Exploring Public Perceptions of Nutrition Gardening as a Strategy for Addressing Climate Change, Malnutrition and Mental Health

Abstract

This study aims to assess public awareness and perceived benefits of nutrition gardening, along with the support needed to adopt such practices. An online survey among urban residents in Kolkata, mainly students and their families, yielded 95 responses. The study revealed that that more than 87% favored rooftop or terrace nutrition gardens, though about 40% cited lack of time and 77% highlighted the need for equipments, knowledge and financial support. Findings indicate strong public interest in nutrition gardening as a way to address climate change, improve nutrition and enhance women's health. Based on these results, a schematic idea of conducting a Sequential Multiple Assignment Randomized Trial (SMART) design is proposed to develop and evaluate a more practical implementation strategy in future.

Keywords: *Nutrition Gardening; Climate Change; Logistic regression; SMART Trial*

1 Introduction

Malnutrition, climate change and mental health challenges remain critical threats to global public health, particularly in developing nations such as India. According to the Global Hunger Index (2019), India ranked 102^{nd} out of 117 countries, with more than half of its female population affected by anemia, which is a major contributor to low birth weight and impaired early childhood development. These conditions not only undermine physical health but also lead to long-term adverse outcomes, including cognitive impairments, stunted growth, and weakened immunity.

Nutrition gardening refers to the practice of growing nutrient-rich fruits, vegetables and herbs in small-scale settings to improve dietary diversity and food self-sufficiency. In recent years, nutrition gardening has emerged as a cost-effective and sustainable strategy to enhance food security, promote mental well-being, and mitigate environmental degradation. It can take multiple forms including rooftop, kitchen, school, and home gardens. This approach has received increasing policy attention in India, exemplified by the launch of National Nutrition Month in 2019, which encouraged educational institutions to establish nutrition gardens.

Despite growing recognition of its benefits, public awareness of nutrition gardening and the perceived barriers and facilitators to its adoption, particularly among urban populations, remain inadequately explored. Furthermore, there is a scarcity of quantitative evidence examining how demographic and socioeconomic factors shape individuals' attitudes toward nutrition gardening.

1.1 Motivation and Contribution

This study seeks to address the existing knowledge gap by conducting a structured online survey to assess public awareness, perceptions, and motivations regarding nutrition gardening among urban populations, with a focus on college and university students and their families. Logistic regression modeling is employed to examine the association between willingness to adopt nutrition gardening practices at home and individual characteristics—such as age, gender, education, and occupation.

The study makes three key contributions. First, it offers one of the earliest empirical assessments of urban public perspectives on nutrition gardening within the Indian context. Second, it identifies the

primary barriers and enabling factors that influence adoption, including the perceived need for government incentives, access to tools and equipment and educational outreach initiatives. Third, it proposes a follow-up research framework based on a Sequential Multiple Assignment Randomized Trial (SMART) design to evaluate the effectiveness of targeted interventions aimed at increasing participation in rooftop and home gardening.

The insights generated from this study are expected to inform evidence-based public health policies and urban sustainability programs, particularly those addressing malnutrition, climate adaptation, and mental well-being through community-centered environmental practices.

2 Literature Review

Nutrition gardening has emerged as a viable strategy for enhancing food and nutritional security, especially in urban and peri-urban settings. Canaris (1995) emphasized the integration of gardening and nutrition education into school curricula, which supports both health and educational outcomes. Similarly, in India, nutrition gardening has shown potential to improve household-level food and nutrition security (Singh et al. (2019); Pradhan et al. (2018)).

The COVID-19 pandemic renewed interest in home-based food systems. Lal (2020) argued that home gardening and urban agriculture can strengthen food and nutrition resilience in response to pandemic-related disruptions. In Zimbabwe, lifestyle changes due to lockdown affected diet and health behavior, reinforcing the role of gardening in promoting nutritional stability (Matsungo and Chopera (2020)).

Traditional gardening practices have long supported household food security, especially in low-income settings (Marsh (1998)). Community and home gardens not only provide fresh produce but also serve as platforms for promoting dietary diversity and sustainable living (Suri (2020)).

Gardening also has significant mental and physical health benefits. Studies by Diener and Biswas-Diener (2008) and Diener et al. (2017) highlight how subjective well-being is closely tied to health, while Fredrickson and Levenson (1998) demonstrated that positive emotions, can accelerate recovery from stress, are often enhanced through nature-based activities. Furthermore, emotional well-being has been linked to greater functional independence and reduced risk of stroke among older adults (Ostir et al. (2000, 2001)).

