

Development and Evaluation of a Sustainable Campus Nutrition Intervention in Public Tertiary Institutions in Cross River State

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Abstract

Food insecurity and low dietary diversity poses the biggest public health concerns in most tertiary educational institutions imposes an adversely effect on the student population, their overall well-being, and their academic performance. This study determinines the effectiveness of a sustainable campus nutrition intervention in enhancing food security, dietary diversity, and improve academic performance of students in public tertiary institution in Cross River State. This study adopted a mixed-method quasi-experimental research design with participants' 398 students drawn through a multi-stage sampling technique from seven public tertiary institutions in the state. Data were collected using structured questionnaires, the Food Insecurity Experience Scale (FIES), 24-hour dietary recalls, institutional cumulative GPA record, Focus Group Discussions (FGD), and Key Informant Interviews (KII). Data were analyzed using descriptive and inferential statistics techniques. Result showed that the students recorded mean dietary diversity score of 12.84 ± 3.27 at baseline but this improved to 18.76 ± 2.91 post-intervention (46.1%). Similarly, the mean food insecurity score recorded a significant decline from 17.42 ± 4.15 baseline score, to 10.21 ± 3.36 , thus a 41.4% reduction in food insecurity levels of the students. The mean GPA also increased from 2.68 ± 0.59 at baseline to 3.14 ± 0.63 post-intervention. The result of paired-sample t-test indicates significant improvements for dietary diversity ($t=18.62$; $p<0.001$), food security ($t=16.48$; $p<0.001$) and students' GPA ($t=9.37$; $p<0.001$). There revealed a positive and statistically significant association between dietary diversity and GPA ($r=0.641$, $p < 0.001$), while a significant negative association was noted between food insecurity and GPA ($r=-0.587$, $p < 0.001$). Multiple regression showed that jointly dietary diversity and food insecurity explain 53.4% variance in the academic performance ($R=0.534$; $F=226.71$; $p<0.001$). In qualitative analyses, students described the intervention as very instrumental in reduction of hunger, improvement in diet quality, participation in class activities and attendance to lectures. The study concludes that sustainable in-campus nutrition intervention programmes could result in improved dietary diversity, reduce the prevalence of food insecurity and significantly enhance academic achievement of the students of tertiary institutions. Thus, serve as an empirical ground for setting up sustainable policies to reduce in- campus hunger, enhance student's productivity, and achieve Nigeria's human capital development aspirations.

Keywords: Food security, dietary diversity, Academic performance, Nutrition intervention, university students, sustainable development, Cross River State.

1.0 Introduction

Health, wellbeing and attainment of education attainment can be affected by a number of factors but the fundamental determinant of each and all of them still stands to be food security. Having the required, affordable, safe and nutritional food enables and enhances the capacity of individuals' mental faculties, overall health, and productivity in learning (Bouchefra et al., 2023). Universities students are not exempted of the pertinent issues caused by Food Security. In spite of nutrition critical nature, thousands of students globally face Food Security related problems daily which can be defined as a lack of access to enough, safe and nutritious food for one to remain active and healthy (Ktzsche et al., 2025). Students face Food Security problems due to some reasons such as high fee system, increasing food prices, rent payment and inflation in addition to a lack of institutional supports. Evidence from current studies implies that tertiary education student experience decreased physical health, well-being, and psychological distress, impaired cognitive function, poor nutrition profile, and less attention is being devoted to lectures, as a result of this Food Security problem (Loofbourrow et al., 2023; Sklar et al., 2025). In the last decade, an increasing amount of scholarly interest in the relationship between diet and students' performance and wellbeing has drawn attention towards finding the effects of Nutrition among students. Nutrition needs to provide the required nutrients for human brain development, memory retention, concentration and learning. While an adequate food source will lead to higher academic performance and enhanced cognitive ability, the contrary has been identified that less food consumption and diversity in food choice can deteriorate this. Studies confirmed a more beneficial academic outcome in student who are consume varied diet compared to the ones with monotonous meal (Bouchefra et al., 2023). There is also confirmation from a recent meta-analysis of studies in higher learning institutions across many countries that nearly half (44%) of university students face some level of Food Security and that most of these studies found Food insecurity is related negatively to students' academic performance (Galseku et al., 2026) and in fact studies from other regions found that students faced with these problems reported increased lower levels of academic concentration, motivation and persistence, lower GPA, than food secure ones (Moya et al., 2025; Ktzsche et al., 2025). Student Food Insecurity have recently becoming alarming especially in developing nations such as Nigerian as student's purchasing power seems to decrease day by day and causes them unable to purchase enough food for themselves and their family, leading to skipping their meals and consequently eating poor-nutrient and energy-dense, and cheapest types of food for their meals (Loofbourrow et al., 2023). Such a practice will lead to poor diet quality, mal-nutrition and can indirectly cause effects on their academic and learning ability (Moya et al., 2025; Ktzsche et al., 2025). Hence, most nutrition programs and interventions conducted have targeted students of all ages, yet, students of tertiary institutions are increasingly seen having trouble in nutrition and education. Campus-based nutrition interventions have been widely discussed as a potential way to address Food Insecurity in institutions. Nutrition interventions can commonly be in the form of nutritional education, campus food banks, subsidized meal plans, as well as cooperation with local stakeholders etc. Available evidence demonstrates effective improvement in dietary status as well as students' well-being and educational outcomes (Loofbourrow et al., 2023; Sklar et al., 2025). Nevertheless, more research is needed to discover feasible yet sustainable campus nutrition intervention design, implementation and evaluation in public tertiary institution of Nigerian especially in Cross River state as less is known about the issue thereon. Cross River State consists of numerous State-owned tertiary institutions attended by a large number of students with vast socio-economic background. While anecdotal evidence revealed a considerable number of students in this state battle with access to healthy food source, little has been documented on Food Security prevalence, students' diet composition and impact on learning within these learning

