

# The Role of Plant-Based Diets in the Management of Type 2 Diabetes

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## About the Author



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## Background

A whole food plant-based (WFPB) diet is generally defined as a diet rich in fruits, vegetables, whole grains, legumes, nuts and seeds, and herbs and spices. Many define a WFPB diet as being exclusively plant-based with no animal products, excluding all red meat, poultry, fish, eggs, and dairy products. Other sources define it as a plant-forward dietary pattern that may still include small amounts of meat, eggs or dairy. A WFPB dietary pattern focuses on unprocessed plant foods, while avoiding processed foods containing refined grains, refined oils and added sugars. **Figure 1** depicts an example of a balanced WFPB meal.

On a practical level, it is important to distinguish a WFPB diet from a vegan diet, which eliminates all animal products but may include processed vegan foods (e.g., plant-based meats, pastries and fried foods). However, in the scientific literature, the term “vegan” is often used, and at times it is difficult to assess the amount of processed food included in diets of vegans included in observational studies. This paper will focus primarily on the evidence for an exclusively WFPB dietary pattern in the prevention and management of Type 2 diabetes mellitus (T2DM) and obesity. However, given certain limitations in the literature, some data on vegan diets and plant-rich but not exclusively plant-based diets will also be included.

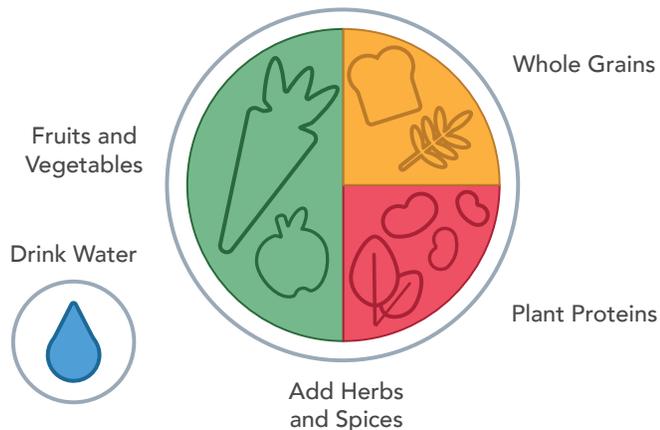
The Dietitians of Canada and the American Dietetic Society have jointly stated that well-planned vegetarian and vegan diets can be healthful and appropriate for all life stages, highlighting the reduced risk of excess weight, cardiovascular disease, hypertension, and T2DM with these dietary pattern.<sup>1</sup> Vegetarian and vegan diets are identified in the Diabetes Canada Guidelines as one of several dietary patterns that have evidence for improved glycemic control, lipid profile and body weight in individuals with T2DM.<sup>2</sup>

## T2DM Prevention

Observational data exists demonstrating that WFPB dietary patterns are associated with lower incidence and prevalence of T2DM. The Adventist Health Study-2 evaluated T2DM prevalence in relation to various types of dietary patterns: vegan, lacto-ovo vegetarian, pesco-vegetarian, semi-vegetarian, and non-vegetarian. Both body mass index (BMI) and risk of T2DM increased progressively with dietary patterns containing more animal products. Even after adjusting for BMI, vegan and lacto-ovo vegetarian diets were associated with a 0.51 (95% [CI 0.40–0.66]) and 0.54 (95% [CI 0.49–0.60]) odds ratio respectively for T2DM vs non-vegetarians.<sup>3</sup>

Similarly, Satija et al used food frequency questionnaire data from three large prospective cohort studies

### A Whole Food, Plant-Based Plate:



**Figure 1.** A fibre-filled, nutrient-dense antioxidant-rich plate for every meal; *courtesy of Dr. Heidi Dutton.*

(Nurses' Health Study, Nurses' Health Study 2 and Health Professionals Follow-Up Study) to create multiple dietary indexes including a healthy plant-based diet index in which all animal foods, and less healthy plant foods such as refined grains, along with fruit juice and sweets, received lower scores vs unrefined plant foods.<sup>4</sup> After adjusting for BMI and other T2DM risk factors, higher scores on the healthy plant-based diet index were associated with a reduced risk of T2DM with a hazard ratio of 0.66 (95% [CI 0.61-0.72]). Findings from these large cohort studies therefore suggest that diets rich in whole plant foods confer a lower risk of development of T2DM.

