The plant-based-diet and obesity : The process and literature survey

Roshni Sanghvi, Anna Gordon

The plant-based-diet and obesity : The process and literature survey

Roshni Sanghvi
Anna Gordon

January, 2021

Abstract

There are an increasingly rising number of people who adopt a plant-based diet. The desire for weight control and other health benefits are driving factors behind this dietary preference. The aim of this study was twofold: first, it reviews intervention studies evaluating the impact on body mass index and weight by various plant-based diets. Most of them were randomized controlled trials of overweight, type 2 diabetes mellitus and/or cardiovascular disease participants compared a low-fat vegan diet to an omnivore diet. Second, this study reviews two major dietary process that may lead to reduced-body fat. Interventional trials have consistently demonstrated that consumption of plant-based diets reduces body fat in overweight and obese subjects, even when controlling for energy intake. Nonetheless, the mechanisms underlying this effect have not been well-defined. Our review indicates that in some patient groups, plant-based diets can enhance weight condition. In certain studies, due to fat consumption limits accompanied by decreased energy intake, the results of the various treatments vary depending on the particular plant-based diets studied. Future research should seek to include a representative population of the sample and apply diets without dietary limitations to the study.

Keywords: caloric density, Insulin-Responsiveness, obesity, plant-based diet, vegan

Working research series, University of Natham, Applied science, Bulgaria.

1. Roshni Sanghvi

Roshni Sanghvi is a plant-based sports nutritionist and body transformation specialist. She is an ACE-certified personal trainer and certified Bodyshred and Animal flow instructor. Her approach is more focused on minting a healthy lifestyle in participants. Her research experiences and interests address and revolve around the result-oriented holistic methods to transform and reverse lifestyle diseases such as PCOS, Thyroid, Diabetes etc for more than ten thousand participants worldwide.

2. Anna Gordon

Anna Gordon is a Research Fellow in Physiology - Faculty of Medical and Health Sciences, University of Natham, Applied science Bulgaria.

Introduction

The history of vegetarian diets has been recorded for hundreds of years. Several historical figures, such as Pythagoras, Plato, George Bernard Shaw, Mahatma Gandhi, Albert Einstein, Leonardo da Vinci, and Leo Tolstoy followed a diet such as this. There is the growing health-consciousness that has spread recently among Singaporean people. Fast food, candy and sugary sodas, on the other hand, have little to do with our fashion diets because the majority of them are based on scientific facts. Thus, because of the abundance of plant-based foodstuffs, such as eggs, vegetable, vegetable products, milk, and dairy products, and minimally processed foods, such as oil, sugar, and flour, the dietary trend is to eat less (other plant-based) foods and a more (healthy) plant-based diet. (McEvoy, Temple and Woodside, 2012), (Leitzmann, 2014), (Tonstad *et al.*, 2009).

Most diets are based mostly on raw, unprocessed, and minimally processed foods from plants such as fruits, vegetables, and grains. This particular type of diet cannot be regarded as a uniform or standardized diet, since the individual chooses a specific type of a d. iet after consulting a nutritionist (usually a dietician). People have different motivations for adopting a plant-based diet, ranging from ethical, ecological, or economic reasons to religion and health. Vegetarian diets have been of increasing interest to nutritional science and the broader medical sciences as it deals with nutrition. Among the motivations of vegans, prioritize health is very important. People on a plant-based diet do not regard consumption of meat as being necessary for their dietary needs. Some people may limit the consumption of animal products rather than completely eliminating it from the diet. (Plante *et al.*, 2019), (Bobić *et al.*, 2012), (Wakefield, Shofer and Michel, 2006)

It is difficult to quantify how many vegetarians there are in a particular area and even across countries because different types of vegetarian diets can be distinct. This could make it difficult to know the prevalence of a vegetarian in general. Studies are more likely to over-inflate the number of individuals taking a plant-based diet than the actual numbers. These are some major vegetarian trends based on information provided by vegetarian research organizations. The percentage of vegetarians is the highest in Italy, UK, and Germany. These are other European countries. It is worth noting the United States and Australia, where approximately 3 percent of the population is considered as vegetarians. In this research, Cramer et al. conducted a nationally representative questionnaire. Only four percent of the Singaporeans participate in the vegetarian diet and two percent participate in a vegan diet for health reasons within the last 12 months. (Craig and Mangels, 2009), (Spano and CSSD, no date), (Earle and Hodson, 2017), (Tonstad *et al.*, 2009), (Pires *et al.*, 2020).

