

A comparative study of a Vegetarian and Non-vegetarian diet among Type 2 Diabetes Mellitus

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Abstract

Studies have found a lower prevalence of type 2 diabetes mellitus and better control of blood glucose levels among vegetarians. Hence, in this study, a comparison of vegetarians' health status and non-vegetarians was evaluated in type 2 diabetes patients. Differences in physical parameters such as height, weight, and BMI were measured. Biochemical parameters were evaluated for both groups. The HbA1c, lipid profile, calorie, carbohydrate, protein and fat intake were calculated for both groups from 24- hour dietary recall. It was found that vegetarians had a lower BMI, better HbA1c levels, and lipid profile. The finding also showed that vegetarian diet had a higher fiber content in their diets which improves glycemic control when compared to that of the non-vegetarians. Non- vegetarians had a higher percentage of the fatty liver when compared with vegetarians. Therefore, taking a vegetarian diet was found to be slightly more protective for diabetic patients when compared to the patients who consumed non-vegetarian foods

Keywords: Diabetes Mellitus, lipid profile, vegetarian diet, Non-vegetarian diet

Introduction

Diet plays an important role in diabetes prevention and management. According to the American Diabetes Association (ADA), various eating patterns are acceptable for the management of diabetes¹. The impacts of vegetarian eating patterns on the risk of type 2 diabetes, glycemic control,

and prevention of diabetes comorbidities have been the focus of several recent research studies. Vegetarian diets encompass several diet types, including semi-vegetarian (flexitarian), pesco-vegetarian, Lacto-vegetarian, ovo-vegetarian, lacto-ovo-vegetarian, vegan, and rawfood vegan diets. Semi-vegetarians include small amounts of meat, mainly from fish and poultry. Pesco-vegetarians ingest some fish, in addition to foods of animal and plant origin. Milk and dairy products are ingested by Lacto-vegetarians; ovo-vegetarians include eggs; and Lacto ovo-vegetarians ingest both dairy products, including milk and eggs.

Vegetarian diets have been associated with improvements in many modifiable heart disease risk factors, including serum lipid profile, serum glucose concentration, and systolic and diastolic blood pressure^{2, 3, 4, 5}. Consequently, vegetarians have been shown to have a lower risk of hospitalization or death from ischemic heart disease⁶. Furthermore, vegetarian diets have been shown to regress arterial stenosis among heart disease patients⁷. These diets are also associated with reduced risk of other health conditions, including type 2 diabetes, some types of cancer, diverticular disease, and cataracts^{8, 9, 10, 11}.

Material and Methods

This study was conducted at MV Hospital for Diabetes, a tertiary care Centre for diabetes in Chennai, South India. One hundred participants were recruited for the study. These participants were divided into

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two groups. Group, I included vegetarians, and Group II was non-vegetarians. In group I, 36 participants were men and 14 were women, and in group II 32 participants were men, and 18 were women. Anthropometric measurements like height, weight, BMI were taken.

Biochemical parameters of all 100 participants were estimated using fasting and postprandial blood samples; fasting blood glucose, postprandial blood glucose, HbA1c, and lipid profile was evaluated. 24 hours dietary recall was documented for both groups. Dietary intake of calories, carbohydrate, protein, and fat was calculated using the recipe calculator software. The fasting and postprandial glucose was measured enzymatically on an automatic analyzer (BS-400mind ray). HbA1c was quantified using immuno turbi metric method (Cobas 311), total cholesterol and triglyceride using enzymatic method, and LDL by direct measurement (BS-400mind ray), and HDL were measured using immuno inhibition method.

Objectives of the study

1. To observe Physical Parameters such like Height, Weight, and BMI.
2. To see the effects of Vegetarian and Non-vegetarian diets among T2DM, fasting blood sugar, Post Prandial blood sugar, HbA1c, Lipid Profile, Liver parameters.

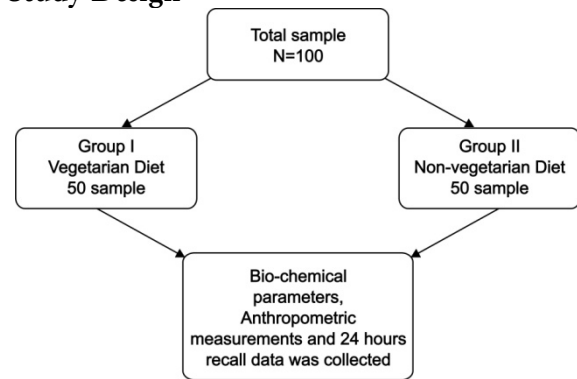
Inclusion criteria

- Patients with type 2 DM
- Both male and female
- Patients from age 30-65
- Patients who are only on OHA.

