Original Article

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CLINICAL NUTRITION RESEARCH

Vegetarian dietary patterns are not associated with lower odds of noncommunicable diseases among patients presenting to a tertiary care center in North India: a cross-sectional survey

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Objective: Noncommunicable diseases (NCDs) present a huge global burden, accounting for approximately 7.3 trillion cases and 43.8 million deaths in 2021. In India, 68% of all deaths are caused by NCDs. Carbohydrate intake has been associated with NCD development. Standard Indian diets mainly comprise carbohydrates. In this study, we aimed to analyze the association of vegetarian versus omnivorous diets with the odds of developing NCDs in patients visiting the emergency department.

Methods: Over 18 months, a cross-sectional epidemiological survey-based study was conducted among patients aged >18 years presenting to our department with documented comorbid conditions (e.g., diabetes mellitus [DM], hypertension, heart disease, hypothyroidism, Alzheimer disease, and cancer). These patients completed a 32-item questionnaire survey regarding dietary and lifestyle choices. Associations between comorbidity status and dietary variables were evaluated by bivariate analysis. Additionally, unadjusted odds ratio (OR) and adjusted OR for DM, hypertension, and heart disease were calculated.

Results: This study included 11,011 patients, of which 55.31% were males and 68.91% were >55 years old. Furthermore, 65.87% were vegetarians, whereas 28.97% were omnivores. Hypertension, DM, and heart disease were found in 62.6%, 49.9% and 26.0%, respectively, while 58% had combinations of NCDs. Adjusted for age, sex, smoking, sugar, alcohol, exercise, and packaged food, OR (omnivore vs. vegetarian) was 0.94 (95% confidence interval [CI], 0.86–1.03; P=0.180), 0.91 (95% CI, 0.83–1.00; P=0.052) and 1.02 (95% CI, 0.92–1.13; P=0.690) for DM, hypertension, and heart disease, respectively.

Conclusion: Most patients with NCDs followed a vegetarian dietary pattern, which was not associated with lower odds of developing NCDs.

Keywords: Vegetarian diet; Metabolic diseases; Noncommunicable diseases; Ketogenic diet; Life style

INTRODUCTION

In 2021 alone, noncommunicable diseases (NCDs) accounted for 7.3 trillion cases and 43.8 million deaths worldwide [1], reflecting a significant global health burden. Nearly 20% of the world population is from India, and 68% (6.3 million) of all deaths in this country are caused by NCDs [2]. Metabolic syndrome (MetS) refers to a pathophysiological state involving ≥3 cardiovascular risk

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factors, such as central obesity, insulin resistance, hypertension, hypertriglyceridemia, and decreased high-density lipoprotein (HDL) [3]. MetS is one of the major upstream drivers for a spectrum of NCDs, including type 2 diabetes mellitus (DM), coronary artery disease (CAD), stroke, chronic kidney disease, metabolic-dysfunction–associated steatotic liver disease (MASLD), polycystic ovarian syndrome (PCOS), chronic respiratory diseases, certain cancers (colorectal, breast, pancreatic, etc.), hypothyroidism, and Alzheimer disease [4-6].

MetS affects 30% of the Indian adult population [7]. MetS and subsequent NCDs have numerous attributable risk factors, including diet, tobacco use in various forms, alcohol, sedentary lifestyle, and air pollution [5]. Carbohydrate intake has been associated with MetS and NCD development in various populations [8]. The standard Indian diet is largely vegetarian and carbohydrate-based, with the staples being cereals, pulses, fruits, and vegetables [9]. The Dietary Guidelines for Indians 2024 published by the Indian Council of Medical Research (ICMR) [10] recommend 50%–60% of total energy consumption from carbohydrates. In a study by ICMR, 83% of the participants had at least one metabolic risk factor, which included either newly diagnosed type 2 DM, pre-DM, dyslipidemia, general obesity, abdominal obesity, or hypertension, as well as a high intake (62.3% of energy) of refined carbohydrates [6].

Many patients visit emergency departments daily with various acute complications and manifestations of NCDs, including myocardial infarction, stroke, diabetic ketoacidosis, hypoglycemia, thyroid storm, myxedema coma, accelerated hypertension, acute on chronic disease, and heart failure.