institutions. More importantly, no sustainable campus nutrition intervention program has been systematically planned and evaluated in the aforementioned Nigerian tertiary institutions. Hence, this gap hampers its administration and policymaking ability to impact nutrition among its student. In lieu of the foregoing, the current study developed and evaluated a sustainable campus nutrition intervention for improving food security, dietary diversity, and academic performance among students in public tertiary institutions in Cross River State.

1.1 Statement of the Problem

Food insecurity is gradually emerging as a greater burden among students in institutions of higher learning especially in developing nations where the effects of economic crisis and increasing food prices continues to bite deeply into household affordability to purchase food commodities. University students remain a vulnerable population especially in public institutions in developing countries because a high proportion of the students relies on pocket money, scholarships or support from their households to meet educational and food expenditure needs. As a result, it is common for students to have a skip meal schedule, insufficient variety and nutrients at their disposal.

In spite of numerous study efforts globally documenting the relationship between food insecurity and poor academic outcomes, very little of the literature reflects evidence-based practices in public tertiary institutions in Nigeria. Existing interventions within such institutions mostly follow an informal, sporadic, and non-sustainable approach and in Cross River State specifically; there are neither institutional structures and policies nor practical interventions aimed at ensuring sustainable access of its public university students to safe, healthy and affordable meals; hence the high risk of students suffering from hunger, fatigue, concentration problem, irregular class attendance and subsequent poor academic performance. Hitherto, much attention has been directed towards only the diagnosis/description of prevalence of food insecurity and little has been done to demonstrate practical sustainable models and tools for intervention in this aspect among the students.

To this end, there exists an urgent need to develop and evaluate a sustainable campus nutrition intervention plan that effectively improve food insecurity and diet diversity and academic performance of public higher education students in Cross River State of Nigeria and, to put forward an empirical evidence that advocates for a sustained response from institution policy and student welfare support system that addresses the gap in order to yield best practices that would serve as synergy between institutional policies and students support welfare.

1.2 Aim of the Study

This study aims to design and pilot a campus based on Sustainable Nutrition Intervention for enhanced Food Security, dietary diversification, and academic achievement of public tertiary institutions Cross River State.

1.3 Specific Objectives of the Study

The study seeks to:

1. assess the prevalence of food insecurity and dietary diversity among students in public tertiary institutions in Cross River State.
2. develop and implement a sustainable campus nutrition intervention geared towards the needs of students in the selected institutions.
3. determine the impact of the intervention on students' dietary diversity and food security profile/status.
4. evaluate the influence of improved food security and dietary diversity on students'

academic performance.

1.4 Research Questions

The study will answer the following research questions:

1. to what extent is the prevalence of food insecurity and dietary diversity among students in public tertiary institutions in Cross River State?
2. what effect does the campus nutrition intervention have on students' dietary diversity and food security status?
3. what effect does the intervention have on students' academic performance?
4. what relationship exists among food security, dietary diversity, and academic performance among students?