Exclusion criteria

- i. Type 1 DM
- ii. Gestational diabetes patients
- iii. Diabetic complications.

Study Design



Statistical Method

Statistical analysis was performed using IBM SPSS version 2.0. Overall analysis was done for both the groups using descriptive analysis. The comparison between vegetarian and non-vegetarian groups was done by the one-way ANOVA method.

Results

A total of 100 participants were recruited for the study and divided into two groups. Fifty participants were vegetarians and formed group I, and the other 50 participants were non-vegetarian.

The subjects mean ages were 53.32 ± 8.8 for group I and 50.54 ± 9.9 for group II

Table 1 Anthropometric Measurements

Variables	Group I (Vegetarian)	Group II (Non-vegetarian)
Age (Years)	53.32 ± 8.8	50.54 ± 9.96
Height (cms)	162.68 ± 8.42	163.42 ± 9.05
Weight (Kg)	66.374 ± 9.35	77.63 ± 19.52
BMI	25.019 ± 2.49	28.87 ± 5.85

Values are mean $\pm$ SD

The mean weight was 66.374 ± 9.35 and 77.63 ± 19.52 for group I and II respectively. . BMI was 25.019 ± 2.49 and 28.87 ± 5.85 for group I and II, respectively. (Table 1) It can be seen from the table that the weight and the BMI of the non-vegetarian group were higher.

Table 2 depicts the range of BMI of both groups.

Table 2 Comparison of BMI between both groups

BMI range	Classification	Group I (Vegetarian)	Group II (Non-vegetarian)
18.5 - 22.9	Normal	13	8
23 - 24.9	Overweight	16	5
25 - 29.9	Obese class I	20	17
> 30	Obese class II	1	20

Values are mean $\pm$ SD

On comparing the BMI of the two groups, 13 participants were in the normal BMI range in group I while only 8 in group II. Participants who were overweight were 16 from group I and five from group II. In obese class 1, there were 20 from group I and 17 from group II. Similarly, obese class II had only 1 participant from the vegetarian group but had 20 from the non-vegetarian group. On average, non-vegetarians were more prone to obesity than vegetarians

Table 3 Comparison of blood glucose and HbA1c levels of both groups

Variables	Group I	Group II
FBS	125.06 $\pm$ 33.98	200.38 $\pm$ 69.63
PPBS	195.28 $\pm$ 58.04	282.44 $\pm$ 117.62
HbA1c	6.7 $\pm$ 0.49	9.48 $\pm$ 1.93

Table 3 gives the fasting, postprandial, and HbA1c levels of the groups. There was a difference between both groups. Participants who were from group I had a satisfactory HbA1c when compared to that of group II. Because vegetarian participants have consumed more fiber with moderate amount of fat, which shows the normal level of HbA1c and triglycerides, this proves to have a beneficial effect in maintaining glycemic control when compared with non-vegetarians. It was also seen that vegetarians had a higher intake of fiber-containing vegetables (Table 4)

Table 4 shows the frequency of food eaten by both groups. The intake of high fiber foods is relatively less among the non-

Table 4 Average of food frequency (% of subjects consuming)

FOOD LIST	Daily		Alternate days		Once a week		Twice a month		Never	
	Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II
Agathi	-	-	-	-	-	4	54	28	46	68
Ponagani	-	-	-	-	-	-	42	28	58	72%
Drumstick leaves	-	-	-	-	14	6	72	18	14	42%
Carrot	-	-	-	6	-	10	22	40	78	44%
Potato		10		8		10	10	28	90	44%
Raddish	-	-	-	-		14	10	38	90	48%
Ladies finger	-	-	8	6	36	16	54%	66	2%	14
Drumstick	-	-	10	-	42	24	46%	68	2%	8
Brinjal	2	6	14	4	38	18	42%	64	4%	8
Onion	92	100	-	-	-	-	-	-	8	-
Tomato	98	100					2			
Snake gourd					6	2	70	28	24	70
Bitter gourd					10	2	66	26	24	72

vegetarian group as many of them reported that on the days NV items were cooked, there were no vegetables in the meal. It is observed that 42% to 72% of the subjects in group II and 14% to 58% in group I did not include green leafy vegetables in the diet.

