



## Research Article

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### NON-VEGETARIAN DIET AS A RISK FACTOR FOR TYPE II DIABETES: A RETROSPECTIVE STUDY OF CROSS-SECTIONAL POPULATION IN BENGALURU, KARNATAKA, INDIA

Chandini Chandrasekharan <sup>1\*</sup>, Sulochana Bhat <sup>2</sup>, Raghavendra Naik <sup>3</sup>, Anjana KS <sup>4</sup>

<sup>1</sup> Consultant (Ayu), Centre of Excellence in Research and Clinical Services for Madhumeha (Diabetes mellitus), Central Ayurveda Research Institute (Unit of CCRAS), Bengaluru, Karnataka, India

<sup>2</sup> Assistant Director in Charge and PI of Centre of Excellence in Research and Clinical Services for Madhumeha (Diabetes mellitus), Central Ayurveda Research Institute, Bengaluru, Karnataka, India

<sup>3</sup> Research Officer (CCRAS), Bureau of Indian Standards (BIS) headquarters, New Delhi, India

<sup>4</sup> Senior Research Fellow (Biostatistics), Centre of Excellence in Research and Clinical Services for Madhumeha (Diabetes mellitus), Central Ayurveda Research Institute, Bengaluru, Karnataka, India

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#### \*Corresponding author

E-mail: chandni.nambiar@gmail.com

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#### ABSTRACT

Background: Diabetes is a chronic condition that can be avoided or postponed via proper eating and weight management. Some research shows that the prevalence of type-II Diabetes increases from vegans to non-vegetarians. Additionally, the results of many studies have consistently connected consuming meat with a higher risk of developing Diabetes; more research would be beneficial to ascertain if a non-vegetarian diet can be considered a therapeutically important risk factor. Objective: To understand the association between non-vegetarian diet and type-II Diabetes. Methods: Retrospective OPD data from March 2022 to March 2023 of 1011 type-II diabetes patients, aged 24-85, without a history of high-fat diet or genetics, were included. Descriptive statistics were used to summarise demographic data to conclude. Categorical data were summarised using proportions, and continuous data were summarised using mean and standard deviation. The chi-square test was applied to test for associations. Results: The study also revealed that 720 (71.2%) subjects consumed a non-vegetarian diet. Among the study population, only 29.6% of the respondents were doing regular exercises. In this study, the mean (n=1011) BMI was  $26.47 \pm 4.32$  kg/m<sup>2</sup> with a minimum of 11.5 and a maximum of 49.9. The chi-square test showed an association ( $p < 0.001$ ) difference between the type of diet with respect to education, occupation, physical activity and BMI. Non-vegetarian diet was predominant across all socioeconomic and demographic categories, with a prevalence of high BMI and type-II Diabetes. Conclusion: Even though the study methodology cannot fully rule out the potential of confounding effects, the findings that a non-vegetarian diet is a risk factor for Diabetes offer clinical practitioners and those at risk with helpful direction and pave the way for positive behavioural adjustments.

**Keywords:** Non-vegetarian diet, Prameha, Type-II Diabetes

#### INTRODUCTION

Diabetes is a chronic illness that can be prevented or delayed by living a healthy lifestyle and maintaining a healthy weight. <sup>1</sup> Maintaining a healthy body weight and lowering the risk of type-II Diabetes require eating a balanced diet and engaging in physical activity. Diabetes is correlated to Prameha roga, mentioned in Ayurveda texts, due to the similarity of symptoms. Prameha is categorised based on a variety of criteria, including genetics, environmental circumstances, behavioural issues and dietary habits. <sup>2</sup> Adverse diet and lifestyle choices are among the acquired causes of Prameha, <sup>3</sup> but it is unclear how much the Indian diet contributes to the country's rising diabetes prevalence. A vegetarian diet, one that excludes meat, fish, and fowl in the broadest sense, may have a protective role in the development of Diabetes while the prevalence of type-II Diabetes rises from vegans to non-vegetarians, according to some studies. <sup>4,5</sup> Similarly, regular use of anupa mamsa (meat from terrestrial animals), audaka mamsa (meat from aquatic animals) and gramya mamsa (meat from domesticated animals), according to Ayurvedic literature can cause overnutrition and is one of the main etiological factors in the development of Prameha. <sup>6</sup> Additionally, meat-eating has been repeatedly linked to an increased risk of Diabetes, according to several study findings. <sup>7,8</sup> Therefore, a retrospective cross-sectional study was conducted to

understand the association between non-vegetarian diet and type-II Diabetes, and further study would be helpful to determine if a non-vegetarian diet can be therapeutically meaningful as a risk factor.