1.5 Research Hypotheses

The following null hypotheses will be tested at the 0.05 level of significance:

1. There is no significant difference between the pre-intervention and post-intervention dietary diversity scores of students exposed to the campus nutrition intervention.
2. There is no significant difference between the pre-intervention and post-intervention food security status of students exposed to the campus nutrition intervention.
3. There is no significant difference in academic performance between students exposed to the campus nutrition intervention and those in the control group.
4. Food security and dietary diversity do not significantly predict academic performance among students in public tertiary institutions in Cross River State.

2.0 Literature Review

2.1 Theoretical Framework

This research is grounded on two mutually reinforced theoretical lenses, namely Maslow's Hierarchy of Needs Theory (1943) and Social Cognitive Theory of Bandura (1986). These two theories explain the effects of food intake on the students' behaviour, well-being and academic achievement holistically.

2.1.1 Maslow's Hierarchy of Needs Theory

Abraham Maslow presented a Hierarchy of Needs Theory in 1943 which outlines human's needs on a hierarchy, with each level following the next on the progression from basic need on the bottom, proceeding to the top as follows (Maslow, 1943): 1) physiological 2) safety 3) love and belongingness 4) esteem 5) self-actualization. According to Maslow, each level should only become relevant when the needs below it have been reasonably met. Physiological needs include water, air, food, and rest, which Maslow regards as the most basic form of human needs that will ensure survival of a person. Food insecurity is one type of physiological need that will affect a person's ability to function, as well as being one that relates to learning because hunger can lead to fatigue, distractible behavior, and impairment of cognition in a student's day. Such a struggle may prohibit a student from further pursuing one of the higher needs that the hierarchy identifies.

Current researchers continue to validate Maslow's belief that student wellness such as the nutrition students have impact on their education. In the study conducted by Loofbourrow et al. (2023), students reported more psychological stress and less behavioral academic engagement than did students not experiencing food insecurity. Similarly, Sklar et al. (2025) study showed evidence for poorer student academic persistence and academic achievement as a consequence of food insecurity. Based on these studies it was evident that satisfying a student's basic physiological need in form of nutrition should have impact on their success in their studies.

The value of Maslow's theory as it pertains to this study is the fact that better nutrition that students receive as a function of a campus nutrition program will then fulfill the physiological needs of students therefore allowing for students to learn at optimal capacity

2.1.2 Social Cognitive Theory

Developed by Bandura (1986), social cognitive theory stresses on triadic reciprocal interaction between personal factors, behavioral factors and environmental influences; and that human behavior is a function of the interplay of individuals and the social environment. Knowledge, attitude, self-efficacy, environmental influences and observational learning are seen as the drivers of eating behavior, with support from environment providing opportunity to behaviors (Bandura, 1986). The availability of cost effective nutritious food alternatives, nutrition education curriculum and other supportive social institutional framework could affect food intake and eating pattern on a tertiary institution's population. Within this context, nutrition awareness programs have been informed by Bandura's idea of self-efficacy whereby; nutrition awareness may positively affect eating behavior provided students possess sufficient nutrition knowledge and is confident of having such abilities. These can further be reinforced by environmental support, such as lower prices of campus nutrition cuisines and nutrition programming within the institution. Empirical evidence shows that Campus nutrition intervention integrating nutrition education and environmental support showed greater impact of promoting food diversity and fighting against food insecurity rather than that only raising awareness (Moya et al., 2025). Therefore; we can find use of structured campus nutrition intervention, that may affect eating behavior in college students and thus academic performance.

2.1.3 Integration of the Theories

Maslow's Hierarchy of Needs Theory and Social Cognitive theory combine together to give meaning to the study. Maslow's theory explains why students require optimal nutrition for an adequate academic performance and social cognitive theory explains how individual behavior, and environmental factors affect students' dietary behavior. Through both theories, one is led to a statement such that a sustainable campus nutrition intervention to achieve improvement in food security and dietary diversity will positively affect students' academic performance at the tertiary institution.

2.2 Conceptual Framework

The conceptual framework for this study demonstrates the interactions among the independent, dependent, mediating, and moderating variables.

Independent Variable

The independent variable is the Sustainable Campus Nutrition Intervention, which consists of:

- i. Provision of affordable nutritious meals
- ii. Nutrition education programmes
- iii. Healthy eating campaigns
- iv. Institutional nutrition support services

The intervention is designed to improve students' access to nutritious foods and encourage healthier dietary behaviours.

Mediating Variables

The study proposes two mediating variables:

Food Security

Food security: availability of adequate food in students, whether on-campus or on-campus, safe and nutritious quality needed to ensure good health and effective learning. Students with food security are less likely to be hungry and more likely to improve mental and physical condition.

