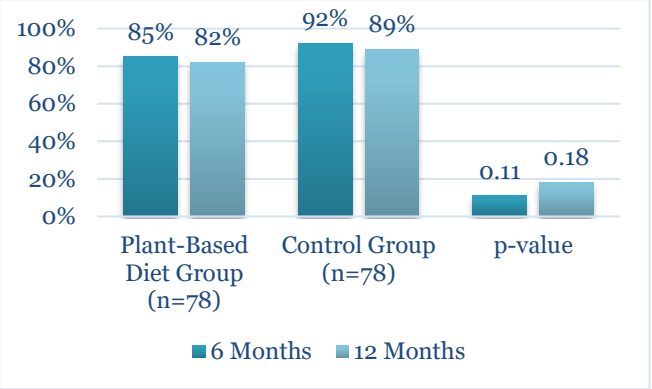

Figure 3: Dietary Adherence Rates

In neither group were there any notable side effects associated with the dietary treatments documented. During the first few weeks of the intervention, there were some minor gastrointestinal issues in the plant-based diet group. However, these were only temporary and went away on their own, without the need of medical attention.

Discussion

Our research showed that over the course of a year, those following a plant-based diet significantly reduced their HbA1c levels in comparison to those following a typical diet. This is in line with other studies that have repeatedly shown how plant-based diets may help people with type 2 diabetes manage their blood sugar levels [11, 12]. The 1.3 percentage point HbA1c decrease that we saw in our plant-based group is similar to the reductions of 0.8 to 1.5 percentage points that have been documented in previous dietary intervention trials. According to these research, plant-based diets' high fiber content and low glycemic index may be very important for regulating blood sugar levels and improving insulin sensitivity [13]. Our plant-based diet group's notable improvements in lipid profiles and blood pressure are consistent with earlier research results. Systolic and diastolic blood pressure reductions of 11.5 mmHg and 7.8 mmHg, respectively, were seen in our trial; these drops are similar to those shown in prior plant-based diet regimens [14, 1]. Given that even slight drops in blood pressure may dramatically reduce the risk of cardiovascular events, these decreases are clinically substantial.

The cardiovascular advantages of plant-based diets are further supported by improvements in lipid profiles, including the decrease in LDL cholesterol and the rise in HDL cholesterol. Consistent with our results, comparable studies have shown increases in HDL cholesterol by 3-6 mg/dL and decreases in LDL cholesterol by 15-30 mg/dL. These alterations most likely result from eating less cholesterol and saturated fat and more dietary fiber and plant sterols, which are linked to plant-based diets. Our plant-based diet group's lower levels of C-reactive protein (CRP) are consistent with findings from earlier research showing that plant-based diets may lessen systemic inflammation [16, 17]. The high concentrations of antioxidants, polyphenols, and other phytonutrients present in fruits, vegetables, whole grains, and legumes are thought to be responsible for the anti-inflammatory qualities of plant-based diets. It has been shown that these elements lessen inflammatory pathways

and oxidative stress, which lowers CRP levels.

Notable are the substantial gains in quality of life metrics among people following a plant-based diet, especially in physical functioning, overall health, and vitality. These enhancements are in line with results from related food regimens in which subjects reported feeling better physically and mentally. Higher consumption of foods high in nutrients and fiber is probably what caused people to feel more energized, less worn out, and to perceive their general health as being better. Our study's high rates of plant-based diet adherence suggest that these diets are not only sustainable and beneficial for people with type 2 diabetes, but also acceptable to them. The absence of noteworthy adverse effects confirms the safety of plant-based diets and is consistent with earlier studies that found minimal and temporary gastrointestinal problems [18].

Glycemic control and cardiovascular health indicators seem to be improved by plant-based diets just as much, if not more, as by other dietary therapies like low-carb or Mediterranean diets. Low-carb diets have been shown to quickly improve glycemic control, but it is unclear if they will be sustainable in the long run or have any positive effects on the heart. On the other hand, plant-based diets provide a nutrient-rich, well-balanced approach that supports long-term health advantages. Our study's findings, together with an increasing amount of supporting data, advocate incorporating plant-based dietary approaches into patients' standard of treatment for cardiovascular and type 2 diabetes [19]. As a practical means of lowering cardiovascular risk, increasing general quality of life, and glycemic management in this patient group, healthcare clinicians need to think about endorsing plant-based diets [20].

Limitations

Although our research offers compelling proof of the advantages of plant-based diets, there are some Limitations. The high adherence rates were reported, the reliance on self-reported dietary data may introduce bias; future studies should include objective adherence measures, such as serum carotenoids or plasma phytonutrients, to validate these reports. It is important to take into account the possibility of selection bias and the dependence on self-reported dietary adherence. It is necessary to do additional research on the processes behind the health advantages of plant-based diets and to corroborate these results using bigger sample sizes and objective measures of dietary adherence.

Conclusion

This research shows that in people with Type 2 Diabetes Mellitus, plant-based diets substantially enhance glycemic management, cardiovascular health indicators, inflammatory markers, and quality of life. According to these results, adopting a plant-based diet may help manage type 2 diabetes and improve general health in a sustainable and efficient manner. For patients with T2DM and cardiovascular disorders, including plant-based dietary regimens into therapeutic treatment may have a significant positive impact.

Acknowledgments

The authors would like to express their gratitude to the KTH staff and participants for their invaluable contributions to this research. Additionally, we acknowledge the use of ChatGPT for sentence corrections and editing, which aided in refining the manuscript.

Conflict of interest

The authors state no conflict of interest.

Author Contributions

All authors have reviewed the final version of the manuscript and agreed to be accountable for all aspects of the work. Contributions were made equally by all authors in the following areas:

Concept and design
Acquisition, analysis, or interpretation of data
Drafting of the manuscript
Critical review of the manuscript for important intellectual content

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