#### MATERIALS AND METHODS

Data from 1011 type-II diabetic patients aged 24-85 who attended the OPD between March 2022 and March 2023 were used for the study. Patient data with a history of frequent use of high-fat diets and genetic predispositions were excluded from the research. Insulin resistance was assessed through blood investigation during their OPD visit. This study is retrospective; participant information was kept confidential, and there was little to no risk associated with the research. Nonetheless, the hospital administration has granted prior approval for the data to be analysed anonymously. Diabetes patients' socio-demographic information and self-care practises were noted separately, as well as in connection to the kind of food they consume. Dietary consumption was assessed based on the sorts of vegetarian diets that the patients often follow. Diabetic patients who consume chicken, fish or other meat items, dairy products along with fruits, vegetables, pulses or beans are categorised as non-vegetarians, and those who include fruits, vegetables, pulses or beans, dairy products but no fish, eggs, chicken or meat are grouped under

lacto-vegetarians. Those who identified themselves as lacto-ovo vegetarians admitted to consuming just fruits, vegetables, pulses or beans, milk or milk products, and eggs, but not any fish, poultry, or other sorts of meat, whereas vegan status is given to patients who never consume any animal products of any kind. The body mass index (BMI) of each patient was calculated using kg/m<sup>2</sup> and classified in relation to the type of diet. The classification was based on BMI criteria according to the World Health Organisation (WHO).<sup>9</sup> Patients were categorised as underweight if their BMI was less than 18.5; normal weight if their BMI was between 18.5 and 24.9; overweight if their BMI

was between 25.0 and 29.9; and obese Class I, II, or III if their BMI was between 30 and 34.9, 35 and 39.9, and 40 and above, respectively.

Data were analysed using STATA version 17.0, licensed to the Institute. Descriptive statistics were used to summarise demographic data and arrive at a conclusion. Categorical data were summarised using proportions, and continuous data were summarised using mean and standard deviation. The chi-square test was applied to test for associations.

**RESULTS**

**Table 1: Socio-demographic characteristics of type-II diabetic patients aged 24-85 years**

Category	Percentage
<b>1. Age (Mean±SD)</b>	54.44±11.50
<b>2. Gender</b>	
Male	614 (60.7)
Female	397 (39.3)
<b>3. Marital status</b>	
Ever married	913 (90.3)
Never married	24(2.4)
Separated/ Widow/Widower	74 (7.3)
<b>4. Education</b>	
Primary school	174 (17.2)
Secondary school	274 (27.1)
Graduate	225 (22.3)
Postgraduate or higher	47 (4.6)
Intermediate/Diploma	137 (13.6)
Illiterate	153 (15.1)
Pre-University Course	1 (0.1)
<b>5. Occupation</b>	
Professional and semi-professional	198(19.6)
Skilled worker and farmer	169 (16.7)
Semi and unskilled	271 (26.8)
Unemployed including homemakers	305 (30.3)
Retired	67 (6.6)

**Table 2: Diabetes self-care behaviours amongst type-II diabetic patients aged 24-85 years**

Smokeless Tobacco	
No	991 (98)
Yes	20 (2)
Current smoking	
No	918(90.8)
Yes	93 (9.2)
Other addictions	
No	978(96.74)
Yes	33(3.26)
Physical Activity	
No	30 (3)
Non-regular	681 (67.4)
Regular	300 (29.6)
Diet	
Non-vegetarian	720 (71.22)
Ovo-vegetarian	9 (0.89)
Vegan	2 (0.20)
Vegetarian	280 (27.7)