The intake of other high fiber foods was also relatively less in group II while the use of roots and tubers (high starch vegetables) was more in group II

Table 5 Intake of Non-vegetarian foods

FOOD LIST	Daily	Alternate days	Once a week	Twice a month	Never
Egg white	32%	2%	8%	6%	52%
Egg whole	22%	16%	8%	6%	48%
Chicken with skin	2%	10%	38%	20%	30%
Chicken without skin	4%	6%	54%	20%	16%
Mutton	2%	14%	52%	32%	-
Crab	-	-	-	8%	92%
Prawn	-	-	8%	42%	50%
Fish	-	4%	2%	36%	60%

From table 5, it is seen that 22% to 32% consumed eggs daily, 6% to 10% consumed chicken on alternate days, and 52% consumed red meat at least once a week.

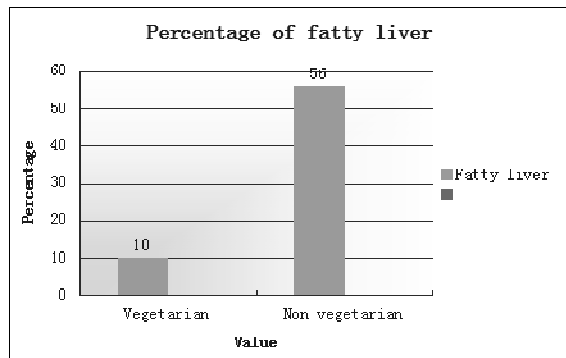


Figure 1:

Values are mean $\pm$ SD

Figure 1 represents the percentage of fatty liver, which was seen for both the groups. There were only 10% from the vegetarian group who had fatty liver, but there were 56% showed evidence of fatty liver in the non-vegetarian group.

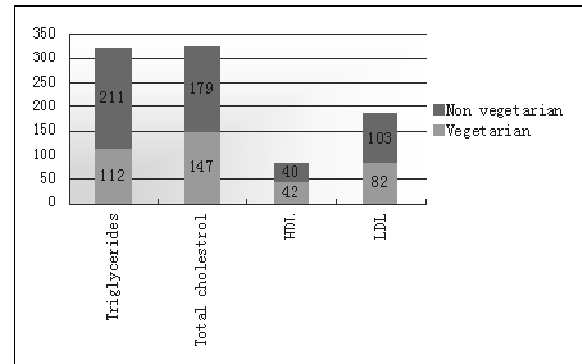


Figure 2: Lipid Profile of Participants

Values are mean $\pm$ SD

This figure represents the lipid profile of both the vegetarian and non-vegetarian groups. From figure 2, it was observed that total cholesterol and LDL were elevated in group II while HDL levels were slightly less in this group.

Table 6: Diet intake of both Groups

Variables	Group I (Vegetarian)	Group II (Non-vegetarian)
Calories	1251 $\pm$ 122.25	1343 $\pm$ 237.54
protein	40 $\pm$ 7.78	45 $\pm$ 8.3
Carbohydrate	199 $\pm$ 24.9	204 $\pm$ 60.4
Fat	29 $\pm$ 5.57	34 $\pm$ 10.3

Values are mean $\pm$ SD

Table 5 shows the total intake of calories, carbohydrates, protein, and fat intake. Group II shows a higher intake of calories and fat which correlates with a higher BMI of this group.

Discussion

The prevalence of diabetes is on the rise, both in the United States and worldwide. According to the International Diabetes Federation (20), ~415 million individuals

worldwide have diabetes. This number is projected to increase to 642 million by 2040. Epidemiological studies^{5,12,13} comparing the prevalence of type 2 diabetes among vegetarians and non-vegetarians have shown that vegetarians have a lower risk. Thus, it is logical to conclude that the promotion and adoption of a vegetarian diet may help in controlling the diabetes epidemic.

The lower risk of type 2 diabetes among vegetarians may be explained in part by improved weight status (i.e., lower BMI)⁸. However, the lower risk also may be explained by higher amounts of ingested dietary fiber and plant protein, the absence of meat and egg-derived protein and heme iron, and a lower intake of saturated fat¹²⁻¹⁷. Most studies report the lowest risk of type 2 diabetes among individuals who adhere to vegan diets. This may be explained by the fact that vegans, in contrast to ovo- and Lacto- ovo-vegetarians, do not ingest eggs. Two separate meta-analyses^{18,19} linked egg consumption with a higher risk of type 2 diabetes. The studies included in the meta-analysis that assessed the impact of vegetarian diets on plasma glucose showed that vegetarian diets not only improved glycemic control, but they also did so to a greater level than did control diets, including diets based on carbohydrate counting²⁰. Also, these diets were associated with an improvement of secondary outcomes, such as weight reduction, serum lipid profile, and systolic and diastolic blood pressure.