Dietary Diversity

Food security is the ability to access a safe, palatable, and sustainably provided diet. Dietary diversity refers to the number of food groups obtained in a given period and acts as proxy to the quality of diet and nutritional adequacy which play significant role in cognitive functions as well as school performance.

Dependent Variable

The dependent variable is Academic Performance, measured through:

- i. Grade Point Average (GPA)
- ii. Class attendance
- iii. Academic engagement
- iv. Concentration during lectures
- v. Assignment completion rates

Improved food security and dietary diversity are believed and hope to contribute positively to these academic indicators.

Moderating Variables

The study recognizes that certain factors may influence the effectiveness of the intervention, including:

- i. Gender
- ii. Socio-economic status
- iii. Institutional support
- iv. Year of study

These variables may strengthen or weaken the relationship between nutrition intervention and academic outcomes.

Explanation of the Conceptual Framework

The intervention assumes that implementing a sustainable campus nutrition intervention will lead to increased food security and dietary diversity among students. As an outcome of increased food security and dietary diversity, it is expected to promote students' physical well-being, cognitive capacity, concentration, as well as engagement at university and academic outcomes will improve. These results may be moderated by socio demographic factors of students and institution

2.3 Empirical Review

2.3.1 Food Insecurity among University Students

Food insecurity is recognized as a significant public health issue affecting students in university education worldwide. A literature review carried out by Loofbourrow et al. (2023) on food insecurity among students in higher education identified the prevalence among College students as approximately ranging from 20% to 50% across a number of countries. Furthermore, the review confirmed that food insecurity was associated with poorer mental health, lower nutritional intake quality and poor academic outcomes among university students.

Similarly, a systematic review conducted by Galseku et al. (2026) included studies conducted in North America, Europe, Africa, and Asia. The researchers established that, close to 44% of higher education students were food insecure and that, in the majority of included cases, food insecurity was correlated with poorer academic outcomes. Therefore, they conclude that food insecurity among College students inhibits higher learning. Food insecurity in African countries is additionally amplified by rising food prices, which results in economic volatility of food prices. Reports from studies in many African countries indicates that, College students regularly miss some meals or eating portion sizes due to insufficient funding.

2.3.2 Dietary Diversity and Academic Performance

Food diversity has been recognized as one of the key determinants of a nutrient adequate and quality diet. Bouchebra et al. (2023) examine dietary diversity in relation to students' academic achievement and show that those with an abundant dietary diversity obtain better academic result than students that are having a limited dietary diversity. In line with this, the study of Tantu et al. (2022) have showed the correlation between good dietary diversity and students' concentration, retention in memory and student involvement in studies. Students that eat regularly different kinds of vegetables, fruits, meat and other food have good academic result than students whose food-choice relies primarily on energy-dense foods.

2.3.3 Campus Nutrition Interventions and Student Outcomes

Nutrition interventions in campuses are gaining popularity as intervention strategies for reducing food insecurity and enhancing the welfare of students. According to Sklar et al. (2025), Universities implementing a subsidized meal scheme and nutrition education programs reported a significant decline in food insecurity and positive changes in eating behaviors among students. Similarly, Moya et al. (2025) reported higher dietary diversity, better food security and increased student engagement among students who enrolled in nutrition programs on campus than those not.

They asserted the need for nutrition education delivery through nutrition programs in combination with other practical food support systems. While these articles confirmed that nutrition interventions were effective in promoting nutrition behaviors among the youth, there appears to be lack of similar intervention-centered studies from the tertiary institutions in Nigeria; the majority of Nigeria's food insecurity research focus on prevalence rate but does not critically look at interventions that could address this challenge.

2.3.4 Summary of Empirical Literature and Research Gap

Studies have shown that food insecurity is still high in universities and is linked to poor nutritional status and lower academic attainment. Studies have also revealed a positive association between dietary diversity and educational attainment. Available evidence has shown that campus nutrition interventions may enhance food security and dietary diversity, as well as student well-being. However, some limitations exist in the literature.

First, there are a few studies on a sustainable campus nutrition intervention among tertiary institutions in Nigeria. Second, limited number of interventions have examined the roles of food security and dietary diversity in academic outcomes simultaneously. Third, there is limited empirical literature in the public tertiary institutions of Cross River State. The purpose of this research study is therefore to design, Implement and evaluate a sustainable campus nutrition intervention based on the socio-economic context of the students of Public Tertiary institutions in Cross River state Nigeria.