**Table 3: body mass index (BMI) of participants (n=1011)**

*BMI (kg/m <sup>2</sup> )	n (%)
< 18.5	15 (1.5)
≥18.5 and <24.9	360 (35.6)
≥ 25.0 and <29.9	441 (43.6)
≥30 and < 34.9	158 (15.6)
≥35 and< 39.9	28 (2.7)
BMI ≥40	9 (1)

**Table 4: Percentage distribution of non-dietary variables according to types of diet consumption in population (n = 1011) aged 24-85 years**

Characteristics	Type of diet				Chi-square p values *
	Non-Veg	Ovo-Veg	Veg	Vegan	
<b>Sex</b>					
Male	446 (72.64)	7 (1.14)	161 (26.22)	0	>0.001
Female	274 (69.2)	2 (0.50)	119(29.97)	2 (0.50)	
<b>Education</b>					
Primary school	147 (84.97)	2(1.16)	24(13.87)	0	<0.001
Secondary school	200 (73.8)	2 (0.74)	69 (25.46)	0	
Graduate	122 (54.22)	2 (0.89)	101 (44.89)	0	
Postgraduate or higher	22 (46.81)	0	24 (51.06)	1 (2.13)	
Intermediate/Diploma	91 (67.41)	3 (2.22)	41 (30.37)	0	
Illiterate	132 (86.84)	0	19 (12.50)	1 (0.66)	
Pre-University Course	0	0	1	0	
<b>Occupation</b>					
Professional and semi-professional	122(61.6)	3 (1.5)	73 (36.87)	0	<0.001
Skilled worker and farmer	224 (84.21)	1.13	39 (14.66)	0	
Semi and unskilled	60(89.55)	0	7 (10.45)	0	
Unemployed including homemakers	217(71.15)	1 (0.33)	86 (28.2)	1 (0.33)	
Retired	92(54.44)	2 (1.18)	74(43.79)	1 (0.59)	

**Table 5: Percentage distribution of lifestyle and self-care behaviours according to types of diet consumption in the population (n = 1011) aged 24-85 years**

Characteristics	Non-Veg	Ovo-Veg	Veg	Vegan	Chi-square p values *
<b>BMI</b>					
BMI < 18.5	10 (66.67)	0	4(26.67)	1 (6.67)	<0.001
≥18.5 and <24.9	222 (61.7)	3(0.83)	134(37.22)	1 ((0.28)	
≥ 25.0 and <29.9	336(76.19)	5(1.13.)	100(22.68)	0	
≥30 and < 34.9	122(77.22)	1 (0.63)	35 (22.150)	0	
≥35 and< 39.9	22(78.57)	0	6 (21.43)	0	
BMI ≥40	8 (88.89)	0	1 (11.11)	0	
<b>Current smoking</b>					
No	647 (70.48)	9 (0.98)	260(28.32)	2(0.22)	>0.001
Yes	73 (78.49)	0	20 (21.51)	0	
<b>Tobacco</b>					
No	702 (70.84)	9 (0.91)	278 (28.05)	2 (0.20)	>0.001
Yes	18 (90)	0	2 (10)	0	
<b>Other addictions</b>					
No	690 (70.55)	9 (0.92)	277 (28.32)	2 (0.20)	>0.001
Yes	30 (91)	0	3 (9)	0	
<b>Physical activity/Exercise</b>					
No	21 (70)	0	9 (30)	0	<0.001
Non-regular	518 (76.06)	5 (0.73)	157 (23.05)	1 (0.15)	
Regular	181 (60.33)	4 (1.33)	114 (38)	1 (0.33)	

The present study population consisted of type-II diabetes patients (n=1011) aged 24-85 years; 60.7% were male, and 39.3% were female. The mean age of the patients was 54.44±11.50 years. Prevalence of Diabetes was observed, and Diabetes was more (58.8%) common in the highest age group (55-65 years). Developing countries like India, which was also seen in the current study, have a larger number of diabetics in the age range of 52 to 66 years due to the early beginning of the disease.<sup>10</sup> Surveys indicate that prevalence rises sharply with age. Type-II diabetes mellitus usually appears in the middle years of life and begins to increase in frequency after that. The findings showed that 85% were literate, and 19.6 % of the subjects had a high occupation level (Table 1).

