Plant-Based Dietary Program in Patients with Diabetes

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Dietary choices play a key role in insulin sensitivity among diabetes patients. An 8-week pilot study was conducted to evaluate whether a mostly plant-based dietary program will lead to improvement in biochemical markers in adults with diabetes.

Keywords: diabetes ; HbA1c ; plant-based diet ; nutrition ; weight

1. Introduction

In the United States, more than 34 million Americans (>1 in 10) have been diagnosed with diabetes [1] and at least 88 million American adults (about 1 in 3) are at high risk for diabetes. Globally, the incidence of diabetes has increased to 453 million in recent years and is projected to reach 693 million by 2050. Newly diagnosed cases of type 1 and 2 diabetes have significantly increased among American youth, of which 90% are diagnosed with type 2 diabetes and 10% with type 1 diabetes, although atypical diabetes has a mixed presentation and is also on the rise during the pandemic. COVID-19 has caused a new onset of diabetes [2], particularly type 1 diabetes and dietary measures may be potentially useful in reducing complications and improving glycemic control.

Besides exercise [3], dietary choices is a key factor driving insulin sensitivity. The consumption of low nutrient-dense foods in addition to sugar-laden beverages remain the most important etiology for developing diabetes. The landmark diabetes prevention program (DPP) trial [4] showed that dietary and lifestyle modification does not only help remit diabetes but also reverse and prevent complications. The DPP study showed a 68% reduction in the risk of developing type 2 diabetes. Plant-based diets emphasize intake of whole grains, vegetables, fruits and nuts, seeds, legumes and pulses and protein from plant sources with limited amounts of animal fats have shown potent effects in lowering or preventing the risk of type 2 diabetes by improvement in insulin resistance and lipid profile, in addition to other benefits.

Edge et al. [5] and Kim et al. [6] suggested that personal diet may affect the progression and development of complications in patients with type 2 diabetes. Additionally, reductions in biomarkers can result in positive outcomes for diabetic patients, as improvements in glycemic control, blood pressure and cholesterol can decrease the risk of developing diabetes-related complications [7]. A recent research review demonstrated that predominantly plant-based diets decrease all-cause mortality rates, improve glycemic control [8], markers for lipids and blood pressure and are associated with metabolic and cardiovascular benefits [6][9]. The authors concluded that dietary changes could be used as a preventive measure for type 2 diabetes. More importantly, they believed that this change could lead to the reduction in the use of antidiabetic medications [9].

The evidence supporting the role of glucose monitoring, exercise and medical nutrition therapy in monitoring diabetes cannot be overstated. Other forms of diabetes management include weight loss measures involving plant-based diets, pharmacotherapy and bariatric surgery. Although dietary habits and weight loss measures play key roles in diabetes management, the issue of what diet pattern best addresses hyperglycemia and its risk factors, as well as weight control, remains somewhat controversial. The idea of prolonged and uniform calorie-controlled diet plans for diabetic individuals have been replaced by individualized diabetic meal-plan approaches utilizing nutritional guidelines of the ADA and the U.S. Department of Agriculture's 2015–2020 Dietary Guidelines [10]. With this release came praise for mostly plant-based diet models, which have been extensively studied among participants with diabetes and obesity. In another study, Trapp and her colleagues [11] concluded that patronizing or adhering to mostly plant-based diets can possibly reduce the risk of developing type 2 diabetes.

A plant-based diet needs to be considered as part of diabetes patients' lifestyle changes that include the use of nutrition therapy, regular physical activity, restorative sleep, stress management, avoidance of risky substances and positive social connection as a primary therapeutic modality for treatment and reversal of chronic conditions. Adherence to this diet can be associated with fewer calories, higher nutrient density, less fat, low cholesterol, less saturated fat and, potentially, a

lower risk of high BMI compared to non-followers. Indulging in healthful eating of a predominately plant-based diet has varied evidence for promoting overall health and preventing, treating and reversing diabetes [12]. Adherers often consume more fiber, potassium and vitamin rich foods including vitamin C. This can lower their risk and prevalence for obesity, hyperglycemia and cardiovascular disease [13][14][15]. In support of these findings, the ADA and the American Academy of Nutrition and Dietetics [16] have now started considering mostly plant-based diets for individuals diagnosed with diabetes.