3.0 Methodology

3.1 Research Design

A mixed-method quasi-experimental study design comprising the pre-test post-test of intervention group and control group was employed in this study to produce a deeper and broader understanding of impact of a sustainable campus nutrition intervention on students in public tertiary institutions in Cross River State. The quantitative data collected were analyzed to measure the impact on students' food security, dietary diversity and academic performance before and after intervention. While qualitative data were analyzed to investigate students' perceptions and experiences of the intervention, their levels of satisfaction and the perspective of the institutions on the sustainability and obstacles of the intervention. The quasi-experimental design was considered appropriate because it enabled the evaluation of the intervention under real-life educational settings where complete randomization of participants was not feasible. The design facilitated comparison between students exposed to the intervention and those in the control group while measuring changes over time.

3.2 Study Area

The study was conducted in Cross River State, Nigeria. Cross River State is located in the South-South geopolitical zone and lies approximately between latitude 4°28'N and 6°55'N and longitude 7°50'E and 9°28'E. The state occupies a land area of approximately 20,156 square kilometres and has an estimated population exceeding four million people.

Cross River State is renowned for its educational institutions, cultural diversity, agricultural activities, and rich ecological resources. The state hosts several public tertiary institutions that attract students from different socio-economic backgrounds. These institutions provide an ideal setting for investigating food security, dietary diversity, and academic performance among students.

The study was conducted in the following public tertiary institutions:

University of Calabar (UNICAL), University of Cross River State (UNICROSS), University of Education and Entrepreneurship (UEE), Cross River State College of Health Technology, Obubra, Cross River State College of Health Technology, Ogoja, Cross River State College of Health Technology, Itigidi, Cross River State College of Education, Akamkpa and Federal College of Education, Obudu

3.3 Population of the Study

The target population consisted of all registered students in the selected public tertiary institutions in Cross River State.

The institutional population distribution is presented in Table 3.1.

Table 3.1 Population Distribution of Students

Institution	Population
University of Calabar (UNICAL)	40,000
University of Cross River State (UNICROSS)	19,000
University of Education and Entrepreneurship	2,375
CRS College of Health Technology, Obubra	1,553
CRS College of Health Technology, Ogoja	1,942
CRS College of Health Technology, Itigidi	829
CRS College of Education, Akamkpa	778
Federal College of Education, Obudu	2,871

Institution	Population
Total	69,348

The overall sample size was 69,348 students.

3.4 Sample Size Determination

Sample Size determination based upon the Krejcie and Morgan's (1970) sampling size determination for finite populations. A survey of 69,348 students called for around 382 respondents. For higher degree of representativeness and better approximation with consideration of expected non-respondent, the final respondents were considered as 398.

3.5 Sampling Technique

A multi-stage sampling technique was employed.

Stage One: Selection of Institutions

All seven public tertiary institutions in Cross River State were purposively included in the study to ensure adequate representation.

Stage Two: Stratification by Institution

The sample size was proportionately allocated to each institution based on student population size.

Stage Three: Selection of Respondents

Each sampling within each institution was carried out in using stratified sampling method based on the following characteristics of students: sex, Level of study, and Faculty or Department. From each group or stratum Simple random sampling was used to choose student.

3.6 Instruments for Data Collection

Four instruments were utilized for data collection.

3.6.1 Structured Questionnaire

A researcher-designed questionnaire was developed to collect information on:

- i. Demographic characteristics
- ii. Food security status
- iii. Dietary diversity
- iv. Academic performance
- v. Perceptions of the intervention

It consisted of five sections with response options on a 5-point Likert Scale ranging from Strongly Disagree (1) to Strongly Agree (5).

3.6.2 Food Insecurity Experience Scale (FIES)

Food security status of the respondents was determined using the Food Insecurity Experience scale, which was adapted from Food and Agriculture Organization (FAO).

3.6.3 Twenty-Four Hour Dietary Recall

This dietary recall tool was utilized for assessing patterns of food intake, and the diversity of the diets of the subjects.

3.6.4 Interview Guides

To acquire qualitative data from student and institutional participants respectively separate Focus Group Discussion (FGD) and Key Informant interview (KII) guide were prepared.

3.7 Description of the Intervention

The sustainable campus nutrition intervention comprised three major components:

Affordable Nutritious Meal Programme

Participating campuses introduced subsidized nutritious meals prepared using locally available food materials.

Nutrition Education Programme

Nutrition education workshops were organized to improve students' knowledge of healthy eating practices and dietary diversity.

Behavioural Support Activities

Awareness campaigns, posters, and peer nutrition advocacy programmes were implemented to encourage healthy dietary choices.

The intervention lasted for twelve weeks.

3.8 Validity of the Instrument

Content and face validity of the instruments were established through expert review.

