

ASSESSMENT OF THE KNOWLEDGE OF FLEXITARIAN DIET, REFLECTION OF CLIMATE-FRIENDLY FOOD CHOICES, AND ITS IMPACT ON CLIMATE CHANGE

Khadijja Moazzam^{*1}, Areeba Kanwal², Sadia Sabir³, Noor ul Huda⁴, Shehriyar Nasir Ali⁵

¹Faculty of Allied Health Sciences, The Superior University Lahore, Pakistan

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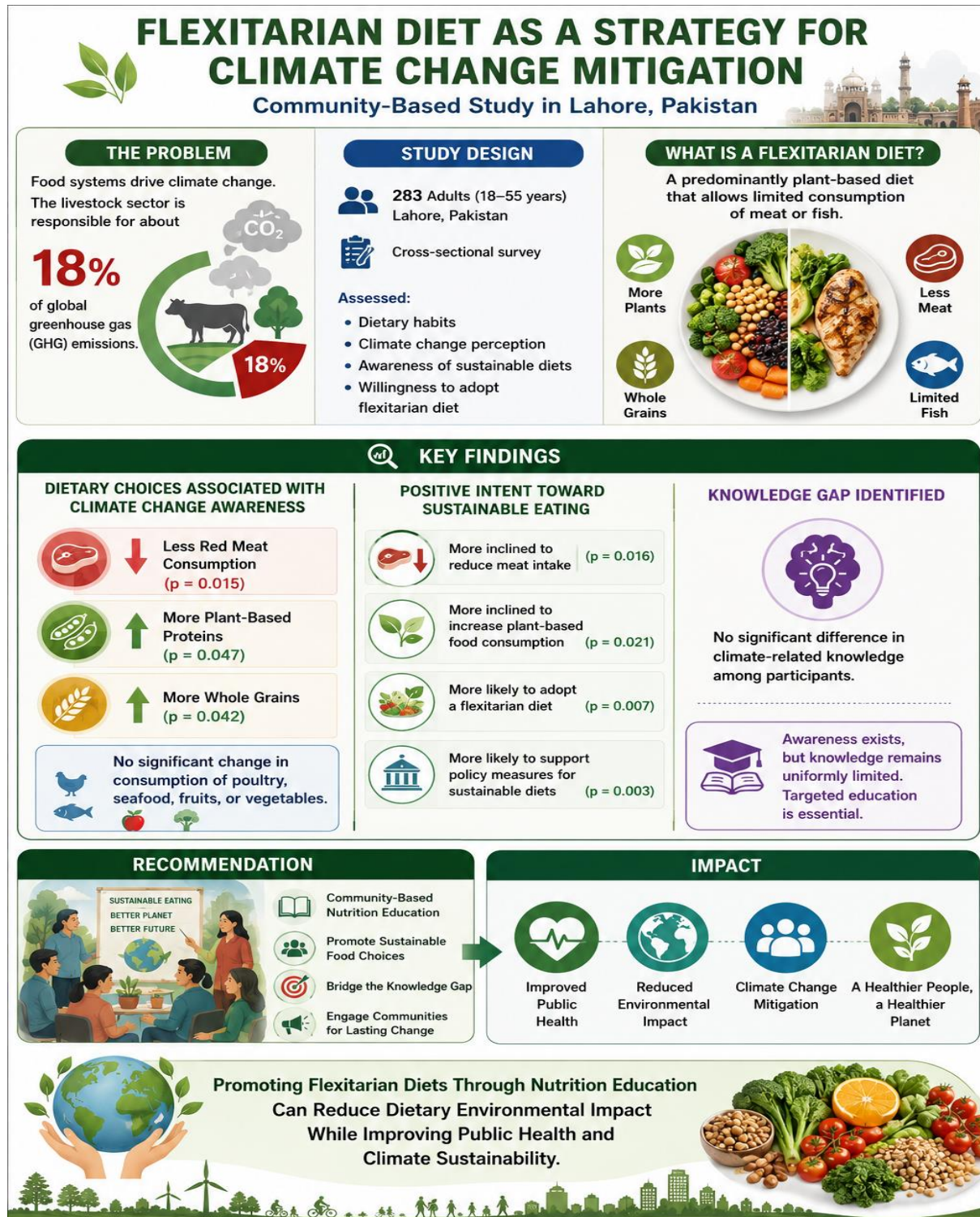
*Corresponding Author:

Khadija Moazzam*

khadijamoazzam08@gmail.com

Abstract

Climate change is significantly influenced by food systems, especially the livestock sector, which contributes about 18% of global greenhouse gas (GHG) emissions. This study explores the role of assessment of dietary shifts—specifically the flexitarian diet—in mitigating climate change. A flexitarian diet emphasizes plant-based foods while allowing limited meat or fish consumption. The study aimed to evaluate awareness and promote this diet through community-based nutrition education in Lahore, Pakistan. Using a cross-sectional descriptive design, 283 adults aged 18–55 participated in the study. A structured questionnaire assessed their demographics, eating habits, perceptions of climate change, and willingness to adopt sustainable diets. The results revealed a significant association between climate change awareness and certain dietary choices. Participants with higher environmental concern consumed less red meat ($p = 0.015$) and more plant-based proteins ($p = 0.047$) and whole grains ($p = 0.042$). However, no significant change was observed in the consumption of poultry, seafood, fruits, or vegetables. Environmentally aware participants were also more inclined to reduce meat intake ($p = 0.016$), increase plant-based food consumption ($p = 0.021$), adopt a flexitarian diet ($p = 0.007$), and support related policy measures ($p = 0.003$). Despite these differences in behavior and intent, climate-related knowledge did not vary significantly among participants, indicating a knowledge gap. The study concludes that while environmental concern influences dietary behavior, knowledge about sustainable eating remains uniformly limited. Therefore, effective, targeted nutrition education is essential to bridge this gap. Promoting the flexitarian diet through community engagement offers a practical strategy to align public health and environmental sustainability, supporting more conscious and informed food choices that benefit both people and the planet Earth.



INTRODUCTION.

Climate change has become one of the most urgent global issues in recent decades, involving long-term variations in temperature, weather patterns, global warming, and greenhouse gas emissions (1). Climate change is widely regarded as one of the most significant global health challenges of the 21st century. Its potential negative health impacts include higher mortality rates due to extreme temperatures, a rise in allergic conditions caused by extended pollen seasons, and an increased risk of infectious diseases linked to flooding. Taking action to address climate change can help safeguard public health for future generations (2). Worldwide, agriculture and food production contribute to over 25% of total greenhouse gas emissions, while all forms of transportation—including cars, airplanes, trains, trucks, and ships—collectively generate only 14% (3). The emissions of major greenhouse gases, CO₂, CH₄, N₂O and hydrofluorocarbons (HCFCs), are closely related to the production and consumption of food. During the life cycle of food, many human activities lead to the emission of these gases (4). The livestock sector is responsible for around 18% of global greenhouse gas emissions, primarily methane (CH₄) from enteric fermentation, nitrous oxide (N₂O) from manure and fertilizers,

and carbon dioxide (CO₂) from land use change and agricultural energy consumption (5).

Our dietary choices influence both personal health and the environment. The food supply chain contributes to nearly one-third of global human-caused greenhouse gas emissions, making it crucial to address these emissions to achieve climate goals (6). The rapid growth of the human population demands higher food production to meet nutritional needs. However, expanding the production of animal-derived foods, key protein sources, may exacerbate issues like climate change, greenhouse gas emissions, and a larger carbon footprint (7). It is estimated that eliminating meat could reduce diet-related greenhouse gas emissions by 35% compared to a normal diet (5). Adopting eating habits that prioritize environmental sustainability is increasingly recognized as a crucial step in combating climate change. A key characteristic of these eco-friendly diets is a emphasis on whole, plant-based foods and a reduction in the consumption of animal products and processed foods. While the environmental effects of these diets can differ, they are commonly known as "environmentally conscious" or "green" diets (6). However, food-related emissions vary among individuals due to differences in lifestyle, dietary choices, and economic factors both within and

between countries. Excessive food consumption, particularly diets rich in animal products, is a major contributor to obesity and non-communicable diseases, while also significantly increasing emissions (6)(7). Shifting to a diet with reduced meat consumption has the potential to substantially lower greenhouse gas emissions (8).