A growing body of evidence supports the health advantages of interacting with green spaces. Pressman and Cohen (2005) reviewed how positive affect contributes to long-term health outcomes, and Barton and Rogerson (2017) emphasized the mental health benefits of greenspaces. Outdoor environments also promote physical activity, which supports cardiovascular and metabolic health Gladwell et al. (2013).

Recent umbrella reviews and meta-analyses have consolidated these findings, showing that gardening significantly reduces depression, anxiety, stress, and BMI, while improving quality of life, physical activity, cognitive function, and community cohesion Barthel et al. (2010). These studies underscore the potential of gardening to serve as a low-cost public health intervention and highlight the need for policy support to promote gardening practices among urban populations.

3 Methods

3.1 Study Design and Participants

A cross-sectional online survey was conducted to assess public awareness, attitudes, and engagement with nutritional gardening. The survey targeted college and university students and their family members residing primarily in Kolkata and other suburban areas, particularly Kolkata. A questionnaire consisting 14 multiple-choice questions was distributed via Google Forms among the peer groups and families.The questionnaire was designed to enable respondents to answer easily and quickly, without much hassle. A total of 95 participants responded, out of which, 2 were removed due to incompleteness and inconsistency. Finally, 93 responses were considered for the analysis.

3.2 Survey Instrument

The survey instrument consisted of 14 structured multiple-choice questions, covering demographic information, awareness of nutritional gardening, current engagement in gardening practices, perceived barriers, and preferred forms of support for initiating such practices. The complete questionnaire is presented in Table 1.

Table 1: Structured questionnaire used in the nutrition gardening survey

Survey Questions and Response Options	**Variable Type**
Q1. What is your age group?	
Response Options: Under 18, 18–45, 45–65, 65 and above	Categorical
Q2. What is your gender?	
Response Options: Female, Male	Binary
Q3. What is your occupation?	
Response Options: Student, Service, Homemaker, Business, Teaching, Non-working	Categorical
Q4. What is your highest level of education?	
Response Options: Below High School, High School Diploma, Some College, Bachelor's Degree, Master's Degree, Doctorate	Categorical
Q5. Are you aware of nutrition gardening?	
Response Options: Yes, No, Maybe	Categorical
Q6. If yes, how did you learn about it?	
Response Options: Internet/Social Media, Friends/Family, School/College, TV/Radio, Books/Magazines	Categorical
Q7. Do you have a garden at your home, and are you involved in any of the following?	
Response Options: Rooftop Gardening, Kitchen Gardening, School Gardening, No Garden	Categorical
Q8. If yes, do you grow any fruits, vegetables, or herbs?	
Response Options: Yes, No, Maybe	Categorical
Q9. Do you feel like having any type of nutrition gardening at your home?	
Response Options: Strongly Yes, Somewhat Yes, Not at all	Categorical
Q10. If yes, why are you not currently involved in it?	
Response Options: Space/Resource Constraints, Lack of Time, Lack of Enthusiasm, Lack of Soil, Health Issues, Others	Categorical
Q11. What kind of support would help you initiate nutrition gardening?	
Response Options: Monetary Support, Free/Subsidized Seeds and Fertilizers, Equipmental Support, Government Incentives, Awareness Programs	Categorical
Q12. Do you think nutrition gardening can provide better daily nutrition?	
Response Options: Yes, No	Binary
Q13. Do you believe nutrition gardening can help mitigate climate change and air pollution?	
Response Options: Yes, No, Maybe	Categorical
Q14. Do you believe gardening can have a positive impact on your family's health?	
Response Options: Significantly Yes, Somewhat Yes, No Noticeable Impact	Categorical

3.3 Primary Outcome Variable

The primary outcome variable was whether the respondent felt inclined to have a nutritional garden at home (**Q9** in Table 1). In the original survey, this was captured through three categorical responses: "Strongly feel yes," "Somewhat feel yes" and "No". For the purpose of logistic regression analysis, this variable was recoded into a binary outcome, where responses indicating "Strongly feel yes" and "Somewhat feel yes" were combined and coded as $Y = 1$, while the response "No" was coded as $Y = 0$.