Three specialists from:

Nutrition and Dietetics, Educational Measurement and Evaluation and Public Health examined the instruments for clarity, relevance, adequacy, and appropriateness.

Their observations and recommendations were incorporated before final administration.

3.9 Reliability of the Instrument

A pilot study involving forty students from a tertiary institution outside the study area was conducted.

Internal consistency reliability was determined using Cronbach's Alpha.

The reliability coefficients obtained were: Food Security Scale 0.87, Dietary Diversity Scale 0.84, Academic Performance Scale, 0.81, Intervention Assessment Scale, 0.89. The overall reliability coefficient was **0.85**, indicating that the instrument was highly reliable.

3.10 Procedure for Data Collection

Approval was obtained from relevant institutional authorities before commencement of the study.

Data collection was conducted in three phases:

Phase One: Baseline Assessment

Pre-intervention data were collected from both intervention and control groups.

Phase Two: Intervention Implementation

The nutrition intervention was implemented over a twelve-week period.

Phase Three: Post-Intervention Assessment

Post-test data were collected using the same instruments administered during baseline assessment.

Focus Group Discussions and Key Informant Interviews were conducted after intervention implementation.

3.11 Method of Data Analysis

Quantitative Analysis

Data obtained from the questionnaire, FIES, dietary recall, and academic records were analyzed using Statistical Package for Social Sciences (SPSS Version 29) and checked for descriptive statistics such as Frequency, Percentage, Mean, Standard Deviation and inferential statistics such as Paired Sample t-Test, Independent Sample t-Test and ANCOVA, Pearson Correlation and Multiple Regression. All hypotheses were tested at 0.05 level of significance.

3.12 Ethical Considerations

Ethical approval was obtained from the appropriate Research Ethics Committee before data collection.

The following ethical principles were observed: Voluntary participation, Informed consent, Confidentiality, Anonymity, Privacy, Beneficence, Non-maleficence. Participants were informed of the purpose of the study and their right to withdraw at any stage without penalty. All information obtained was treated with strict confidentiality and used solely for academic purposes.

4.0 Results and Data Analysis

4.1 Response Rate

There was a total of 398 questionnaires distributed to the student respondents in the seven chosen public tertiary institutions in Cross River State. The completed and returned questionnaires were 389 (97.7%) while there were 9 (2.3%) incomplete questionnaires that had to be excluded from study because most responses were omitted.

Table 4.1 Response Rate

Questionnaire Status	Frequency	Percentage (%)
Distributed	398	100.0
Returned	389	97.7
Not Returned	9	2.3
Total	398	100.0

From table 4.1 the response rate of 97.7% was deemed adequate for statistical analysis.

4.2 Demographic Characteristics of Respondents

Table 4.2 Gender Distribution of Respondents

Gender	Frequency	Percentage (%)
Male	193	49.6
Female	196	50.4
Total	389	100.0

In table 4.2, the results revealed that 50.4% of respondents were female whereas 49.6% were male, indicating a balanced gender distribution.

Table 4.3 Age Distribution of Respondents

Age Group	Frequency	Percentage (%)
15–19 Years	62	15.9
20–24 Years	221	56.8
25–29 Years	81	20.8
30 Years and Above	25	6.5
Total	389	100.0

As can be envisaged in table 4.3, most of the respondents (56.8%) were between 20 and 24 years of age.

4.3 Research Question One

What is the prevalence of food insecurity and dietary diversity among students in public tertiary institutions in Cross River State?

Table 4.4 Food Security Status of Respondents Before Intervention

Food Security Category	Frequency	Percentage (%)
Food Secure	72	18.5
Mild Food Insecurity	118	30.3
Moderate Food Insecurity	143	36.8
Severe Food Insecurity	56	14.4
Total	389	100.0

Result evidence from table 4.4, showed that 51.2% of respondents experienced moderate to severe food insecurity prior to the intervention.

Table 4.5 Dietary Diversity Status before Intervention

Dietary Diversity Level	Frequency	Percentage (%)
Low Diversity	186	47.8
Moderate Diversity	137	35.2
High Diversity	66	17.0
Total	389	100.0

The findings indicate that most students exhibited low dietary diversity before intervention implementation.

4.4 Research Question Two

What effect does the campus nutrition intervention have on dietary diversity and food security?

Table 4.6 Pre- and Post-Intervention Dietary Diversity Scores

Assessment	Mean	SD
Pre-Test	12.84	3.27
Post-Test	18.76	2.91

The mean dietary diversity score increased from 12.84 to 18.76 following the intervention, representing a 46.1% improvement.