A flexitarian or semi-vegetarian diet (SVD) is primarily plant-based but occasionally includes meat or fish (8). "Flexitarianism" is a relatively new term that has recently gained traction in both scientific and public discourse. "Flexitarian" combines "flexible" and "vegetarian" to describe individuals who follow a mostly vegetarian diet but occasionally consume meat or fish. Despite the high global demand for meat, an increasing number of consumers are adopting a flexitarian approach by reducing their regular meat consumption (9). The evidence is clear that flexitarian diet less contribute in increasing greenhouse gas (GHG) emission. So society must transition to more plant-based diets to mitigate environmental degradation (8). The environmental and nutritional aspects of our food system are deeply interconnected (8). Reducing meat and dairy consumption is a proven strategy for safeguarding both human and planetary health. Shifting towards diet rich in fruits, vegetables, legumes, and whole grains while

lowering intake of animal source food present a valuable opportunity to align consumer choices with modern nutritional and environmental goals (10). Despite the potential benefits of the flexitarian diet, there are several barriers to its adoption, including lack of awareness, limited access to plant-based foods, and cultural and social norms that prioritize meat consumption. Community-based nutrition education is a key strategy for promoting healthy eating habits and sustainable food system (10).

1.1. Objectives

The specific goals of the study include assessing the participants' knowledge about climate change, their level of concern about climate change, and their relationship to climate-friendly food choices. The other goals of the study include assessing the participants' awareness and understanding of a flexitarian diet and its impact on climate change, particularly when it comes to meat intake and plant-based foods. All the goals of the study are important because they are related to one another.

METHODOLOGY

2.1. Research design:

This study utilized a cross-sectional descriptive design to assess the relationship between climate change awareness and dietary choices among adults in Lahore, Pakistan. Data were collected

over a period of four months using a structured questionnaire administered through a community-based survey (11).

Assessment of Awareness of Climate Change:

The questionnaire captured demographic information, dietary habits, perceptions of climate change, and behavioral intentions related to sustainable eating. Participants were categorized into three groups—“Yes,” “No,” and “Somehow”—based on their responses to question which was “Do you believe that food choices can impact climate change” for assessing climate change awareness and concern.

Assessment of Dietary Choices:

The data collection tool measured frequency of consumption of various food items such as red meat, poultry, fish, plant-based proteins, fruits, vegetables, and whole grains participants were asked to report how often they consumed various foods, using a five-point frequency scale tailored for clarity and consistency. The response options provided were Daily, Three to four times a week, One to two times a week, Rarely, and Never. By selecting the choice that most accurately reflected their usual eating habits, respondents offered a straightforward but comprehensive snapshot of their dietary intake over the 12-month period. This approach—rooted in standard food-frequency questionnaire (FFQ) methodology—ensures

researchers can efficiently capture and compare retrospective dietary patterns without the complexity of daily food diaries

Additionally, participants were asked about their knowledge of climate-related dietary issues and their willingness to change eating behaviors. The study was approved by the Ethics Committee of the superior University Lahore.

2.2.Sample size: The study population included 283 participants (131 males and 152 females) aged between 18 and 55 years (12).

2.3.Sampling Technique: Participants were selected through a random sampling technique, and ethical approval was obtained prior to data collection.

2.4.Duration of the study: The duration of study was 4 months.

2.5.Slection criteria

2.5.1 Inclusion criteria: The criteria of study were including males and females of 18 to 55 years old.

2.5.2 Exclusion criteria: Exclusion criteria included individuals who were pregnant, lactating, engaged in intensive physical training, or diagnosed with any chronic illness, to ensure consistency and reduce confounding variables.