### T2DM Management

Limited randomized controlled trials have been performed to evaluate the effect of a fully WFPB dietary pattern on glycemic control in patients with T2DM. In one study, Barnard et al randomized patients with T2DM to either the American Diabetes Association (ADA) diet or to a low-fat WFPB (vegan) diet consisting of vegetables, fruits, whole grains, and legumes. In the intention-to-treat analysis, HbA1c and body weight decreased by 0.96% and 6.5 kg respectively in the vegan group, and by 0.56% and 3.1 kg respectively in the ADA group ( $P=0.089$  for HbA1c and  $P<0.001$  for body weight). In individuals whose T2DM medications did not change during the trial, HbA1c fell by 1.23% in the vegan group and by 0.38% in the ADA group ( $P<0.001$ ). Therefore, while both groups experienced glycemic control and weight loss benefit, the improvements appeared to be greater in the vegan group.<sup>5</sup> A

systematic review and meta-analysis of six controlled trials of vegetarian and vegan dietary interventions in T2DM found that these diets are associated with significant improvement in HbA1c (pooled reduction of 0.39%).<sup>6</sup>

A recent non-randomized crossover trial evaluated a WFPB diet and a Dietary Approaches to Stop Hypertension (DASH) diet on insulin dose changes in 15 patients with T2DM managed with insulin (mean dose of 90 units/day).<sup>7</sup> The DASH diet is rich in whole plant foods but it is not exclusively plant-based. Participants completed seven days of the DASH diet, followed by seven days of the WFPB diet and subsequently seven days of the DASH diet again. Following the DASH diet week 1, the total daily dose (TDD) of insulin dropped by 24%; following the WFPB week, the TDD of insulin dropped by a total of 39% vs baseline; following the DASH diet week 2, insulin dosing increased 15% from the WFPB week. HOMA-IR decreased by 49% from baseline at the end of the WFPB week. Average daily blood glucose measured by continuous glucose monitoring improved by 22–24% from baseline across the three intervention weeks. Although the study was small and of short duration, this highlights that improvements in glycemic control and insulin requirements can occur rapidly with a shift toward a more WFPB dietary pattern.

### Mechanisms for Improving Glycemic Control with a WFPB diet

A WFPB diet improves insulin resistance and glycemic control in T2DM via multiple mechanisms. Increased dietary fat intake is well-known to increase insulin resistance via increased intramyocellular lipid storage and lipotoxicity.<sup>8</sup> In particular, this is seen with high intake of saturated fat,<sup>9</sup> and animal products are the main source of saturated fat in human diets. In one small study, vegan subjects matched by BMI to omnivores were found to consume a similar percentage of dietary fat intake, but less saturated fat and more polyunsaturated fat. In addition, they demonstrated less intramyocellular lipid storage and better beta cell function.<sup>10</sup>

The high fibre content of a WFPB diet also plays a role in the prevention and management of T2DM. Higher fibre content in a meal reduces postprandial blood glucose response and promotes satiety.<sup>11</sup> Furthermore, fermentation of dietary fibre via gut bacteria in the large intestine produces short chain fatty acids which have important metabolic health modulating effects, such as reduced postprandial glucose response and increased GLP-1 levels.<sup>12</sup> WFPB diets are also low in advanced glycation end products (AGEs) and trimethylamine

N-oxide, both of which are thought to play a role in the pathogenesis of T2DM, and are found in high levels in meat (AGEs are particularly high when meat is broiled, grilled or roasted at high temperatures).<sup>13</sup> Thus, WFPB dietary patterns are potentially protective against T2DM via multiple mechanisms.

### Obesity Management and the WFPB Diet

Numerous different dietary patterns have been shown effective for weight loss, with no one dietary pattern recognized as being superior.<sup>14</sup> However, evidence certainly exists that a WFPB dietary pattern can promote weight loss. The BROAD study randomized overweight and obese individuals to either a low-fat (7%-15% total energy from fat) WFPB dietary intervention or standard care.<sup>15</sup> The intervention group utilized a group educational format and, notably, did not include any exercise interventions or restrict caloric intake. At six months, mean BMI reduction in the WFPB group was 4.4 kg/m<sup>2</sup> vs 0.4 kg/m<sup>2</sup> in the standard care group ( $P < 0.0001$ ). Another randomized crossover trial assigned overweight adults to a Mediterranean or low-fat (10% total energy from fat) vegan diet for 16 weeks, followed by return to baseline for four weeks and subsequently the opposite diet for 16 weeks.<sup>16</sup> Overall net weight changes were 0 kg on the Mediterranean diet vs -6.0 kg on the vegan diet ( $P < 0.001$ ). This trial did not prescribe any caloric restriction or exercise changes to participants.