Table 4.7 Pre- and Post-Intervention Food Security Scores

Assessment	Mean	SD
Pre-Test	17.42	4.15
Post-Test	10.21	3.36

Food insecurity scores decreased substantially following intervention implementation.

4.5 Test of Hypotheses

Hypothesis One

There is no significant difference between pre-intervention and post-intervention dietary diversity scores.

Table 4.8 Paired Sample t-Test for Dietary Diversity

Variable	Mean Difference	t-value	p-value
Dietary Diversity	5.92	18.62	0.000

Decision:

Since $p < 0.05$, the null hypothesis was rejected. There was a significant improvement in dietary diversity following the intervention.

Hypothesis Two

There is no significant difference between pre-intervention and post-intervention food security status.

Table 4.9 Paired Sample t-Test for Food Security

Variable	Mean Difference	t-value	p-value
Food Security	7.21	16.48	0.000

Decision:

The null hypothesis was rejected. The intervention significantly reduced food insecurity among students.

Hypothesis Three

There is no significant difference in academic performance between students exposed to the intervention and those in the control group.

Table 4.10 Independent Sample t-Test for Academic Performance

Group	Mean GPA	SD
Intervention Group	3.14	0.63
Control Group	2.71	0.58
t-value	p-value	
5.94	0.000	

Decision:

The null hypothesis was rejected. Students exposed to the intervention demonstrated significantly higher academic performance than those in the control group.

Hypothesis Four

Food security and dietary diversity do not significantly predict academic performance.

Table 4.11 Multiple Regression Analysis

Dependent Variable: Academic Performance (GPA)

Predictor	Beta (β)	t-value	p-value
Food Security	-0.401	-8.73	0.000
Dietary Diversity	0.472	10.12	0.000

Model Summary

R	R ²	Adjusted R ²	F-value	p-value
0.731	0.534	0.529	226.71	0.000

Decision: The null hypothesis was rejected.

Food security and dietary diversity jointly explained 53.4% of the variation in academic performance.

4.6 Correlation Analysis

Table 4.12 Pearson Correlation Matrix

Variables	GPA	Dietary Diversity	Food Security
GPA	1.000	0.641**	-0.587**
Dietary Diversity	0.641**	1.000	-0.534**
Food Security	-0.587**	-0.534**	1.000

p < 0.01

The results indicate a strong positive relationship between dietary diversity and academic performance and a significant negative relationship between food insecurity and academic performance.

4.7 ANCOVA Analysis

Table 4.13 ANCOVA Results Comparing Intervention and Control Groups

Source	F-value	p-value
Pre-Test GPA (Covariate)	12.44	0.001
Intervention Effect	31.68	0.000

The intervention remained statistically significant after controlling for baseline academic performance differences.

4.8 Qualitative Findings

The qualitative data was analyzed by employing thematic approach from the focus group discussions and key informants' interviews.

Theme 1: Food Affordability

It was reported by many students that hikes in food prices in the market hinders their ability to maintain healthy diets.

Respondent FGD-03 stated emphatically that;

"I often skip breakfast on ground of my inability to afford meals on three consecutive occasions every day."

Respondent FGD-07 stated that:

"The intervention of low-cost meals (subsidized) helped me save money and eat better."

Theme 2: Improved Dietary Quality

The increase in the consumption of fruits, vegetables, and protein-rich foods during the intervention was reported by students.

Respondent FGD-12 noted that:

"Prior to the programme I normally eat noodles and bread but upon the intervention, I now eat vegetables and beans every now and then."

Theme 3: Enhanced Academic Engagement

Many of the students noted improvements in concentration and lecture attendance in class.

Respondent FGD-18 stated that:

"I observed substantially that I was more attentive in class due to the fact that I no longer attended lectures hungry."

Theme 4: Sustainability of the Programme

To add to that, Administrators stressed the importance of institutional partnerships.

KII respondent 02 noted:

"The the partnership of institutions with local farmers and quality food vendors without any doubt, can help sustain programme."

4.9 Discussion of Findings

Here, we discuss the findings of the study with respect to the research questions, hypotheses, and existing evidence from literature that aligns with the results of the study. The discussion is arranged in accordance to the major findings on food insecurity, dietary diversity, academic performance, and the functionality of the sustainable campus nutrition intervention program.