3.4 Statistical Analysis

To assess the factors associated with a respondent's willingness to adopt nutritional gardening, we employed a logistic regression model. The explanatory variables included demographic characteristics, awareness level regarding nutrition gardening, perceived barriers and the types of support required to initiate such practices. The logistic regression model is specified as

$$\log\left(\frac{\pi_i}{1-\pi_i}\right) = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_k X_{ki},$$

where $\pi_i = P(Y_i = 1 \mid X_{1i}, X_{2i}, \ldots, X_{ki})$ denotes the probability that the i^{th} respondent is willing to have a nutritional garden. Here, X_{ji} represents the j^{th} covariate for the i^{th} individual and β_j are the corresponding regression coefficients quantifying the direction and magnitude of each covariate's effect.

3.5 Interpretation of Model Coefficients

Each β_j coefficient represents the change in the log-odds of willingness to have a nutritional garden associated with a one-unit change in the corresponding covariate, holding all other covariates constant. When both Y and a given X_j are binary, $\exp(\beta_j)$ yields the odds ratio. An odds ratio greater than 1 indicates a positive association between the response variable Y and covariate X_j, less than 1 indicates a negative association, and equal to 1 implies no association.

3.6 Software and Reproducibility

All analyses were performed using the open-source statistical software `R` (version 4.5.1). The dataset and the complete R code used for the analysis are publicly available on GitHub at https://github.com/ganirban004/nutrition-gardening-paper.git to ensure reproducibility of the results.

4 Results

4.1 Descriptive Statistics

The demographic characteristics of the 93 respondents are summarized in Table 2. The majority of participants (74.2%) belonged to the age group of 18–45 years, followed by 17.2% in the 45–65 age group. Female respondents constituted 64.5% of the sample, while males represented 35.5%.

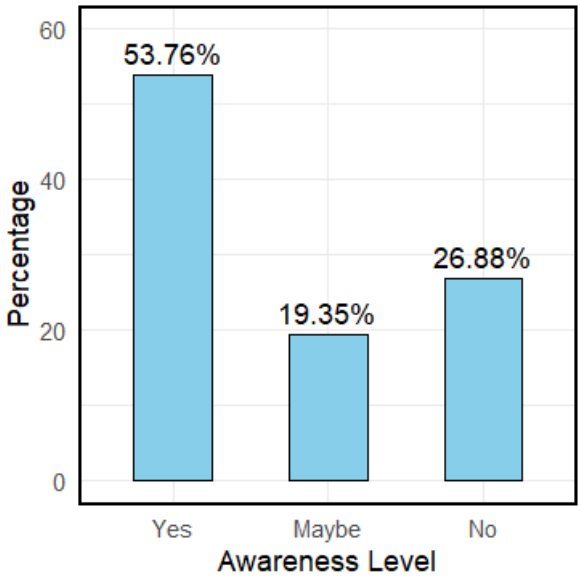
In terms of occupation, 44.1% of the respondents were students, 15% were employed in service sectors, 15% were homemakers, 14% were engaged in business, 8.6% were teachers, and 3.23% were non-working individuals, indicating representation from a diverse range of occupational groups. Regarding educational qualification, 47.3% held a bachelor's degree, 20.4% had completed a master's degree, 25.80% had completed high school.

The level of awareness regarding nutrition gardening was found to be moderate (see Figure 1a). Specifically, 53.76% of participants reported being familiar with the concept, 26.88% had not heard of it, and 19.35% expressed uncertainty. Among those aware, sources of information included social media (41.84%), friends or family (34.69%), books or magazines (14.29%), educational institutions (6.12%) and television or radio (1.02%) as depicted in Figure 1b.

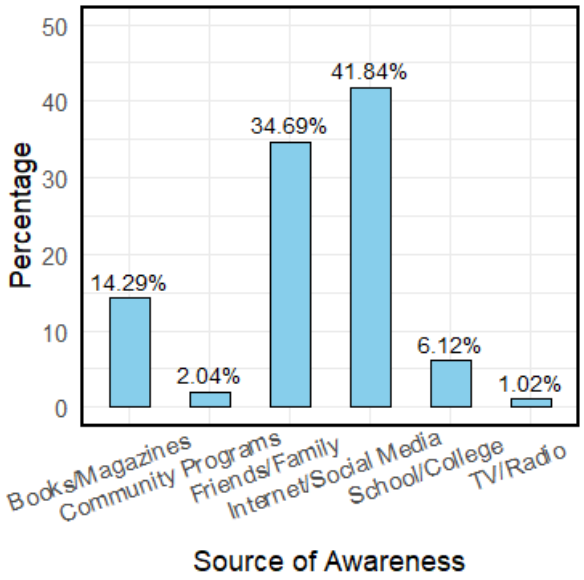
From Figure 2a, approximately 45.16% of respondents reported involvement in rooftop gardening, 17.2% in kitchen gardening and 7.53% in school gardening. However, 30.11% indicated no engagement in any form of nutrition gardening. A majority (76.56%) reported growing fruits, vegetables or herbs, while 17.19% did not and 6.25% were unsure (Figure 2b).