2.6.Ethical consideration: Ethical approval was obtained prior to data collection, that there will be no physical harm nor benefit for a person who

fill the form, and the data will be kept confidential.

2.7.Data collection procedure: This study employed a standardized questionnaire to ensure uniformity in data collection, thereby enhancing the reliability, validity, and generalizability of the findings. By using consistent wording, structure, and response formats, researchers were able to minimize response bias and systematically compare responses across participants. The questionnaire consisted of 30 items: 9 on demographic characteristics, 7 on dietary habits, 8 on climate change and diet, 4 on behavioral intentions, and 3 on knowledge and attributes. Data were acquired through structured face-to-face interviews and focus group discussions, allowing for comprehensive, in-depth responses. Participants' answers were meticulously documented to maintain integrity, while any ambiguities or uncertainties were promptly

clarified to ensure accuracy and completeness of the dataset. This methodological approach strengthened the robustness and scientific credibility of the research by applying rigorous empirical survey methods and enhancing data consistency and comparability.

2.8.Data Analysis: Data were analyzed using SPSS software, with chi-square tests used to determine the statistical significance of differences among groups based on awareness levels.

RESULTS

The study population was n=283 out of which 131 were male and 152 female. Out of the whole study population 48.40% had heard the term climate sustainability and 51.59% had not heard the term climate sustainability in relation to food choices. In which the total female ratio that have heard the term is 61.31% and male ratio is 38.68%. That means that female ratio is more than male as shown in the table 1.

DEMOGRAPHIC INFORMATION			
VARIABLES	YES	NO	P-VALUE
1. Age Groups			
18-25	85	92	0.524
26-35	33	27	
36-45	12	15	
46-55	7	12	
2. Gender			
Male	53	78	0.013

Female	84	68	
3. Education			
Illiterate	0	2	0.060
Matric	3	11	
Intermediate	16	24	
Graduation	93	91	
Post-graduation	25	18	
4. Residence			
City	119	126	0.890
Village	18	20	

Table 1. Association of knowledge about “climate sustainability” and demographic variables like gender, age groups, education level, residence. perceptions of climate change, behavioural intentions, and sustainability awareness, grouping participants based on their responses: Yes, No, and Somehow as shown in the table 2.

The research study explored the connection between dietary habits and individuals’

VARIABLES	YES	NO	SOMEHOW	P-VALUE
DIETARY HABITS				
1. How often do you consume red meat? (beef,lamb)				
Daily	1	6	0	0.015
3-4 times/week	14	11	9	
1-2 times/week	46	31	24	
Rarely	53	24	33	
Never	13	5	13	
2. How often do you consume poultry? (chicken,egg)				
Daily	20	11	12	0.712
3-4 times/week	59	31	27	
1-2 times/week	36	29	31	

Rarely	11	5	7	
Never	1	1	2	
3. How often do you consume fish and seafood?				
Daily	1	0	1	0.424
3-4 times/week	3	5	1	
1-2 times/week	17	7	6	
Rarely	86	53	62	
Never	20	12	9	
4. How often do you consume plant-based protein sources?(legumes,beans,lentils)				
Daily	14	3	4	0.047
3-4 times/week	46	23	20	
1-2 times/week	38	35	42	
Rarely	27	13	11	
Never	2	3	2	
5. How often do you consume fruits?				
Daily	37	20	22	0.961
3-4 times/week	51	27	27	
1-2 times/week	30	22	22	
Rarely	7	7	7	
Never	2	1	1	
6. How often do you consume vegetables?				
Daily	32	23	20	0.808
3-4 times/week	61	34	33	
1-2 times/week	29	14	19	
Rarely	5	5	6	
Never	0	1	1	
7. How often do you consume whole grains?				
Daily	79	43	45	0.042

