

Plant Based Diets for the Prevention and Treatment of Diabetes: A Mini-Review



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Abstract

The implementation of a whole food plant-based diet is a proven strategy in decreasing the incidence of type 2 diabetes in those at risk and improving glycemic control in individuals with type 2 diabetes. Here we explore the evidence in support of its use and outline the mechanisms by which it may benefit patients.

Keywords: Plant-based diet; Food; Type 2 diabetes; Red meat; Poultry; Game; Fish; Eggs; Fruits; Vegetables; Whole grains; Beans

Definition

At present there is no firm definition of a plant-based diet. Some leading proponents suggest a plant-based diet (PBD) may include a small amount of animal products, while others recommend a diet completely abstaining from red meat, poultry, game, fish, eggs and all dairy products.

The consensus, however, is that a healthy PBD emphasizes the consumption of whole plant foods, discourages animal based, processed foods and is typically low in fat. Foods recommended in abundance are fruits, vegetables, whole grains, herbs, spices, nuts and seeds while more refined grains and processed plant foods such as oil are to be used minimally.

For the purposes of this review, we will be referring to a PBD as one that excludes all animal products and is of a whole food nature unless otherwise specified.

Clinical Perspective

Plant-based diets, maximizing whole nutrient dense plant foods, are associated with lower risk of developing diabetes and can even reverse type 2 diabetes [1]. These dietary patterns emphasizing high fibre foods such as fruits, vegetables, whole grains, beans and legumes have been shown to improve glycemic control in established diabetes, slow the rate of carbohydrate absorption and protect against diabetes [2].

Plant based diets are also associated with much lower rates of several chronic diseases including obesity, hypertension, hyperlipidemia, cardiovascular disease, cancer and all-cause mortality [3-5].

Introduction

Type 2 diabetes is undoubtedly a global epidemic. In 2018, the estimated number of cases of type 2 diabetes was more than 500 million globally. In America, 34.2 million people or just over 1 in 10, have diabetes [6]. 88 million American adults or almost 35% of American adults have prediabetes, and people 65 years and older have the highest rate (48%) compared to other age groups [7]. Almost 90% of adults with diabetes also are overweight or have obesity [7]. The total direct and indirect estimated costs of diagnosed diabetes in the United States in 2017 was \$327 billion [8].

The association between high BMI and diabetes is well established. In the United States, 74 percent of adults have overweight or obesity, creating an increased risk for the development of not only type 2 diabetes but other chronic health conditions including cardiovascular disease and certain types of cancer. Part of the protection associated with PBD is due to the lower BMI of vegetarians compared to diets with higher intakes of animal products [9].

Adults ages 40 to 59 have the highest rate of obesity (43%) of any age group with adults 60 years and older having a 41% rate of obesity. About 40% of children and adolescents are overweight or have obesity; the rate of obesity increases throughout childhood and teen years [7].

Prevention and Treatment

Dietary choices and weight play a key role in preventing and treating insulin resistance. With the increased consumption of high calories, highly processed foods including fast food, refined grains, sugary beverages and animal products are seen rising rates of type 2 diabetes and obesity globally [10-13]. A whole food PBD not only emphasizes protective foods which are high in fibre but also exclude foods which promote insulin resistance in animal-based foods, particularly in red meat [14-23]. When digested, animal products produce TMA in the gut which is later converted to TMAO in the liver. This compound has been linked to insulin resistance [24-26]. Further, heme iron which is only found in animal products is a pro-oxidative that promotes insulin resistance [25].

In a randomized placebo-controlled study, involving more than 3200 participants, lifestyle intervention decreased the incidence of type 2 diabetes in those at risk by 58% compared with 31% in the metformin-treated group [27].

The Adventists Health Study 2 demonstrated a decrease in type 2 diabetes with each reduction in animal products with 7.6% in non-vegetarians who consumed red meat or poultry one to two times weekly, 6.1% in semi-vegetarians, 4.8% in pescatarians, 3.2% in lacto-ovo vegetarians and 2.9% in vegans on what would be considered a PBD. These data suggest even minimal consumption of red meat or poultry increases the risk of type 2 diabetes significantly.

Long term cohort and prospective studies present similar findings. Adherence to a healthful, whole food, PBD resulted in lower risk of developing diabetes. In the Adventist Mortality study, long term adherence to a diet that included weekly meat intake increased the odds of developing diabetes by 74% compared to PBD [28]. In the Nurses' Health Study 2, those with the highest level of adherence to a healthful PBD had a 24% lower risk of developing diabetes [24].

Plant based diets, high in whole grains, including brown rice and whole grain cereals, fruits, vegetables, including root vegetables, leafy greens, nuts and seeds have all been linked to lower rates of diabetes. Specifically, legumes have been shown to ameliorate insulin resistance and protect against the metabolic syndrome [26-37].

Weight loss undoubtedly plays an important role in the treatment of type 2 diabetes. The Diabetes Prevention Program determined Interventions to reduce diabetes risk should primarily target weight reduction. The data support a minimum of 7% of weight lost and maintained through lifestyle modifications.