Table 2: Demographic Characteristics of the Respondents (n = 93)

Category	Subgroup	Percentage (%)
Age Group	Below 18 years	5.38
	18 - 45 years	74.20
	45 - 65 years	17.20
	65 years and above	3.23
Gender	Male	35.50
	Female	64.50
Occupation	Student	44.10
	Service	15.00
	Homemaker	15.00
	Business	14.00
	Teacher	8.60
	Non-working	3.23
Education Level	Below High School	3.23
	High School	25.80
	Some College	12.80
	Bachelor's Degree	47.30
	Master's Degree	20.40
	Doctorate	3.23

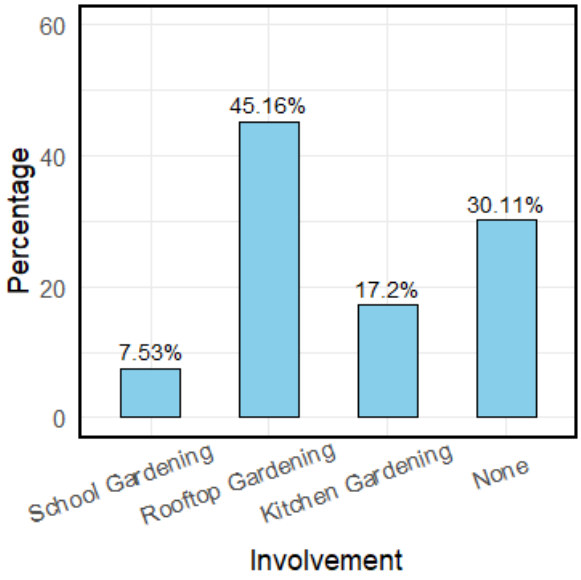


(a) Percentages of the respondents aware about nutrition gardening

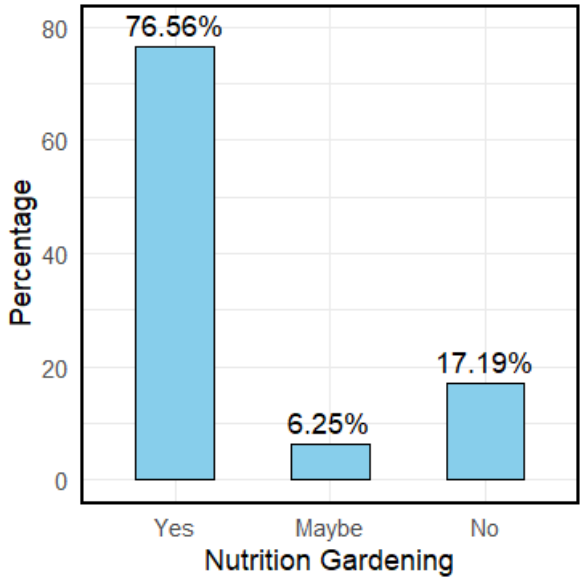


(b) How do the respondents know about nutrition gardening

Figure 1: Awareness of nutrition gardening



(a) Percentages of the respondents involved in various types of gardening



(b) Whether the involved respondents grow any fruits, vegetables and herbs

Figure 2: Involvement in nutrition gardening

4.2 Perceptions and Barriers

When asked about interest in starting nutrition gardening at home, 40.86% of respondents strongly agreed, 46.24% somewhat agreed and 12.9% expressed no interest as shown in Figure 3. The main barriers to adoption were lack of free time (39.5%), resource or space constraints (26.89%), lack of consistent enthusiasm (20.17%), lack of soil (9.24%), health issues (2.52%) and other unspecified reasons (1.68%) (Figure 4a).

Respondents expressed the need for various types of support to begin gardening: 25.9% needed equipment, 18.71% requested awareness programs, 17.27% sought subsidized seeds or fertilizers, 15.11% required financial assistance, 10.07% favored government incentives and 12.95% required no support (see Figure 4b).