The study also revealed that 720 (71.2%) subjects consumed a non-vegetarian diet. Among the study population, only 29.6% of the respondents were doing regular exercises. (Table 2).

The mean Body Mass Index (BMI) of the study participants was 26.4±4.32 kg/m<sup>2</sup>. According to BMI, 43.6% of patients were overweight. 16% were found to be obese Class I, 3% were found to be obese Class II, and 0.89% were obese Class III, thus a total of 62.9% falling under overweight/obese category. Higher BMI and hyperlipidaemia are significant and distinct risk factors for type-II Diabetes.<sup>11</sup> In this study, the mean (n=1011) BMI was 26.47±4.32 kg/m<sup>2</sup> with a minimum of 11.5 and a maximum of 49.9. It demonstrates parallels with other research findings.<sup>11,12</sup> (Table 3)

Socioeconomic demographic and lifestyle characteristics varied significantly between dietary groups, but overall, non-vegetarian diet was predominant across all socioeconomic and demographic categories. The prevalence of Diabetes and overweight is high among non-vegetarians. Two-thirds of the respondents were males (n=614, 60.7%), and the majority (72.64%) are in taking non-vegetarian food. In India, non-vegetarian food consumption has increased significantly during the previous six years, especially among men.<sup>13</sup> Among the respondents doing regular and non-regular exercises and not doing any exercises, 60%, 76%, and 70% are non-vegetarians, respectively. The chi-square test showed an association (p<0.001) difference between the type of diet with respect to education, occupation, physical activity and BMI (Table 4 and 5).

## DISCUSSION

Diabetes is a condition of lifestyle. In the last 10 years, industrialisation, urbanisation, and economic growth have all accelerated, while eating habits and lifestyles have changed. These changes have significantly influenced population health and nutrition, particularly in developing nations. Even if diets have gotten more diverse, food alternatives have expanded, and access to services has increased, several significant adverse impacts must be taken into consideration, such as developing bad eating habits and a decline in physical activity, which can significantly improve chronic diet-related illnesses like Diabetes.<sup>14</sup> Although type-II Diabetes has a significant genetic propensity, its early start<sup>15</sup> and higher incidence in the 55–65 age range point to the influence of environmental factors, particularly obesity and physical inactivity (Table 1).

Non-vegetarian diet was predominant across all socioeconomic and demographic categories, with the prevalence of high BMI and type-II Diabetes, according to the study. This study methodology cannot completely rule out the possibility of confounder effects, and for further validity, the research topic can be further investigated using a clinical trial or case-control strategy. As per Ayurveda, an unhealthy lifestyle, including regular intake of meat from terrestrial animals or animals of the marshy region, aquatic animals, and domesticated animals, may primarily lead to increased production and vitiation of Kapha dosha (regulatory factor responsible for body fluids and keeping the body constituents cohesive), medo dhatu (fat tissues) and mutra (urine) giving rise to Prameha roga.<sup>6,16</sup> Overweight or obesity is a clinical hallmark of the Kapha-Medra (regulatory factor responsible for body fluids and keeping the body constituents cohesive and fat tissue) vitiation. Although several study reports have associated obesity and being overweight with an increased risk for Diabetes, it's probable that the saturated fat present in meats, especially red meats, might contribute to diabetes risk. This is true even if non-vegetarian cuisine is an excellent source of many nutrients. Consuming meat products with saturated fats can greatly increase the amount of insulin secreted, which may cause insulin resistance and the emergence of type-II Diabetes mellitus.<sup>17</sup> Additionally, those who often used high-temperature cooking techniques had a higher chance of gaining weight and becoming obese, which may have contributed to the development of Diabetes.<sup>18</sup> Therefore, the key to diabetes prevention is

maintaining a healthy body weight and avoiding gaining weight as an adult. Research studies also revealed that non-vegetarian patients' blood glucose levels were higher than those of vegetarians and patients who regularly consumed junk food.<sup>19</sup> Hence, reducing red and processed meat intake, which may be substituted with other protein sources, including chicken, lean fish, and plant-based diets, is crucial to lower the risk of developing Diabetes. A non-vegetarian diet plan that encourages the consumption of lean meats (chicken, turkey, etc.) that are high in protein and low in calories may assist in maintaining a healthy body weight and minimise the risk of developing Diabetes. Similarly, Indian meals containing marine lean fish rich in omega-3 fatty acids are found to be beneficial to diabetic risk and obesity management.<sup>20,21</sup> The research also indicates that switching to unsaturated (polyunsaturated and/or monounsaturated) fats instead of trans fatty acids and saturated fats improves insulin sensitivity and may lower the incidence of type-II Diabetes.<sup>22</sup>