3-4 times/week	20	10	14	
1-2 times/week	20	12	18	
Rarely	4	11	2	
Never	2	1	0	
CLIMATE CHANGE AND DIET				
8. How concerned are you about climate change?				
Very concerned	74	13	28	0.000
Somewhat concerned	38	38	33	
Not very concerned	14	20	15	
Not at all concerned	1	6	3	
9. Do you believe that human activities contribute to climate change?				
Yes	114	56	61	0.000
No	3	15	2	
Not sure	10	6	15	
don't know	0	0	1	
10. Do you think individual dietary choices can impact climate change?				
Yes	97	18	29	0.000
No	9	29	3	
Not sure	20	29	41	
don't know	1	1	6	
11. In your opinion, which diet has the lowest environmental impact?				
Vegan	27	13	8	0.158
Vegetarian	45	25	31	
Flexiterian	25	16	25	
Omnivorous	30	23	15	
12. Would you be willing to change your diet if you knew it could reduce environmental damage?				
Yes	69	26	30	0.006

No	15	20	11	
I can try	43	31	38	
13. Have you noticed any community initiative promoting sustainable eating in your area?				
Yes	60	23	18	0.001
No	67	54	61	
14. Do you believe government should encourage plant based diets to fight climate change?				
Strongly agree	49	21	13	0.003
Agree	46	22	34	
Neutral	30	27	25	
Disagree	2	7	7	
BEHAVIORAL INTENTIONS				
15. How likely are you to adopt a flexitarian diet in next 6 months?				
Very likely	35	15	8	0.007
Somewhat likely	67	31	41	
Not very likely	18	23	23	
Not at all likely	7	8	7	
16. How likely are you to reduce your meat consumption in next 6 months?				
Very likely	28	9	8	0.016
Somewhat likely	56	27	40	
Not very likely	35	30	19	
Not at all likely	8	11	12	
17. Would you increase you consumption of plan-based foods in next 6 months?				
Yes	70	25	37	0.021
No	14	10	5	
Not sure	41	37	31	
don't know	2	5	6	

KNOWLEDGE AND ATTRIBUTES				
18. What do you think is the most significant way that human activities contribute to climate change?				
Burning fossil fuels	12	9	15	0.303
Deforestation	22	18	16	
Agriculture	19	13	6	
All	74	37	52	
19. How do you think a flexitarian diet can help reduce greenhouse gas emission?				
By reducing meat consumption	18	9	14	0.233
By increasing plant-based food consumption	54	23	27	
By reducing food waste	46	40	29	
Other (please specify)	9	5	9	
20. Have you heard of the term “climate sustainability” in relation to food choices?				
Yes	70	31	36	0.101
No	57	46	43	

Table 2. The believe of induvial' s food choices can impact on climate change through there dietary habits, behavioral intentions and their knowledge and attributes.

Dietary Habits

The results revealed that red meat intake was significantly related to responses, as the p-value was 0.015. Most of the participants ate red meat rarely.

Poultry intake was not significantly related to responses, as the p-value was 0.712. Most of the participants ate poultry 3 to 4 times a week.

Intake of fish and seafood was low among the participants, as most of them ate fish and seafood rarely. The relationship was not significant, as the p-value was 0.424.

Intake of plant-based protein was related to responses, as the p-value was 0.047.

Intake of fruits and vegetables was not significantly related to responses, as the p-values were 0.961 and 0.808.

Intake of whole grains was related to responses, as the p-value was 0.042. Most of the participants ate whole grains daily (7).

Climate Change and Diet

The study revealed that all participants demonstrated high concern towards climate change, and it was a very significant relationship ($p = 0.000$).

The majority of respondents agreed that human activities contribute to climate change ($p = 0.000$), and that their dietary choices influence climate change ($p = 0.000$).

The willingness to change their diets to minimize environmental degradation was also significant ($p = 0.006$).

In addition, awareness of initiatives to promote sustainable diets in their community was also significant ($p = 0.001$).

Moreover, a majority of respondents agreed that their government should promote a plant-based diet ($p = 0.003$).

Behavioural Intentions

The study revealed that all participants demonstrated a significant intention to adopt a flexitarian diet ($p = 0.007$), as well as a reduction

in meat consumption ($p = 0.016$), to be achieved in the next six months.