To date, we have not found any studies investigating the dietary preferences and lifestyle choices of patients with MetS and NCDs presenting with acute complications to emergency departments in India.

This study aimed to analyze the association of vegetarian dietary pattern versus omnivore dietary pattern with the odds of developing NCDs in the adult population presenting to our institution's emergency department.

METHODS

Study design

We conducted a cross-sectional survey-based epidemiological study involving patients aged >18 years arriving in the emergency medicine department irrespective of their acute diagnoses. They were screened through an initial documented family meeting for the following comorbid conditions if any: hypertension, DM, dyslipidemia (high triglyceride and low HDL levels), heart disease (CAD, dysrhythmia, heart failure, cardiomyopathy), stroke, PCOS, hypothyroidism, cancer, Alzheimer disease, Parkinson's disease, and bronchial asthma. After providing written informed consent, patients filled out our questionnaire using Google Forms. This questionnaire focused on known documented comorbid conditions and dietary and lifestyle choices. For patients who could not fill out the survey (e.g., patients on ventilator or those with stroke), their next of kin were requested to do it. All emergency physicians were tasked to recruit patients during their shifts. Patients were then selected through convenience sampling. Patients received protocol-based clinical management, and those under all triage categories were included. The survey questionnaire was prepared in both English and Hindi. Our study protocol obtained approval from the institution's ethics committee (approval no.: IR.MUBABOL.HRI.REC.1401.049). All data were de-identified before analysis to ensure confidentiality, and this study conformed to the principles of the Declaration of Helsinki.

Setting

From April 11, 2024 to October 31, 2025, this study was conducted in the emergency medicine department of a tertiary care hospital in North India.

Study population

This study included all patients aged >18 years who presented to the department for acute conditions with documented medical history. The emergency medicine consultants and residents recruited such patients during their respective shifts.

Intervention

After acquiring patients' written informed consent, the emergency physicians requested these patients to fill out a 32-item questionnaire through Google Forms shown on a tablet or smart phone. Questionnaire pretests took approximately 3–4 min, which was considered an appropriate time frame for filling out by the patients or their relatives. Each question had multiple choices. This study recruited patients under triage priority 1 (most critical) to triage priority 3 (least critical).

The questionnaire was divided into four sections: Demographics, Comorbid conditions, Dietary preferences and Lifestyle choices. Dietary preferences were classified into the following: vegetarian (plant-based diet with dairy but no eggs), vegan (plant-based diet with no dairy), omnivore (plant- and meat-based diet),

ovo-vegetarian (plant-based diet with eggs but no meat/seafood), pescatarian (plant-based diet with some seafood but no meat), carnivore (meat-based diet including eggs, meat, seafood, and dairy).

Our survey also recorded consumption of food items as per the NOVA classification, which groups food items according to the nature and extent of processing they undergo. These NOVA food groups are as follows [11]: Group 1, unprocessed or minimally processed foods (fruits, grains, beans, lentils, leaves, eggs, milk, meat, seafood, tea, coffee, mushrooms, etc.); Group 2, processed culinary ingredients (vegetable oils crushed from seeds, nuts or fruit, butter and lard, honey, maple syrup, etc.); Group 3, processed foods (canned vegetables/legumes in brine, salted nuts, fruit in syrup, smoked meats, canned fish, etc.); and Group 4, ultraprocessed food (UPF) and drink products (sausages, burgers, pizza, cakes, pastries, chocolates, candies, energy drinks, fruit yogurt, milk drinks, cookies, carbonated soft drinks, etc.). This classification allowed us to determine the consumption of processed or unprocessed foods by the study population. The Dietary preferences section also included questions regarding the consumption of sugars (in the form of table sugar, jaggery, desserts, and sugar substitutes) and the type of cooking oil used. For ovo-vegetarians, omnivores, or pescatarians, they were asked to comment on how frequently they consumed eggs, meat, and fish. Consumption of carbohydrates (if any) with eggs, meat, and fish was also documented, as well as consumption and frequency of food from restaurants. The Lifestyle choices section included questions regarding smoking, alcohol intake, recreational drug habits, and exercise. All questions contained multiple choices.