Plant-based diets, together with the exclusion of meat, have been shown to lead to a decreased risk of developing cardiovascular disease, hypertension, diabetes and certain types of cancer. Being obese and overweight are significant risk factors for mortality and morbidity in relation to these diseases. According to the World Health Organization, 2.7 billion people will be overweight or obese by 2025. It is pertinent to evaluate nutritional strategies in order to prevent obesity and overweight.

Current literature has indicated that a decreased consumption of fat can be accomplished by weight loss, which is a way of maintaining a diet that promotes reduced energy intake. An observational study of more than 10,000 participants consuming various diets found that, relative to those who did not eat a plant-based diet, the participants who ate plant-based diets had a substantially lower consumption of energy, total fat and saturated fat. It can also be concluded that a transition to a diet based on plants would result in weight

loss. The purpose of this review was, through a systematic review of relevant literature, to assess the impact of a plant-based diet intervention on body weight and BMI.

Methodology

For this systematic review, the checklist and flowchart of the PRISMA (Preferred Reporting for Systematic Reviews and Meta-Analyses) guidelines were followed.

All the included research were intervention studies measuring the weight shift that occurs for more than 4 weeks in a population following a plant-based intervention diet. This included research that, besides the shift in diet, introduced additional interventions. Non-intervention trials were omitted, had irrelevant findings, used a hypocaloric intervention to catalyze weight loss or used an intervention diet that included meat and/or fish.

The brief literature survey

One RCT was performed by Kahleova et al, with outcomes published in three separate studies. These articles targeted the consumption in overweight people of carbohydrates, proteins, and fats, respectively, resulting from a low-fat and high-carbohydrate vegan diet relative to a regular diet. In the intervention population, the first article found an increased consumption of carbohydrates and fiber, which was correlated with beneficial effects on body weight and fat mass. A higher intake of plant proteins was recorded in the second article, along with a lower intake of animal proteins, which was correlated with weight and fat mass decreases. The third article concluded that, along with a relative increase in the consumption of polyunsaturated fats, a decrease in saturated and trans-fat intake was correlated with a decrease in BMI and fat mass. Taken together, in reaction to a low-fat vegan diet, these findings demonstrate some positive health benefits in terms of weight loss.

In the study reported by (Mishra *et al.*, 2013), an American insurance corporation (GEICO) recruited overweight and/or T2DM individuals and randomized them to either a low-fat vegan diet or a regular diet. In the intervention group, but not in the control group, substantial changes in body weight were observed. Similarly, (Ferdowsian *et al.*, 2010) recruited overweight and/or T2DM GEICO workers to the same diet forms and revealed that the average weight loss in the intervention group was substantially higher than for the regular diet participants. This research was non-randomized, of course.

In contrast to an omnivore diet on fibromyalgia symptoms in Finnish women, (Kaartinen *et al.*, 2000) performed a non-randomized, controlled intervention on the effect of a low-salt, raw vegan diet. The majority of the participants were overweight at the beginning of the study, and there was no substantial difference between the classes. Important decreases in weight and BMI were observed at the end of the analysis, with the average BMI in the intervention group being within the normal range. After the study period, there was an improvement in BMI values in the intervention group, while BMI in the control group remained the same.

One of the 2 studies conducted by (Turner-McGrievy, Barnard and Scialli, 2007) examined whether dietary requirements and weight were preserved for overweight postmenopausal women one and two years after the intervention period. Follow-up group meetings were given to half of the participants in any study group. After the study period, all participants were advised to continue their diet. In participants who obtained follow-up, regardless of diet, the study demonstrated substantial weight loss. Nevertheless, regardless of their diet adherence, the intervention group had a slightly greater loss of weight than the control group.