4.3 Perceived Benefits

From Figure 5a, it can be seen that, a strong majority (94.85%) agreed that nutrition gardening contributes to improved daily nutrition. Moreover, 65.22% believed it can help mitigate the effects of climate change and air pollution, while 29.35% were uncertain and 5.43% disagreed (see Figure 5c). Regarding mental and family health, 65.22% felt that gardening significantly improves family health, 31.52% somewhat agreed and 3.26% saw no significant benefit (see also Figure 5c).

4.4 Inferential Analysis: Logistic Regression

To identify the factors that most significantly influence the willingness to adopt nutrition gardening, a logistic regression model was fitted, with willingness as the dependent variable and demographic, educational, and occupational factors such as age, gender, education, and occupation as predictors. The regression equation is given by:

$$\log\left(\frac{\pi_i}{1-\pi_i}\right) = \beta_0 + \beta_1 \text{Age}_i + \beta_2 \text{Gender}_i + \beta_3 \text{Education}_i + \beta_4 \text{Occupation}_i + \beta_5 \text{Awareness}_i + \beta_6 \text{Support}_i + \beta_7 \text{TimeConstraint}_i + \varepsilon_i,$$

where π_i denotes the probability that individual i is willing to have a nutrition garden at home.

The regression results indicate that awareness level has a statistically significant positive effect at 10% significant level on willingness to adopt nutrition gardening ($p < 0.1$), suggesting that aware individuals are more likely to engage. Though gender is not statistically significant, female participants showing a higher likelihood of interest compared to males. While occupation and age are not statistically significant at the 5% level, they exhibit moderate trends, with students and younger participants appearing to have higher odds of being willing to adopt nutrition gardening.

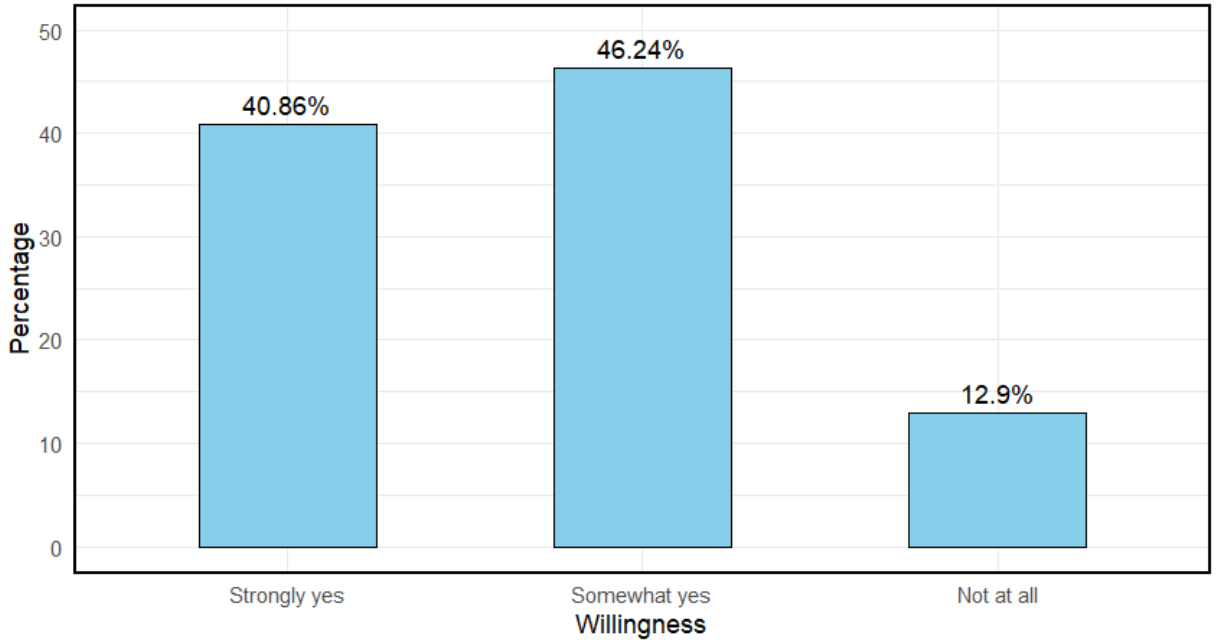
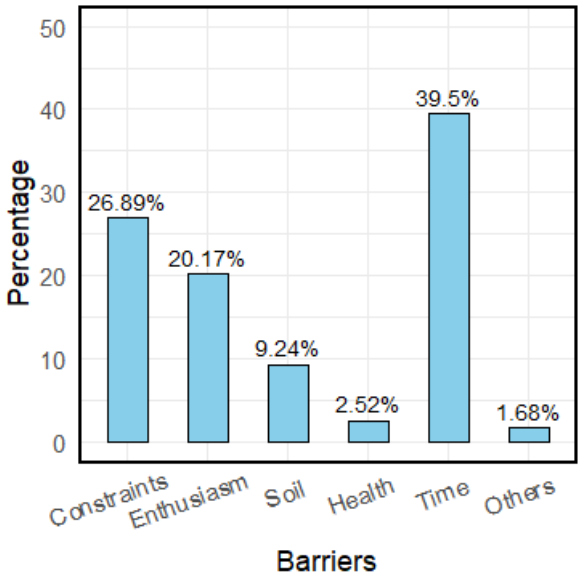
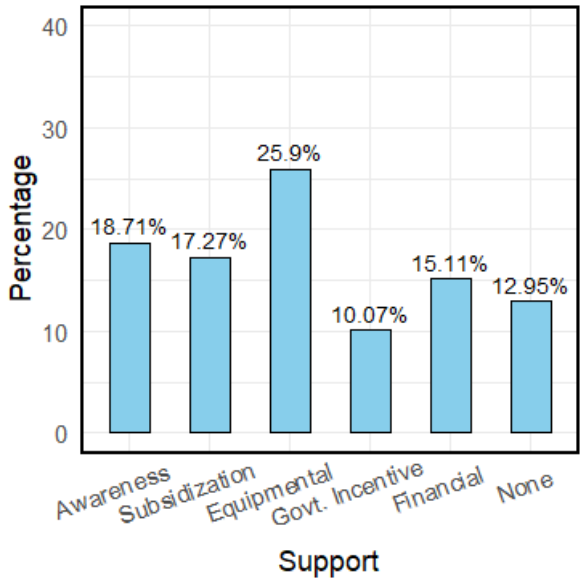