Plant-based diets have decreased levels of saturated fat, which decreases cardiovascular risk factors, and this marked decrease provides potential benefits to diabetes patients [17]. Although the benefits are intriguing, transitioning to a mostly plant-based diet can often be difficult without proper education and frequent follow-up sessions with medical professionals for type 1 and 2 diabetic patients. Many studies and conclusions have been drawn about the impact of dietary changes on type 2 diabetic patients and their health outcomes. However, no recommendations exist for mostly plant-based diets in diabetes patients, with either type 1 or 2. Any reduction in biochemical markers could potentially result in positive outcomes for diabetic patients, as improvements in glycemic control, blood pressure and cholesterol can decrease the risk of developing diabetes-related complications [18].

One such modification in diet that has been evaluated for its effectiveness in improving biochemical markers is a low-fat mostly plant-based diet. Specifically, the study compared participants following an ADA recommended diet (15–20% protein, <7% saturated fat, 60–70% carbohydrates and monounsaturated fats, cholesterol ≤ 200 mg/day) to those following a low-fat mostly plant-based diet for 22 weeks found greater improvements in HbA1c, weight, BMI, waist circumference, total cholesterol and LDL cholesterol in the vegan group [19]. A low-fat, mostly plant-based diet produced a greater improvement in glycemic and plasma lipid levels as compared to the ADA dietary recommendation [20]. Other studies on plant-based diets have been shown to improve metabolic and cardiovascular health, decrease all-cause mortality rates [6], improve glycemic control and markers for lipids and blood pressure [9].

2. Findings and Analysis

These findings from this pilot program confer HbA1c lowering as noted in other studies [21]. Mostly plant-based diets can help improve the outcomes among individuals diagnosed with diabetes. We investigated the effect of a mostly plant-based dietary program on individuals living with diabetes. Participants reported feeling less tired. This suggests that a mostly plant-based diet is beneficial to diabetic patients due to improvements in their clinical markers and their overall health. HDL levels were lower at the end of the intervention which confirms what has been shown in other studies [22]. However, the mechanism for lower HDL remains unclear as many of these diets have been thought to be beneficial to people with cardiovascular risk. The possible mechanism is believed to lower Apo A-1 production rates, an increase physical activity or possibly overall reductions in all lipid subfractions.

A major theme observed during the intervention sessions was that the plant- based dietary program was easy to implement both at home and when travelling. In effect, it is hoped that the adoption of a mostly plant-based diet will potentially reduce the number of direct contacts with the health-care system thereby reducing the strain of higher demand on healthcare professionals. We observed improved estimates for the markers, but this was not significant among the type 1 diabetic patients and a large-scale study might be needed to evaluate the benefits in such a subgroup. This might be effective also in group settings with multidisciplinary teams including endocrinology, lifestyle medicine and nutrition to evaluate them on a joint basis and help with the motivation to adhere to and plan these diets.

The 8-week plant-based diet program was a tool that enhanced the understanding of the benefits associated with transitioning to a mostly plant-based dietary program. An effective plant-based diet program may incorporate regular meetings and educational sessions while also considering the participants' financial status, time availability, meal preparation and gastrointestinal sensitivity. The dietary program not only improved the participants' understanding of the benefits of plant-based diets but also offered an alternative way of managing chronic diseases.

3. Conclusions

The 8-week dietary program interventions demonstrated an increased association between plant-based diets and improvements in physical and psychological well-being, as well as improvements in HbA1c control [8] in individuals diagnosed with diabetes. Additionally, the educational sessions and cooking demonstrations helped improve the understanding of the benefits of mostly plant-based diets in the management of diabetes. These improvements translated to a discontinuation or reduction in the use of diabetes-related medications such as insulin doses among participants post-intervention results. These results were similar to the findings of Toumpanakis et al. [23]. Our study supports the recommendations of the Centers for Disease Control and Prevention guidelines for diabetes and prediabetes control [24].