A review article²¹ has reported that a vegetarian diet helps in preventing diabetes, treatment, and reducing diabetes complications. The differences in therapeutic effects of the various vegetarian diets may be explained by examining what types of foods are beneficial for diabetes prevention and management. Increased fiber, fruit, and vegetable intake replacing meat with other types of protein foods may incorporate more beneficial nutrients into the diet. For example,

soybeans are a common protein substitution for lacto-ovo-vegetarians and vegans. This food is high in lysine, leucine, isoleucine, phenylalanine, calcium, and phosphate, all of which have been shown to aid in increasing glycemic control and insulin sensitivity^{22, 23}. Overall, vegetarians have a higher intake of fruits and vegetables, fiber, and antioxidants, and phytochemicals. There is evidence that high consumption of fruits and vegetables can decrease the risk of developing T2DM^{24, 25}. The high amounts of soluble fiber in the diet may be beneficial for diabetes management, as soluble fiber binds glucose, slowing absorption into the blood²⁵. Higher intake of whole grains and vegetables has been found in vegetarians compared to non-vegetarians²², and these foods have high amounts of fiber and magnesium. Whole grains have been found to reduce the risk of developing diabetes²⁵. Consuming sufficient amounts of magnesium is important, as a deficiency can possibly impair insulin signaling²².

Conclusion

The benefits of all types of vegetarian diets in the prevention and treatment of diabetes have been well established. Clinicians and healthcare providers should feel confident in recommending a vegetarian diet to their patients who have pre-diabetes or T2DM. However, the type of foods that should be consumed while following this diet is critical to achieving the therapeutic effects. As Satija et al.²⁶ demonstrated, a vegetarian diet that is high in unhealthy foods such as refined grains, saturated fats, and added sugars is positively associated with T2DM compared to a vegetarian diet with lower amounts of these nutrients. The foods that are important to consume while following a vegetarian diet for treating diabetes are whole grains, fruits, vegetables, nuts, legumes, and unsaturated fats.

Each of these foods has functional components that reduce the symptoms of diabetes. For these reasons, patient education is

extremely important to ensure adherence to a healthy vegetarian diet. No matter the type of vegetarian diet followed, there are therapeutic effects. However, there is evidence that a vegan diet has the most benefits for reducing the fasting plasma glucose levels of persons with diabetes and other complications, such as CVD risk. Patients should follow the diet that they feel they can adhere to.