Figure 3: Willingness to have a nutrition garden at home



(a) Reasons for not engaging in nutrition gardening

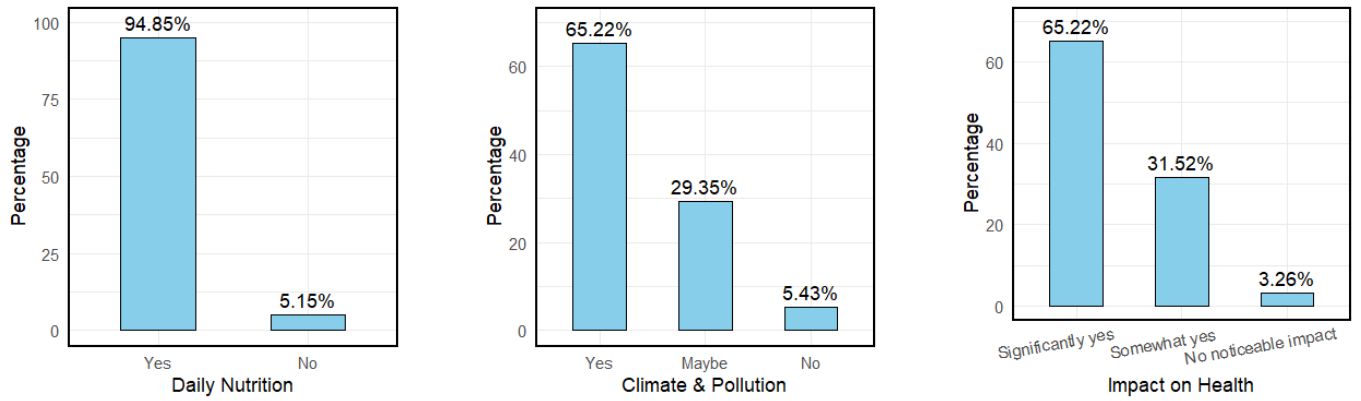


(b) Supports needed for doing nutrition gardening

Figure 4: Problems in starting in nutrition gardening

Table 3: Logistic Regression Results for Willingness to Have a Nutrition Garden at Home

Variable	**Coefficient**	**Std. Error**	p**-value**	**Odds Ratio**
Intercept	17.8202	4683.4775	0.9970	-
Age (18–45)	−16.3002	4683.4776	0.9972	0.00
Age (45–65)	1.1838	5312.8319	0.9998	3.27
Age (65 and above)	0.7181	7578.9052	0.9999	2.05
Gender (Female)	0.3526	0.7065	0.6177	1.42
Education Level	−1.2758	1.1874	0.2826	0.28
Occupation Type	0.0110	0.6925	0.9874	1.01
Awareness Level	1.5949	0.8309	0.0549	4.93
Support Availability	0.4725	0.8300	0.5692	1.60
Model Fit	AIC = 74.323; McFadden's $R^2 = 0.21$			