Statistical analysis

All statistical data were analyzed using Microsoft Excel and Python. The study dataset comprised respondents who provided complete information on core demographic, dietary, lifestyle, and comorbidity variables. Continuous variables, including age, were summarized using appropriate descriptive statistics, while categorical variables were described using frequencies and percentages. Missing responses were reported where applicable, and analyses were based on the available observations for each variable. We conducted bivariate analysis to examine the associations between comorbidity status and dietary variables, particularly consumption of NOVA 1 foods, which were examined using 2×2 contingency tables. Although multiple NCDs were documented in our participants, we selected DM, hypertension, and heart disease for primary odds ratio (OR) and adjusted OR (aOR) analyses because they were the most commonly reported individual comorbidities. Additionally, the primary dietary exposure was dietary preference, categorized as vegetarian or omnivore, which were also the most frequently reported dietary preferences in this cohort.

The magnitude of association between comorbidity status and dietary preferences was quantified by calculating unadjusted ORs with 95% confidence intervals. To estimate aORs for the association between dietary preference and outcome, we conducted multivariable logistic regression analysis after adjusting for age, sex, smoking status, sugar and alcohol consumption, exercise, and packaged food consumption. Missing observations were handled according to available data for the variables included in each analysis.

To ensure analytical clarity, statistical stability, and interpretability, we used a systematic grouping approach to categorize multicondition combinations. Mutually exclusive clinical categories were then developed from self-reported comorbidities and oil consumption patterns to consistently depict all descriptive and bivariate analyses.

RESULTS

This study included all 11,011 enrolled patients. Of them, 55.31% were males, and 68.91% were >55 years old. Heart disease was more prevalent among males than females (31.3% vs. 19.5%), whereas thyroid disorders were more prevalent in females (9.9% vs. 2.1%). Table 1 summarizes the demographic characteristics and prevalence details of the patients.

Hypertension, DM, and heart disease history were found in 62.6%, 49.9%, and 26.0% of the patients, respectively. Meanwhile, 58% had combinations of various NCDs. Table 2 enumerates the NCDs of the study participants.

Regarding dietary preference, 65.87% followed a vegetarian diet, while 28.97% followed an omnivore diet (Table 3). Most omnivores, ovo-vegetarians, and pescatarians would consume meat, eggs, or seafood once weekly followed by fortnightly consumption (Fig. 1). All omnivores, ovo-vegetarians, and pescatarians (100%) consumed carbohydrates (chapati, bread, parantha, rice, etc.) along with meat, eggs, and seafood.

With regard to lifestyle choices, 297 patients did not respond to alcohol consumption. Out of the remaining patients, 85.1% did not claim to consume alcohol. Furthermore, 5.64% of the total study population acknowledged to have been smoking and tobacco-chewing.

In addition, 94.81% vegetarians who responded to questions re-

Table 1. Gender and age distribution of participants and prevalence of comorbid conditions by gender (n=11,011)

Variable	Value
Gender, No. (%)	
Male	6,090 (55.31)
Female	4,915 (44.64)
Undisclosed	5 (0.05)
Transsexual	1 (0.01)
Age group (yr), No. (%)	
18–20	29 (0.26)
21–30	227 (2.06)
31–40	725 (6.58)
41–55	2,440 (22.16)
>55	7,588 (68.91)
Not reported	2 (0.02)
Comorbidity category (%)[a]	
Diabetes mellitus + hypertension	
Male	17.2
Female	16.5
Hypertension only	
Male	21.8
Female	23.7
Diabetes mellitus only	
Male	12.9
Female	11.9
Diabetes mellitus + hypertension + other conditions	
Male	5.2
Female	8.9
Heart disease	
Male	31.3
Female	19.5
Asthma	
Male	2.0
Female	2.1
Thyroid disorders	
Male	2.1
Female	9.9
Stroke	
Male	2.0
Female	0.9
Cancer	
Male	4.6
Female	4.3
Other single and multiple comorbidities	
Male	1.1
Female	2.2

[a]Percentages are calculated within each gender category.

garding consumption of the NOVA food groups claimed to consume Group 1 foods, while 19.72% claimed to consume some forms of Group 4 foods. Meanwhile, 92.32% of the omnivores claimed to consume Group 1 foods, while 71.29% did not consume Group 4 foods (Table 4).