Data for changes in HbA1c and weight were statistically significant with *p*-values 0.001 and 0.002, respectively, shown in **Table 1**, suggesting this plant-based diet program was effective in helping diabetes mellitus (DM) patients improve their glycemic control (**Table 2**). These improvements in biochemical markers could potentially result in better health outcomes. HDL change, despite it decreasing, is a common finding reported in some mostly plant-based diet studies. The real reason behind this is unknown, although possible causes are lowering of Apo A levels or overall improvement in cholesterol levels, hence lowering HDL levels. A statistically significant decrease in HbA1c was not found for type 1 DM patients when analyzed alone ($p = 0.089$). Lack of significant change in biochemical markers in type 1 diabetes patients may be due to the small sample size. However, the program may have some clinical significance, demonstrating levels moving towards ADA recommendations (**Table 1**; **Table 2**).

Table 1. Overall measures for type 1 and 2 diabetes participants of the 8-week dietary program.

	PRE	POST	
Measures	**Mean(SD)**	**Mean(SD)**	***p*-Value**
HbA1c	**7.3(0.74)**	**6.8(0.57)**	**0.001**
C-Reactive Protein (CRP)	**5.7(9.23)**	**4.9(7.25)**	**0.720**
Total Cholesterol	**158.6(35.31)**	**150.1(30.79)**	**0.070**
HDL	**51.5(11.12)**	**49.2(11.12)**	**0.093**
Triglycerides	**125.6(59.35)**	**116.7(58.53)**	**0.378**
LDL	**85.8(28.84)**	**80.0(24.10)**	**0.151**
Non-HDL	**107.6(30.45)**	**100.8(26.64)**	**0.151**
Insulin	**5.2(8.60)**	**3.0(4.34)**	**0.111**
BMI	**31.6(6.71)**	**30.8(6.29)**	**0.002**
Weight	**197.7(38.38)**	**193.3(37.22)**	**0.002**
Systolic Blood Pressure	**122.1(10.47)**	**131.7(9.72)**	**0.013**
Insulin Dose	**55.9(49.77)**	**42.8(33.49)**	**0.188**
Blood Sugar	**136.8(13.57)**	**134.6(27.07)**	**0.804**
AST	**19.4(5.38)**	**21.2(7.89)**	**0.615**
ALT(U/L)	**27.2(31.56)**	**21.1(11.73)**	**0.340**

Table 2. Analysis of the mean difference between the pre- and post-test survey questionnaires.

Questions	**Difference**	***p*-Value**
Overall level of health	**0.346**	**0.230**
Average sleep in a 24-h	**−0.033**	**0.818**
Feel tired or difficulty staying awake	**−0.600**	**<0.001**
Weight management efforts	**−0.267**	**0.041**
Frequency of fast food and sugary drinks	**−0.346**	**0.121**
Frequency of whole fruits servings	**0.179**	**0.239**
Servings of vegetables per day	**0.714**	**0.003**
Frequency of animal-based proteins (chicken, turkey)	**−1.642**	**0.001**
Frequency of plant-based proteins (beans, lentils)	**1.692**	**<0.001**
Days of moderate to strenuous intensity exercise	**0.267**	**0.301**
Minutes of moderate to strenuous intensity exercise	**−0.533**	**0.006**

Questions	Difference	*p*-Value
Days of strength/resistance training exercise per week	**0.400**	**0.028**
Cooking meals	**0.067**	**0.334**
Time spent cooking in a day	**0.167**	**0.504**
Cooked meals in a day	**0.250**	**0.275**
Number of cooked meals for other people	**0.071**	**0.690**
Enjoy cooking	**0.583**	**0.170**
Cook for myself	**−0.083**	**0.339**
Difficulty associated with transition to plant-based diet	**1.358**	**0.007**
Willingness to permanently adopt a plant-based diet	**−0.267**	**0.383**
Willingness to continue with diet/exercise programs	**0.200**	**0.510**

The questionnaire responses showed that the mostly plant-based diet program had a positive impact on diabetic patients. Participants reported lower fatigue levels and increased weekly exercise. The majority of the participants rated the effectiveness of the program as 5/5. Considering these results from the primary and secondary endpoints, we conclude that this plant-based dietary program may be beneficial to all diabetic patients of UCF Health and consideration should be made towards group diabetes sessions which would benefit all interested in making healthier choices with diet. Furthermore, the possibility of having larger scale trials looking at type 1 diabetes subjects and benefits as noted with type 2 diabetes subjects as well. This also brings to light the fact that well planned vegetarian and vegan diets rich in fiber and low in glycemic index and fat can have far ranging benefits which would help revise ADA guidelines in terms of recommending such diets to all diabetic populations.

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