(a) Daily nutrition

(b) Mitigate climate change and pollution

(c) Improvement in mental and physical health

Figure 5: Benefits of nutrition gardening

4.5 Interpretation of the Results from Logistic Regression

Odds ratios derived from the regression suggest that middle-aged individuals (18–45 years) have much more interest in nutritional gardening. Additionally, female respondents have more interest in nutritional gardening compared to their male counterparts (odds ratio =1.42). Although variables other than awareness level are not statistically significant, their coefficient signs suggest meaningful trends. The positive coefficients for older age groups, female respondents, occupation type and support availability imply a general tendency for these groups to be more inclined towards adopting nutrition gardening. Conversely, the negative coefficient for education level indicates that respondents with higher education may be slightly less likely to show interest, possibly reflecting time constraints or urban lifestyle factors. Overall, despite the lack of statistical significance for most predictors, these directional trends provide useful insights into potential demographic patterns. The model demonstrates an acceptable fit (AIC = 74.32; McFadden's R^2 = 0.21), suggesting that awareness promotion and support mechanisms remain key drivers for encouraging wider adoption of nutrition gardening.

5 Discussion

This study provides valuable insights into public awareness, attitudes, and perceived barriers associated with nutrition gardening, particularly among urban and semi-urban populations in India. Our findings indicate that over half of the respondents were aware of nutrition gardening and a significant proportion (more than 87%) expressed a desire to implement it at home. A majority of participants also believed that nutrition gardening contributes to personal health, daily nutrition, and environmental benefits such as reducing the impacts of climate change and improving air quality.

The most commonly cited barriers to adoption included lack of free time, limited space, insufficient resources, and health constraints. Notably, nearly 70% of respondents indicated they would be willing to participate in nutrition gardening if provided with adequate support such as free seeds, fertilizers, tools, financial assistance, or awareness-building programs. This finding aligns with existing literature, emphasizing the importance of supportive infrastructure in translating awareness into action.

Additionally, the data suggests that social media and family/friends are the primary sources of information on nutrition gardening. Formal institutions such as educational settings or government agencies played a much smaller role in spreading awareness, revealing a potential gap in institutional outreach and public education strategies.

The logistic regression analysis revealed that individual awareness significantly influenced the intention to adopt nutrition gardening. Though the demographic factors are not significant, they reveal some important aspects. Specifically, women and individuals in the 45-65 age group demonstrated a greater interest in developing a home-based nutrition garden. Similarly, while occupation and age were not significant at the 5% level, both variables exhibited consistent directional trends, with students and younger respondents showing relatively higher odds of willingness to adopt nutrition gardening. These patterns, though not conclusive, highlight emerging behavioral tendencies that could inform future awareness and engagement