Table 2. Comorbid conditions of the participants

Variable	No. (%)
Overall comorbid conditions	
Hypertension	6,893 (62.6)
Diabetes mellitus	5,491 (49.9)
Heart disease	2,863 (26.0)
Thyroid disorders	1,732 (15.7)
Cancer	937 (8.5)
Stroke	749 (6.8)
Asthma	598 (5.4)
Comorbidity combinations	
Diabetes mellitus + hypertension	2,611 (23.7)
Hypertension only	2,490 (22.6)
Other combinations[a]	1,677 (15.2)
Diabetes mellitus only	1,370 (12.4)
Heart disease + diabetes + hypertension	1,198 (10.9)
Heart disease only	759 (6.9)
Heart disease + hypertension	594 (5.4)
Heart disease + diabetes mellitus	312 (2.8)

[a]Combinations of asthma, stroke, cancer, Alzheimer disease, and hypothyroidism

Table 3. Dietary preferences of the participants

Dietary preference	No. (%)
Vegetarian	7,253 (65.87)
Omnivore	3,190 (28.97)
Ovo-vegetarian	551 (5.00)
Lacto-ovo vegetarian	5 (0.05)
Vegan	5 (0.05)
Pescatarian	3 (0.03)
Paleo	2 (0.02)
Flexitarian	2 (0.02)
Total	11,011 (100)

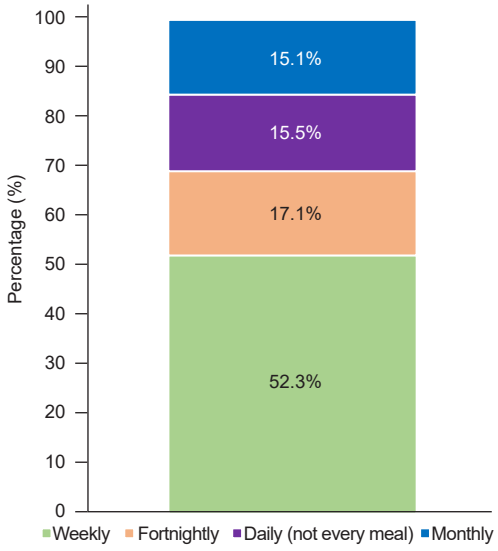


Fig. 1. Frequency of overall consumption of meat, eggs, and seafood by omnivores, ovo-vegetarians, and pescatarians.

Moreover, 62.99% of the population responded positively to exercise; among them, 65.09% were vegetarians. Of the 83.92% of patients who consumed added sugars, 57% claimed they would be able to quit sugar intake. In addition, 50.04% of patients consumed some form of packaged foods. UPF was consumed by only 30.53% of the cohort daily, 32.87% weekly, and 26.34% monthly. Different combinations of oil and ghee for cooking were used by 65.94% of patients. We also found 62% of respondents who used mustard oil alone or in combination for cooking, while 20.4% used ghee alone or in combination with mustard oil. Meanwhile, 58.62% of the respondents consumed food from restaurants occasionally.

Compared with vegetarians, omnivores had 36% lower odds of developing DM and 39% lower odds of developing hypertension. The odds of developing heart disease did not significantly differ between the two groups. These odds were unadjusted and derived from cross-sectional data. After adjustment for age, sex, smoking status, sugar and alcohol consumption, exercise, and packaged food consumption, aORs were 0.94 (95% CI, 0.86–1.03; P = 0.180), 0.91 (95% CI, 0.83–1.00; P = 0.052), and 1.02 (95% CI, 0.92–1.13; P = 0.690) for DM, hypertension, and heart disease, respectively (Table 5).