A WFPB diet is thought to aid in weight loss partially because of the low-calorie density of most whole plant foods. Including more plant foods with higher water content and lower calorie density has been shown to

promote weight loss and improve satiety.<sup>17</sup> A small, randomized crossover trial showed that compared to a low carbohydrate diet high in animal products, a low fat WFPB dietary pattern resulted in an average 689 +/- 73 kcal/d less energy intake when participants were allowed to eat ad libitum.<sup>18</sup> Thus, a WFPB dietary pattern, particularly when low in fat, can allow some patients who are pursuing weight loss to eat to satiety without the need to track calorie intake.

### The WFPB Diet and Planetary Health

Mitigating climate change is another important reason to guide patients toward a more WFPB dietary pattern. Worsening planetary health affects the individual health of our patients on a daily basis, via increased respiratory illness, extreme temperatures and displacement due to events such as flooding and forest fires.<sup>19</sup> In 2020, The EAT Lancet Commission released a report highlighting evidence-based dietary recommendations designed to be beneficial for human health while also optimizing planetary health and sustainable food production. This commission assembled 18 co-authors from 16 countries with expertise in the areas of agriculture, sustainability, political science and human health. The recommended dietary pattern is largely plant-based emphasizing whole plant foods, with flexibility to include very modest amounts of fish, dairy and meat, with red meat largely excluded.<sup>20</sup> The Commission projects that this large dietary shift would allow the planet to sustainably feed an estimated population of 10 billion by 2050; however, consuming even marginally more dairy and red meat than what the report recommends will make this objective unattainable.

#### Clinical Pearls

- ✓ In a real-world setting, some patients may find a given diet more sustainable if small amounts of animal products continue to be included
- ✓ If patients follow a 100% WFPB or primarily WFPB dietary pattern, Vitamin B12 supplementation is necessary, particularly for patients taking metformin. Vitamin B12 levels should be monitored
  - For non-pregnant adults <65 years old, the recommended dose is 50 mcg daily or 2000 mcg weekly of cyanocobalamin<sup>21</sup>
- ✓ A WFPB dietary pattern is intended to be a delicious and enjoyable way of eating. The following websites contain numerous free WFPB recipes and resources to help patients get started:
  - <https://www.forksoverknives.com/>
  - <https://nutritionstudies.org/recipes/>
  - <https://www.pcrm.org/news/news-releases/21-day-vegan-kickstart-program-launches-new-website-and-phone-app>
  - <https://www.pcrm.org/good-nutrition/healthy-communities> (contains resources specific to non-Caucasian communities)
- ✓ WFPB eating does not need to be costly. Staples such as dried legumes, whole grains and frozen vegetables are affordable options at the grocery store
- ✓ Patients with established T2DM may still need to avoid or limit high glycemic index whole plant foods (tropical fruits, whole grain breads/pasta, potatoes) even while following a WFPB diet, as these may cause blood glucose elevation
- ✓ Patients transitioning to an exclusively WFPB dietary pattern can benefit from counselling with a registered dietitian experienced in this area, to ensure adequate intake of nutrients such as iron, calcium and Vitamin B12

## Conclusion

Well-planned WFPB diets can provide adequate nutrients and show evidence for both T2DM prevention and improvement in glycemic control for individuals living with T2DM. With a transition to this dietary pattern some patients may experience rapid improvements in glycemic control, necessitating careful blood glucose monitoring and adjustments of T2DM pharmacotherapy that can cause hypoglycemia. A WFPB dietary pattern can also promote weight loss, primarily via reduced caloric intake that occurs due to the relatively low-calorie density of whole plant foods. In addition, a WFPB dietary pattern is recommended for improving planetary health, as human health and planetary health are inextricably linked.

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## Financial Disclosures

None declared.

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