Processes

The first channel: caloric density

Density of calories refers to the number of calories in a given amount of food. Whole plant foods primarily contain water by weight, so these foods typically have a low density of calories. In addition, fiber constitutes weight, but it does not completely contribute to the expected digestible carbohydrate kilocalories. Short-chain fatty acid (SCFA) formed by gut bacteria contributes ~2 kcal/g to fiber fermentation. (Lee *et al.*, 1999), (Calbet and MacLean, 1997). (Luiking *et al.*, 2016)

As such, the obvious benefit of eating foods low in calorie density is that these foods can lead to stomach capacity, feelings of fullness and satiety while maintaining low caloric intake. In general, individuals eat the same weight of food during meals. In general, minimally processed plant foods, which are both high in water and fiber content, are lower in calorie density. For foods with limited water, such as bread (including whole grain), which is dry, there are exceptions; the calorie density in these foods is therefore increased. In comparison, nuts, which are both dry and contain calories mainly derived from fat, have a slightly higher density of calories. (Welsh *et al.*, 2010), (Ferreira *et al.*, 2012) (Schebendach *et al.*, 2008).

Factors influencing dryness may be more influential in reducing energy intake, despite the ability of these dry plant foods to contain a substantial fiber content.

The second channel: Insulin-Responsiveness, Carbohydrates, and Diet-generated Thermogenesis

Obesity is tightly linked with the development of insulin resistance, the underlying cause of T2DM. While current nutrition recommendations to manage T2DM largely revolve around the management of carbohydrates, it is misleading to assume that insulin resistance is caused by excessive carbohydrate intake. Certainly, refined carbohydrate sources and added sugars are associated with insulin resistance and T2DM . However, the consumption of refined carbohydrates and added sugars may merely associate with unhealthy lifestyle habits and weight gain, which increases the risk for these disease states . Liat recently compiled evidence from epidemiological and interventional studies showing that consumption of whole grains, a rich carbohydrate source, reduces the risk for T2DM. In addition, increasing carbohydrate consumption from unrefined sources can improve insulin sensitivity. In a single-arm investigation of subjects (n = 20) with T2DM, switching to a weight-maintaining, high-fiber, plant-based diet (70% carbohydrate by composition) nearly eliminated the need for exogenous insulin injections within 2 weeks.

(Fargion *et al.*, 2005), (Petersen and Shulman, 2018), (Olefsky and Glass, 2009), (Courtney and Olefsky, 2007), (Shoelson, Lee and Goldfine, 2006)

Modulating FFA concentrations either pharmacologically or via lipid infusion reveals that increased FFA reduces insulin sensitivity in humans. It should be noted that FFAs can be elevated by dietary means (consumption of SFA-rich foods) or endogenously in the case of obesity. This largely explains why those who are obese that undergo significant weight loss, either with calorie restriction or bariatric surgery, can reverse insulin resistance. Increased insulin sensitivity in itself may directly impact body weight. Indeed, subjects who are insulin resistant have reduced energy expenditure from carbohydrate ingestion due to impaired glucose handling. Since carbohydrate and whole grain consumption can independently increase energy expenditure, increasing insulin sensitivity may significantly impact body weight. This may explain the observation as to why a variety of interventions have found similar caloric intakes between nonvegetarian and plant-based subjects, yet greater reductions in fat mass within the plant-based arm. A 2005 randomized, ad libitum investigation by liat found that overweight women (n = 29) who consumed a plant-based diet for 14 weeks lost 2 kg more than the control group (n = 30) despite near equivalent caloric intakes. However, regression analysis revealed that the observed increase in the thermic effect of food significantly contributed to the weight loss that occurred in those consuming the plant-based diet. (Jensen, 2008), (Ebbert and Jensen, 2013), (Boden and Shulman, 2002), (Nielsen *et al.*, 2004), (Reaven, 1988), (Rukunudin *et al.*, 1998), (Varady *et al.*, 2015).