DISCUSSION

To the best of our knowledge, this study is the first to describe dietary and lifestyle preferences in patients with established NCDs presenting to an emergency department in India. Majority of these patients were vegetarians, consistent with the previous documentations of Indian diets being mostly vegetarian alongside sweets and snacks [9]. Our cohort had a propensity to consume added sugar, too. Cereals and grains are the staple food of India, contributing to the bulk of the Indians' caloric intake. All of our patients who consumed meat, eggs, or seafood also consumed these carbohydrates. Interestingly, majority of our cohort responded to consuming mostly unprocessed foods, be it vegetarian or omnivore. Hypertension, DM, and heart disease were the three most common NCDs reported by our study population, with their frequency higher than that reported by general population studies in India. The prevalence rate of hypertension is 13.9%–46.3% in urban India and 4.5%–58.8% in rural India [12]. The Indian Council of Medical Research–India Diabetes survey reported a prevalence of only 11.4%, whereas the *Lancet Global Health* reported 19.8% [6,13]. Regarding cardiovascular diseases, including heart disease, a review by Shannawaz et al. [14] reported a pooled prevalence of 11% in India.

In an Indian epidemiological study by Malhotra [15], animal fat intake is inversely associated with ischemic heart disease. Most of the participants in the present study did not consume animal fats. Even those who consumed some form of eggs, meat, or seafood did so less frequently. India's dietary guidelines promote a whole food-based diet with special focus on cereals, grains, legumes, fruits, and vegetables [10]. Majority of our vegetarian participants claimed to consume unprocessed whole foods (NOVA food group 1), while approximately 20% claimed to consume UPF. Despite consuming predominantly minimally processed foods, they had established NCDs.

Our omnivore, ovo-vegetarian, and pescatarian participants were "plant-based" while consuming meat, eggs, or fish mostly once a week only, often along with carbohydrate-containing foods. Carbohydrates are metabolized into glucose before undergoing glycolysis, which leads to hyperinsulinemia as a result of chronic consumption [16]. Historically, high sucrose consumption has been associated with the development of occlusive atherosclerotic disease [17]. In our cohort, reported carbohydrate

Table 4. NOVA group 1 and 4 consumption in vegetarians and omnivores

Group	Total	No. (%)	
		No	Yes
Vegetarian + NOVA 1	7,168	372 (5.19)	6,796 (94.81)
Vegetarian + NOVA 4	7,169	5,755 (80.28)	1,414 (19.72)
Omnivore + NOVA 1	3,166	243 (7.68)	2,923 (92.32)
Omnivore + NOVA 4	3,159	2,252 (71.29)	907 (28.71)

Table 5. Comparison of uOR and aOR for developing diabetes mellitus, hypertension, and heart disease between omnivores and vegetarians

Exposure	Reference	Outcome	uOR (95% CI)	aOR (95% CI)
Omnivore	Vegetarian	Diabetes mellitus	0.64 (0.59–0.70)	0.94 (0.86–1.03)
Omnivore	Vegetarian	Hypertension	0.61 (0.57–0.66)	0.91 (0.83–1.00)
Omnivore	Vegetarian	Heart disease	1.04 (0.87–1.24)	1.02 (0.92–1.13)

uOR, unadjusted odds ratio; aOR, adjusted odds ratio; CI, confidence interval.
OR <1 indicates lower odds of developing the disease.

consumption was ubiquitous, and added sugar consumption was common. A combination of a high carbohydrate diet and added sugars appeared to be associated with NCD development, as suggested by previous research [8,16,17]. However, given our cross-sectional study design, we cannot establish a causal relationship between these dietary practices and NCDs for our cohort. Conversely, low carbohydrate diets have been successfully used for DM remission [18,19], and they have been shown to improve cardiovascular risk factors [20]. Smoking is a major risk factor for cancer and cardiovascular diseases [21]. Surprisingly, only a small fraction (5.64%) of our respondents reported smoking or chewing tobacco. Majority of our respondents consumed added sugars in the form of table sugar, jaggery, and Indian desserts, in their tea or coffee (most common answer), and also as artificial sugar substitutes. A recent meta-analysis of prospective cohort studies concluded that sugar-sweetened beverages and fruit juices are directly associated with DM risk [22].