It has been noted that non-vegetarians predominate among people with diabetes with low (66.67) and normal (61.7%) BMIs. Regardless of body weight, the kind or quality of dietary fat and carbohydrates is more important in predicting diabetes risk than the quantity.<sup>23</sup> Similarly, eating more meat, mainly processed meat, is often linked to having more visceral fat. In particular, among metabolically obese people with normal body weight (MONW), visceral adipose tissue plays a significant role in the development of type-II Diabetes and glucose intolerance due to the presence of increased proinflammatory cytokines produced by visceral fat cells and adipose tissue-resident macrophages.<sup>24</sup> Hence, metabolically unhealthy groups of any body mass are at risk of Diabetes, and more research is needed in this area.

The westernisation of the Indian diet brought many changes to the cooking method. According to certain research findings, cooking techniques may increase the risk of developing Diabetes and the effects of meat intake. Regardless of the quantity, too. It has been discovered that often preparing non-vegetarian food with high-heat cooking techniques (such as broiling, grilling, and roasting) raised the risk of type-II Diabetes.<sup>25</sup> Some of the research mentions the potentially dangerous substances created during high-heat cooking, such as polycyclic aromatic hydrocarbons, heterocyclic aromatic amines, and nitrosamines (from nitrates and nitrites added to meats as a preservative). These substances may trigger an inflammatory reaction, obstruct the normal synthesis of insulin, or encourage insulin resistance, a condition in which the body cannot use insulin effectively to control blood sugar levels.<sup>18</sup> Therefore, to reduce the risk of developing Diabetes, meat can be prepared using the healthiest techniques possible. Cooking techniques that employ lower temperatures, brief bursts of high heat, like those used with slow cookers, or moderate-temperature techniques like stir-frying, stewing, boiling, or steaming may be picked.<sup>25</sup>

Exercise causes an increase in insulin sensitivity, and this increase in tissue insulin sensitivity has a positive impact on glycaemic management.<sup>26</sup> Although data on how frequently non-vegetarians exercise in relation to how often they consume non-vegetarian food was not available for the study, it was discovered that most non-vegetarians do not engage in regular physical activity. However, the study found that non-vegetarians predominate among diabetic patients who exercise regularly, don't exercise regularly, or don't exercise at all. Exercise and food intake are two crucial diabetes risk factors. Consequently, consistent exercise that balances calorie intake from meals is essential for preserving a healthy body weight and blood sugar level. Since eating a non-vegetarian diet leads to consuming more calories, non-vegetarians should make more attempts to exercise. The necessity of an exercise programme as a therapeutic alternative for treating

their condition is something that primary care doctors and nursing professionals caring for patients should emphasise to them. The majority of physical activity's advantages for managing Diabetes are achieved through short- and long-term enhancements in insulin action, which may be achieved through aerobic and resistance training.<sup>27</sup> Therefore, for diabetes prevention, a well-planned non-vegetarian diet and exercise schedule based on personal needs are crucial. To get more accurate results and reliable data, prospective studies should be conducted over a more extended period of time among a large population. Even though the dataset did not include information on prior smoking, current smokers are more observed among non-vegetarians. Therefore, it is strongly advised that research be conducted to determine the potential effects of a regular non-vegetarian diet along with certain addictions and inadequate exercise on Diabetes.

## CONCLUSION

Non-vegetarian food consumption has been shown to increase the risk of Diabetes. Hence, identifying a non-vegetarian diet as a risk factor for Diabetes provides helpful guidance for clinicians and at-risk individuals and sets the stage for beneficial behavioural changes.

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