References

1. Evert AB, Boucher JL, Cypress M, et al.; American Diabetes Association. Nutrition therapy recommendations for the management of adults with diabetes. *Diabetes Care* 2013;36:3821–3842
2. Ferdowsian HR, Barnard ND. Effects of plant-based diets on plasma lipids. *Am J Cardiol* 2009;104:947–956
3. Pettersen BJ, Anousheh R, Fan J, Jaceldo-Siegl K, Fraser GE. Vegetarian diets and blood pressure among white subjects: results from the Adventist Health Study-2 (AHS-2). *Public Health Nutr* 2012;15:1909–1916
4. Barnard ND, Katcher HI, Jenkins DJ, Cohen J, Turner-McGrievy G. Vegetarian and vegan diets in type 2 diabetes management. *Nutr Rev* 2009;67:255–263
5. Tonstad S, Stewart K, Oda K, Batech M, Herring RP, Fraser GE. Vegetarian diets and incidence of diabetes in the Adventist Health Study-2. *Nutr Metab Cardiovasc Dis* 2013;23:292–299
6. Crowe FL, Appleby PN, Travis RC, Key TJ. Risk of hospitalization or death from ischemic heart disease among British vegetarians and nonvegetarians: results from the EPIC-Oxford cohort study. *Am J Clin Nutr* 2013;97:597–603
7. Gupta SK, Sawhney RC, Rai L, et al. Regression of coronary atherosclerosis through healthy lifestyle in coronary artery disease patients: Mount Abu Open Heart Trial. *Indian Heart J* 2011;63:461–469
8. Tonstad S, Butler T, Yan R, Fraser GE. Type of vegetarian diet, body weight, and prevalence of type 2 diabetes. *Diabetes Care* 2009;32:791–796
9. Tantamango-Bartley Y, Jaceldo-Siegl K, Fan J, Fraser G. Vegetarian diets and the incidence of cancer in low risk population. *Cancer Epidemiol Biomarker Prev* 2013;22:286–294
10. Appleby PN, Allen NE, Key TJ. Diet, vegetarianism, and cataract risk. *Am J Clin Nutr* 2011;93:1128–1135
11. Crowe FL, Appleby PN, Allen NE, Key TJ. Diet and risk of diverticular disease in Oxford cohort of European Prospective Investigation into Cancer and Nutrition (EPIC): prospective study of British vegetarians and non-vegetarians. *BMJ* 2011;343:d4131
12. Yao B, Fang H, Xu W, et al. Dietary fiber intake and risk of type 2 diabetes: a dose-response analysis of prospective studies. *Eur J Epidemiol* 2014;29:79–88
13. Sluijs I, Beulens JW, van der ADL, Spijkerman AM, Grobbee DE, van der Schouw YT. Dietary intake of total, animal, and vegetable protein and risk of type 2 diabetes in the European Prospective Investigation into Cancer and Nutrition (EPIC)-NL study. *Diabetes Care* 2010;33:43–48
14. White DL, Collinson A. Red meat, dietary heme iron, and risk of type 2 diabetes: the involvement of advanced lipoxidation endproducts. *Adv Nutr* 2013;4:403–411
15. Satija A, Bhupathiraju SN, Rimm EB, et al. Plant-based dietary patterns and incidence of type 2 diabetes in US men and women: results from three prospective cohort studies. *PLoS Med* 2016;13:e1002039
16. Comerford KB, Pasin G. Emerging evidence for the importance of dietary protein source on glucoregulatory markers and type 2 diabetes: different effects of dairy, meat, fish, egg, and plant protein foods. *Nutrients* 2016;8:pii:E446
17. Viguioliuk E, Stewart SE, Jayalath VH, et al. Effect of replacing animal protein with plant protein on glycemic control in diabetes: a systematic review and meta-analysis of randomized controlled trials. *Nutrients* 2015;7:9804–9824
18. Shin JY, Xun P, Nakamura Y, He K. Egg consumption in relation to risk of cardiovascular disease and diabetes: a systematic review and meta-analysis. *Am J Clin Nutr* 2013;98:146–159
19. Li Y, Zhou C, Zhou X, Li L. Egg consumption and risk of cardiovascular diseases and diabetes: a meta-analysis. *Atherosclerosis* 2013;229:524–53028.
20. Yokoyama Y, Barnard ND, Levin SM, Watanabe M. Vegetarian diets and glycemic control in diabetes: a systematic review and meta-analysis. *Cardiovasc Diagn Ther* 2014;4:373–382
21. Melissa D. Olfert1 & Rachel A. Wattick Vegetarian Diets and the Risk of Diabetes *Current Diabetes Reports* (2018) 18: 101
22. Chiu THT, PanW-H, Lin M-N, Lin C-L. Vegetarian diet, change in dietary patterns, and diabetes risk: a prospective study. *Nutr Diabetes*. 2018;8:12. <https://doi.org/10.1038/s41387-018-0022-4>.

23. Pathak M. Diabetes mellitus type 2 and functional foods of plant origin. *Recent Pat Biotechnol.* 2014;8(2):160–4.
<https://doi.org/10.2174/1872208309666140904120633>.
 24. McEvoy CT, Temple N, Woodside JV. Vegetarian diets, low-meat diets and health: a review. *Public Health Nutr.* 2012;15(12):2287–94.
<https://doi.org/10.1017/S1368980012000936>.
 25. McMacken M, Shah S. A plant-based diet for the prevention and treatment of type 2 diabetes. *J Geriatr Cardiol.* 2017;14(5):342–54.
<https://doi.org/10.11909/j.issn.1671-5411.2017.05.009>.
 26. Satija A, Bhupathiraju SN, Rimm EB, et al. Plant-based dietary patterns and incidence of type 2 diabetes in US men and women: results from three prospective cohort studies. *PLoS Med.* 2016;13(6):e1002039.
<https://doi.org/10.1371/journal.pmed.1002039>.
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