Participants in this study were encouraged to achieve the 7% weight loss during the first 6 months of the intervention [38]. The initial focus was on reducing total dietary fat. After several weeks, the concept of calorie balance and the need to restrict calories as well as fat was introduced [39]. Those who follow a healthful PBD tend to eat fewer calories and fat than those on conventional diets and therefore tend to weigh less. The Adventists Health Study 2 demonstrated Mean BMI was lowest in vegans (23.6 kg/m) and incrementally higher in lacto-ovo vegetarians (25.7 kg/m), pesco-vegetarians (26.3 kg/m), semi-vegetarians (27.3 kg/m), and nonvegetarians (28.8 kg/m) [9]. In Bernard et al., [40] Body weight decreased 6.5 kg in the vegan group and 3.1 kg in the ADA group ($P < 0.001$).

It is difficult to determine if it is the specific diet components (high fibre, low fat, low animal protein) or the generalized weight loss which results in the greatest benefit. Anderson et al. [41] published a weight control study, demonstrating a greater decrease and even elimination of insulin needs for participants on a high carbohydrate, high plant fibre diet.

A total of 9 studies were identified, totaling 307,099 participants with 23,544 cases of incident type 2 diabetes. A significant inverse association was observed between higher adherence to a plant-based dietary pattern and risk of type 2 diabetes in comparison with poorer adherence even after adjusting for BMI [42].

In 2006 Barnard et al reported the results of a randomized clinical trial comparing a low-fat vegan diet with a diet based on the 2003 ADA guidelines. Participants on the low-fat (<10% of energy) plant based (vegan) diet reduced their A1C levels by 1.23 points, compared with 0.38 points for the people on the ADA diet [40]. In a later (2009) paper Barnard demonstrated a reduction in medication requirements; 43% (21 of 49) of those following the vegan diet reduced their diabetes medications compared to 26% (13 of 50) in the ADA diet group during a 74-week clinical trial [43].

Current Nutrition Guidelines

Weight loss in the Diabetes Prevention Plan includes a reduction of total dietary fat and calories to prevent diabetes for those at high risk of developing type 2 diabetes with an overweight or obese BMI [7].

Dietary Guidelines for Americans 2020-2025 recommend replacing processed or high-fat meats with beans, peas, and lentils. About three-quarter of Americans meet or exceed the recommendation for meats, poultry, and eggs and more than half do not meet the recommendation for nuts, seeds, and soy products [44].

These current guidelines acknowledge that shifts are needed within the protein foods group to add variety to subgroup intakes, however the emphasis of the consumption of "lean meat" remains prevalent. It is clear, however, for those with type 2 diabetes

the emphasis should be on plant-based protein sources which naturally contain fibre and are low in fat. "Protein" foods are generally consumed in forms with higher amounts of saturated fat or sodium and often part of mixed dishes (e.g., sandwiches, casseroles, pasta dishes) that include other ingredients that are not in nutrient-dense forms. More than 90 percent of women and 97 percent of men do not meet recommended intakes for dietary fiber. Fibre, which is only found in plant foods, is associated with weight loss and satiety and a decrease in the markers of inflammation which may also improve insulin resistance [24,25].

When digested, fibre is fermented by the intestinal bacteria to produce short chain fatty acids, which also improve insulin signaling and insulin sensitivity [45-48]. It also modulates post glandular glucose response.

The Dietary Guidelines for Americans also recommend no more than 10% of energy come from saturated or trans fats; however only 23 % of individuals consume amounts of saturated fat consistent with the limit of less than 10% of calories. Saturated fat and trans-fat in the diet increase the risk of developing diabetes [49]. Conversely, monounsaturated and polyunsaturated fats had a favourable effect on insulin resistance and secretion. Sources include nuts, seeds, avocados and olives. This benefit is however not found in those with a high total fat intake (37% of energy) [50].

Carbohydrates have long been considered the villain in individuals who are at risk or have developed type 2 diabetes. It is important to distinguish between the type of carbohydrate sources. While whole grains and cereal fibres reduce the risk of developing diabetes [30], low fibre, refined carbohydrates increase this risk [51]. It is also important to note that compared to a high protein diet, a diet high in refined carbohydrates still resulted in a reduction in A1c and an increase in insulin sensitivity [52]. Low carbohydrate diets with an emphasis on animal protein present with a 37% increased risk of diabetes [53].

Implementation and Practical Strategies

Many physicians and dieticians assume their patients will be reluctant to adopt a PBD because of cultural factors and habit. However, the popularity and acceptance of PBD has increased over the last decade. One study revealed 9.6 million Americans or 3% of the population, identify as vegan.

In one study examining the awareness and perception of PBD for the treatment and management of Type 2 Diabetes, 89% of patients were unaware of the option of using an alternate diet such as a PBD for the prevention and management of type 2 diabetes. Two-thirds of participants showed a willingness to adopt a PBD diet for the short term [54].

On-going support, addressing barriers, education and follow up can increase adherence and long-term adoption [55]. Several

practical strategies have been presented in the literature [56-59]. Kaiser Permanente is an excellent resource for patients and physicians alike [60].

There are also specific nutrient concerns that may arise. Patients can be reassured that a well-planned PBD will not be deficient in any vitamins or minerals with the use of fortified foods such as calcium fortified soy, fortified plant milks and grains [61].

It is important to assure patients that a PBD is not necessarily an all or nothing diet program but instead a lifestyle modification which can be made gradually. Although we see the greatest benefit from those who adopt a purely PBD, even modest increases in plant foods can benefit an individual's health.

Conclusions

The wealth of evidence demonstrating the benefits of a whole food plant-based diet is remarkable. It is a disservice to those at risk and those who have developed type 2 diabetes to recommend lifestyle changes and not discuss the option of adopting a plant-based diet.

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