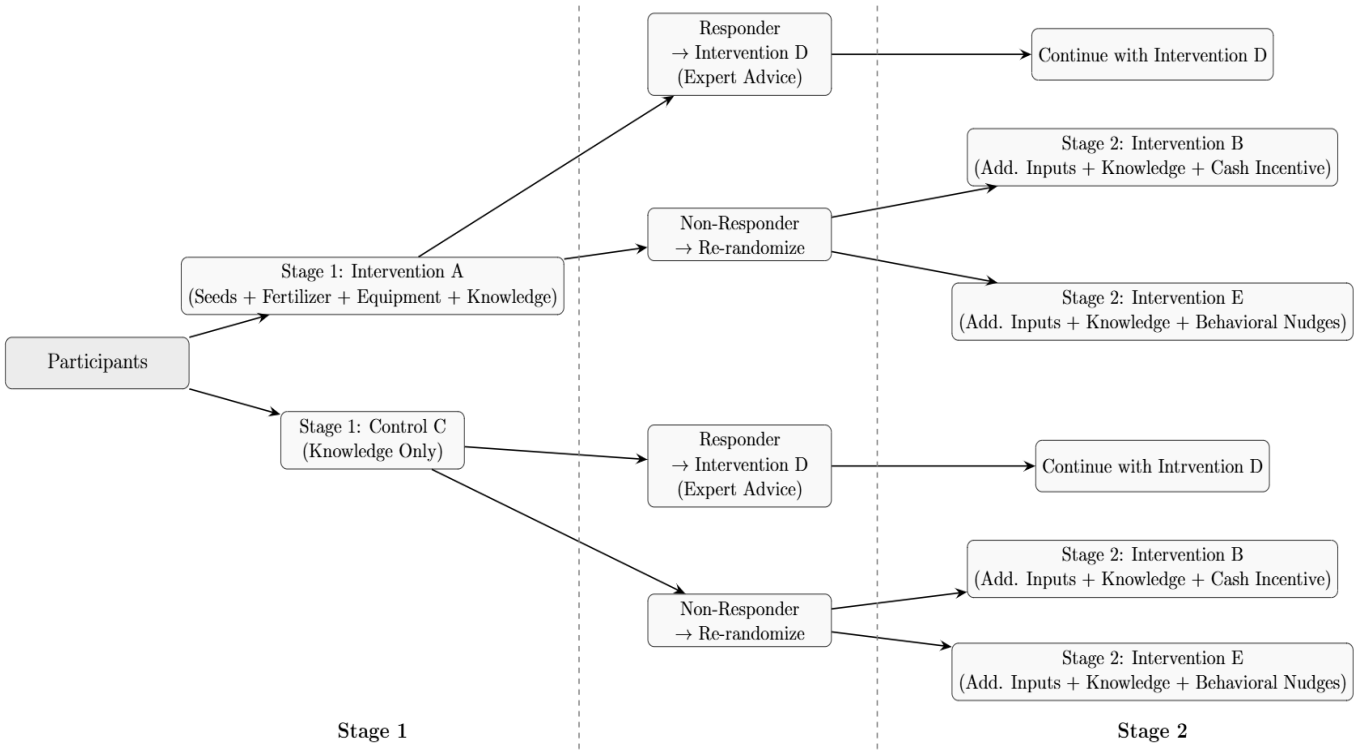


Figure 6: A two-stage SMART design schematic illustrating adaptive interventions to enhance nutritional gardening outcomes

strategies.

6 Future Scope

Future research may employ a Sequential Multiple Assignment Randomized Trial (SMART) design (see e.g., Chakraborty and Moodie (2013); Almirall et al. (2014); Yang and Berdine (2024)) to systematically evaluate adaptive intervention strategies based on participant response profiles. An outline of this two stages SMART trial is proposed as follows. At Stage-1, participants would be assigned to either intervention A (comprising the supply of seeds, fertilizer and equipment along with the provision of relevant knowledge and information) vs intervention C (meaning control that involves provision of knowledge and information only). After a four-month period, participant outcomes (e.g., success in gardening) would be assessed to determine response status. Responders (successful in gardening) may continue without additional intervention or receive limited follow-up support such as access to expert advice, denoted as intervention D. Non-responders would undergo a second randomization to either intervention B (an augmented package including additional inputs, knowledge provision and a cash incentive contingent on production success) or intervention E, which supplements the additional inputs and knowledge with behavioral nudges delivered through periodic SMS reminders or supportive phone calls. The design is presented in a schematic diagram in Figure 6. This two-stage SMART design would enable the identification of an optimal sequence of interventions and provide empirical evidence on the effectiveness of personalized adaptive support mechanisms in promoting sustained engagement and success in gardening activities.

Based on the findings of this study on the willingness to adopt nutrition gardening, several directions for future research can be explored. One possible study could examine the long-term health, economic, and environmental impacts of regular nutrition gardening using cohort or randomized experimental designs. Community-based pilot programs, such as seed banks, rooftop gardening kits, and school gardening curricula, can be developed and tested to assess their cost-effectiveness and potential for large-scale implementation. Further research is needed to understand behavioral factors like motivation, perceived benefits, and social norms that influence gardening practices, so that interventions can be better tailored. Nutrition gardening can also be integrated into public health and nutrition programs, such as the National Nutrition Mission and school mid-day meal schemes, to promote dietary diversity and sustainability. Additionally, smart gardening tools, hydroponic systems, and vertical gardening techniques should be designed and tested to

help urban residents with limited space or time. Finally, establishing knowledge exchange programs between rural farmers and urban gardeners could help share best practices and preserve traditional knowledge about food production.

In summary, this study demonstrates a strong public interest in nutrition gardening and its perceived benefits across multiple domains. A multi-sectoral approach involving government bodies, academic institutions, NGOs, and community members is essential to leverage nutrition gardening as a tool for enhancing food security, public health, and climate resilience.

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