Previous studies have reported associations between the consumption of UPF with the development of MetS, DM, heart disease, cancer, obesity and even depression [3,23,24]. Half our population consumed UPF in packaged form. More than half the study population engaged in exercise. Meanwhile, majority used mustard oil (most common) and ghee as their cooking medium. Mustard oil contains a high proportion of erucic acid, a naturally occurring, nonbranched, monounsaturated fatty acid with 22 carbons and a cis-configured double bond on the 13th carbon. Indians have consumed this oil for centuries. Although rodents who were fed rapeseed oil (also contains erucic acid) developed myocardial lipidosis in previous studies [25], the results were not reproducible on primates or pigs [26]. Currently, no human studies have demonstrated any adverse effects of mustard oil or high erucic acid levels on the heart. In fact, a randomized double-blind placebo-controlled study demonstrated cardioprotective effects of fish oil and mustard oil on patients with acute myocardial infarction compared with those of placebo [27].

On average, India's daily diet in 1961 comprised grains (43%, 378 g), produce (23%, 199 g), dairy and eggs (12%, 108 g), sugar and fat (12%, 108 g), meat (2%, 17 g), and others (8%, 68 g). In 2011, it comprised produce (34%, 450 g), grains (32%, 416 g), eggs and dairy (18%, 235 g), sugar and fat (10%, 129 g), meat (2%, 29 g), and others (4%, 58 g). As per the Food and Agriculture Organization's food balance sheet for India [28], this country remains to have a cereal-dominated dietary pattern, with carbohydrates accounting for 62%–67% of the caloric intake. In a study by Shridhar et al. [29], vegetarians consumed a median carbohydrate intake of 431.5 g/day, whereas omnivores consumed 426 g/day, similar to our participants who all consumed high amounts of carbohydrates. Recent guidelines developed by the U.S. mark a paradigm shift focusing on high-quality proteins from animal products and reducing cereal and grain intake. Generally, vegetarian diets heavily rely on cereals and plant-based foods, which have a lower bioavailability of essential nutrients such as complete amino acids, vitamin B_{12}, heme iron, retinol, vitamin D_3, zinc, eicosapentaenoic acid, and docosahexaenoic acid. These nutrients are essential in metabolic, neurological, and cardiovascular health. Lower intake and bioavailability of these nutrients may contribute to metabolic dysfunctions.

This study has certain limitations. For example, it was epidemiological and cross-sectional in design, which precludes determination of temporal relationships or causality between dietary preferences and metabolic diseases. In addition, reverse causation may be possible, considering that patients might have changed diets or habits after their diagnosis. Any changes in dietary preference over their lifetime were not recorded. Furthermore, convenience sampling was conducted by emergency physicians on shift. During some busy shifts, they could not recruit patients, thereby reducing our sample size and potentially skewing results. This patient selection approach could also have led to recruitment bias at some level. Despite controlling for it by including only patients who had documented evidence of their previous conditions, recall bias for comorbid conditions could still have occurred. Thus, the difference in the frequencies of hypertension, DM, and heart disease as compared with previous studies should be interpreted in the context of our hospital-based cohort of patients with established comorbidities rather than as estimates of disease prevalence in the general population. Moreover, reliability of the answers provided by the next of kin of patients unable to answer can be questioned. Patients could have had a healthy user bias while responding to questions on smoking, alcohol, and diet and may have responded differently. Additionally, this is a single-center study, which limits the nationwide generalizability of the findings.

In conclusion, our study provided interesting insights into dietary and lifestyle preferences of patients with NCDs and metabolic diseases presenting to our emergency department. In India, dietary patterns such as vegetarianism may be influenced by cultural, familial, and religious practices established early in life and maintained over long periods of time. Nonetheless, given that we did not assess the duration of dietary adherence and any changes, the reported dietary pattern reflecting as a lifelong or long-standing habit remains uncertain. Of note, a large proportion of our pa-

tients suffering from NCDs reported following vegetarian diets, consuming minimally processed foods, and engaging in exercise while also reporting low rates of smoking and alcohol consumption. In other words, vegetarian diet alone did not prevent NCDs in our study population. Therefore, in this cohort, the presence of NCDs and metabolic diseases cannot be explained solely by deviations from traditionally recommended dietary or lifestyle practices. However, given that the duration of dietary adherence was not explicitly assessed, temporal relationships cannot be effectively established. In addition, carbohydrate intake was high in this study population, consistent with historical consumption and Indian guidelines. To validate our findings, similar studies should be conducted in multiple centers across India.

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Conflict of interest
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Data availability
Data of this research are available from the corresponding author upon reasonable request.

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