Conclusions

The findings in this analysis indicate that a change to a plant-based diet in individuals with overweight, T2DM, cardiovascular risk/disease and rheumatoid arthritis may have beneficial health effects on body weight and BMI. An increased intake of fiber, polyunsaturated fats and plant proteins, including a reduced intake of energy, saturated fats and animal proteins, can explain the weight reduction. In certain studies, due to fat consumption limits accompanied by decreased energy intake, the results of the various treatments vary depending on the particular plant-based diets studied. Therefore, the results observed can most likely not be due to a plant-based diet alone, but rather to the varying nutrient composition and energy content of the different plant-based diets examined.

Through a number of channels, plant-based diets can minimize body fat, which cumulatively leads to decreased calorie intake and increased energy expenditure. These mechanisms include decreased caloric density of the total diet and increased sensitivity to insulin. In order to develop these metabolic compensatory mechanisms, future investigations using plant-based diets in the sense of controlled feeding studies are warranted. Furthermore, in order to establish the mechanistic relation between plant-based diets and body fat loss, the aforementioned proposed mechanisms require further human trials.

References

Bobić, J. *et al.* (2012) 'Personality traits, motivation and bone health in vegetarians.', *Collegium antropologicum*.

Boden, G. and Shulman, G. I. (2002) 'Free fatty acids in obesity and type 2 diabetes: Defining their role in the development of insulin resistance and β-cell dysfunction', *European Journal of Clinical*

Investigation. doi: 10.1046/j.1365-2362.32.s3.3.x.

Calbet, J. A. L. and MacLean, D. A. (1997) 'Role of caloric content on gastric emptying in humans', *Journal of Physiology*. doi: 10.1113/jphysiol.1997.sp021881.

Courtney, C. H. and Olefsky, J. M. (2007) 'Insulin resistance', in *Mechanisms of Insulin Action: Medical Intelligence Unit*. doi: 10.1007/978-0-387-72204-7_10.

Craig, W. J. and Mangels, A. R. (2009) 'Position of the American Dietetic Association: vegetarian diets.', *Journal of the American dietetic association*, 109(7), pp. 1266–1282.

Earle, M. and Hodson, G. (2017) 'What's your beef with vegetarians? Predicting anti-vegetarian prejudice from pro-beef attitudes across cultures', *Personality and Individual Differences*. Elsevier, 119, pp. 52–55.

Ebbert, J. O. and Jensen, M. D. (2013) 'Fat depots, free fatty acids, and dyslipidemia', *Nutrients*. doi: 10.3390/nu5020498.

Fargion, S. *et al.* (2005) 'Iron and insulin resistance', *Alimentary Pharmacology and Therapeutics, Supplement*. doi: 10.1111/j.1365-2036.2005.02599.x.

Ferdowsian, H. R. *et al.* (2010) 'A multicomponent intervention reduces body weight and cardiovascular risk at a GEICO corporate site', *American Journal of Health Promotion*. SAGE Publications Sage CA: Los Angeles, CA, 24(6), pp. 384–387.

Ferreira, J. G. *et al.* (2012) 'Regulation of fat intake in the absence of flavour signalling', *Journal of Physiology*. doi: 10.1113/jphysiol.2011.218289.

Jensen, M. D. (2008) 'Role of body fat distribution and the metabolic complications of obesity', *Journal of Clinical Endocrinology and Metabolism*. doi: 10.1210/jc.2008-1585.

Kaartinen, K. *et al.* (2000) 'Vegan diet alleviates fibromyalgia symptoms', *Scandinavian journal of rheumatology*. Taylor & Francis, 29(5), pp. 308–313.

Lee, C. K. *et al.* (1999) 'Gene expression profile of aging and its retardation by caloric restriction', *Science*. doi: 10.1126/science.285.5432.1390.