In addition, a significant willingness to consume more plant-based foods was also revealed ($p = 0.021$).

Knowledge and Attributes

The knowledge-based variables, which included main causes of climate change ($p = 0.303$), how a flexitarian diet reduces climate change ($p = 0.233$), and awareness of climate sustainability ($p = 0.101$), were not significant.

DISCUSSION

Main findings

As the study titled "Assessment & Promotion of Flexitarian Diet through Community-Based Nutrition Education for Climate Change" explored how individuals' dietary habits are influenced by their awareness of climate change and sustainability. The key findings revealed significant associations between environmental awareness and specific dietary behaviors. Notably, red meat consumption showed a statistically significant difference ($p = 0.015$) among groups, with those more conscious of climate issues consuming it less frequently. Similarly, participants with heightened environmental awareness reported a significantly higher intake of plant-based proteins ($p = 0.047$) and whole grains ($p = 0.042$), indicating a clear trend towards more

sustainable dietary choices among this group. However, no significant differences were found in the consumption of poultry, fish, fruits, or vegetables, suggesting these choices were likely driven more by cultural or nutritional factors rather than environmental concern (14).

Validity of Results

The study also identified that participants who demonstrated greater concern for climate change were significantly more likely to believe in human contributions to climate change and recognize the role of diet in influencing environmental outcomes (all p -values = 0.000). Furthermore, these individuals expressed a stronger willingness to change their diets for environmental reasons (p = 0.006), were more aware of local sustainability initiatives (p = 0.001), and showed higher support for government promotion of plant-based diets (p = 0.003). In terms of behavioral intentions, they were significantly more inclined to adopt a flexitarian diet (p = 0.007), reduce overall meat consumption (p = 0.016), and increase plant-based food intake (p = 0.021) within the next six months.

Despite these behavioral and perceptual differences, the study found no significant variation in actual knowledge about climate-related dietary issues across the groups. Participants' understanding of major contributors

to climate change (p = 0.303), the role of flexitarian diets in reducing emissions (p = 0.233), and the term “climate sustainability” (p = 0.101) was statistically similar. This indicates that while individuals may differ in their attitudes and actions, their factual knowledge base remains largely the same, pointing to a potential gap in education that community-based interventions could address.

In terms of validity, the study employed a cross-sectional descriptive design with a well-defined sample of 280–300 adults aged 18–55. The use of a standardized questionnaire, structured interviews, and a robust SPSS-based analysis enhances the credibility and reliability of the results. Exclusion of high-risk groups (e.g., pregnant, lactating, or diseased individuals) further ensures data consistency. The findings provide a strong foundation for promoting flexitarian diets as a sustainable eating pattern and highlight the role of community education in shifting dietary behaviors for climate action.

CONCLUSION

The study concludes that there is a significant link between environmental awareness and the adoption of sustainable dietary behaviors, particularly within the context of promoting a flexitarian diet. Participants who exhibited higher concern about climate change were more likely to

reduce red meat consumption and increase their intake of plant-based proteins and whole grains—dietary changes that align with global climate and health recommendations. These individuals also demonstrated stronger intentions to adopt a flexitarian diet, reduce overall meat intake, and increase plant-based food consumption in the near future. Moreover, they showed greater support for government-led and community-based initiatives aimed at encouraging environmentally friendly diets.

However, despite these positive behavioral and attitudinal differences, the study found no significant difference in factual knowledge related to climate-diet connections among participants. This uniformity in knowledge levels across awareness groups indicates that while attitudes and behaviors may vary, there is a general lack of in-depth understanding of sustainable nutrition concepts. Therefore, there is a clear need for targeted community-based nutrition education programs to not only raise awareness but also enhance public understanding of how dietary choices affect the environment.

Overall, the findings emphasize the potential of flexitarian diets to contribute to climate change mitigation and support public health. Promoting these diets through structured, community-centered educational efforts can foster both

environmental responsibility and healthier eating patterns, paving the way for more sustainable lifestyles.

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