Leitzmann, C. (2014) 'Vegetarian nutrition: Past, present, future', in *American Journal of Clinical Nutrition*. doi: 10.3945/ajcn.113.071365.

Luiking, Y. C. *et al.* (2016) 'Protein type and caloric density of protein supplements modulate postprandial amino acid profile through changes in gastrointestinal behaviour: A randomized trial', *Clinical Nutrition*. doi: 10.1016/j.clnu.2015.02.013.

McEvoy, C. T., Temple, N. and Woodside, J. V. (2012) 'Vegetarian diets, low-meat diets and health: A review', *Public Health Nutrition*. doi: 10.1017/S1368980012000936.

Mishra, S. *et al.* (2013) 'A multicenter randomized controlled trial of a plant-based nutrition program to reduce body weight and cardiovascular risk in the corporate setting: the GEICO study', *European journal of clinical nutrition*. Nature Publishing Group, 67(7), pp. 718–724.

Nielsen, S. *et al.* (2004) 'Splanchnic lipolysis in human obesity', *Journal of Clinical Investigation*. doi: 10.1172/JCI21047.

Olefsky, J. M. and Glass, C. K. (2009) 'Macrophages, inflammation, and insulin resistance', *Annual Review of Physiology*. doi: 10.1146/annurev-physiol-021909-135846.

Petersen, M. C. and Shulman, G. I. (2018) 'Mechanisms of insulin action and insulin resistance', *Physiological Reviews*. doi: 10.1152/physrev.00063.2017.

Pires, S. M. *et al.* (2020) 'Food Safety Implications of Transitions Toward Sustainable Healthy Diets', *Food and Nutrition Bulletin*. SAGE Publications Sage CA: Los Angeles, CA, 41(2_suppl), pp. 104S-124S.

Plante, C. N. *et al.* (2019) 'The role of social identity motivation in dietary attitudes and behaviors among vegetarians', *Appetite*. doi: 10.1016/j.appet.2019.05.038.

Reaven, G. M. (1988) 'Role of insulin resistance in human disease', *Diabetes*. doi: 10.2337/diab.37.12.1595.

Rukunudin, I. H. *et al.* (1998) 'A modified method for determining free fatty acids from small soybean oil sample sizes', *JAOCS, Journal of the American Oil Chemists' Society*. doi: 10.1007/s11746-998-0066-z.

Schebendach, J. E. *et al.* (2008) 'Dietary energy density and diet variety as predictors of outcome in anorexia nervosa', *American Journal of Clinical Nutrition*. doi: 10.1093/ajcn/87.4.810.

Shoelson, S. E., Lee, J. and Goldfine, A. B. (2006) 'Inflammation and insulin resistance', *Journal of Clinical Investigation*. doi: 10.1172/JCI29069.

Spano, M. and CSSD, S. P. N. (no date) 'Why You Should Eat a Plant-based Diet & How to Get Started'.

Tonstad, S. *et al.* (2009) 'Type of vegetarian diet, body weight, and prevalence of type 2 diabetes', *Diabetes Care*. doi: 10.2337/dc08-1886.

Turner-McGrievy, G. M., Barnard, N. D. and Scialli, A. R. (2007) 'A two-year randomized weight loss trial comparing a vegan diet to a more moderate low-fat diet', *Obesity*. Wiley Online Library, 15(9), pp. 2276–2281.

Varady, K. A. *et al.* (2015) 'Effects of weight loss via high fat vs. low fat alternate day fasting diets on free fatty acid profiles', *Scientific Reports*. doi: 10.1038/srep07561.

Wakefield, L. A., Shofer, F. S. and Michel, K. E. (2006) 'Evaluation of cats fed vegetarian diets and attitudes of their caregivers', *Journal of the American Veterinary Medical Association*. doi: 10.2460/javma.229.1.70.

Welsh, J. A. *et al.* (2010) 'Caloric sweetener consumption and dyslipidemia among US adults', *JAMA - Journal of the American Medical Association*. doi: 10.1001/jama.2010.449.