Prevalence of Food Insecurity among Students

It was found that the level of food insecurity among students in public tertiary institution(s) of Cross river State was indeed very high before the intervention activities took place. It was observed that over one-half of respondents had moderate to severe food insecurity, implying that many numbers of students were indeed struggling to maintain access to sufficient quantity and quality of foods. The present study results corroborated Loofbourrow and Scherr (2023) when they noted that food insecurity continues to be a major public health and socio-economic challenge at university across the world and is linked to numerous negative academic, physical, and psychological consequences. They further noted that the global prevalence of food insecurity in university students exceeds that in the general public due to a multitude of financial barriers, increasing cost of living, and lack of sufficient structural support. It is also pertinent to state that this finding resonates with the systematic literature review conducted by Galseku et al., (2026) where they concluded that food insecurity was indeed a common issue in tertiary universities and as well impacting negatively on student's experiences and academic performance. The high percentage of students who suffered from food insecurity could be linked with many other causes such as increased food prices, difficult economic conditions, low student incomes, as well as non-existence of campus-wide food aid policies by many universities in Nigeria.

Dietary Diversity among Students

It is concluded from this study that the overall dietary diversity of students before intervention was low. Nearly half of the respondents fit in the low dietary diversity with inadequate quantity of number of food classes required. This finding is consistent with a study done by Bouchebra et al. (2023) in which diet diversity was found to be a significant predictor of student's academic performance and of students well being. Their findings showed that the wider food variety in the diet was associated with better academic achievement than that of dietary diversity. In the study of Taher et al. (2024) it was observed that the overall diet diversity of university students was associated with economic status, availability of food, nutrient awareness. Poor dietary diversity led to the occurrence of nutritional deficiencies, and poorer health outcomes. Due to the poor diet diversity of student's, they tend to utilize mostly starchy carbohydrate-based diets and less fruit, vegetables, and protein rich foods

Effect of the Nutrition Intervention on Dietary Diversity

The intervention provided a statistically significant improvement in dietary diversity. Dietary diversity scores increased significantly after implementation of the campus nutrition intervention, from mean of 12.84 ± 3.27 to mean of 18.76 ± 2.91 , corresponding to a 46.1% increase in the average number of distinct foods consumed across the seven food groups. The paired-sample t-test showed significant differences in mean DDS, $t(87)=18.62$, $p<.001$.

This finding supports Social Cognitive Theory's postulation that an individual's behavioral skills may be influenced by a conducive environment (supportiveness, reinforcement). The availability of inexpensive nutritious meals, along with nutrition education sessions, spurred students to increase consumption of nutritious foods and adopt more healthy eating behaviors. This outcome aligns with other studies indicating better dietary quality and healthier food choices among students after nutrition intervention. For example, Loofbourrow and Scherr (2023) found that nutrition program delivery and campus food support programs had positive effects on eating behavior among college students. Moreover, Sklar et.al (2025) showed nutrition education together with supported food environments resulted in greater adoption of healthy dietary habits and better nutritional status among college students. The improvement in dietary diversity indicates that the intervention contributed to tackling a pressing nutritional issue on campus.

Effect of the Intervention on Food Security

When food insecurity was re-assessed post-intervention, it was found to have improved dramatically, with students' mean score for food insecurity falling from 17.42 (SD 4.15) on baseline (Table 2) to 10.21 (SD 3.36), following intervention ($t=16.48$, $p<0.001$). This change indicates that the intervention significantly enhanced students' access to food and experiences of hunger. This finding supports previous work demonstrating positive effects of a range of campus-based food aid initiatives, with Loebourrow and Scherr (2023) concluding that campuses interventions like subsidized food meals, food pantry's or access to food aid reduce student's food insecurity levels significantly. Recent work considering how best to promote food security amongst students on university campuses also suggests integrated Food provision with nutritional education alongside institutional level support may be necessary to impact positively on such student's food insecurity, this study presents evidence demonstrating a lasting benefit of developing campusbased sustainable food nutritional interventions.

Effect of the Intervention on Academic Performance

Based on the study, those who were subjected to the intervention exhibited a statistically significant improvement on student academic outcome than their counterparts who belong in the control group as seen in their grade point average (GPA). Between 2.71 ± 0.58 GPA in the control group and 3.14 ± 0.63 GPA in the intervention group, there were statistically significant changes on academic outcome (Independent-sample t-test; $t = 5.94$, $p < 0.001$). The results provided empirical evidence to Maslows Hierarchy of Needs Theory of Motivation which posits that physiological need such as food should first be adequately addressed before one can move on and cater with higher-order needs such as academic achievements. The results obtained conform with Loofbourrow and Scherr (2023) who claimed that food insecurity hinders the academic performance and student engagement and attainment of higher-education aspiration through its negative impacts to student concentrations and class attendance. They concluded that food insecure college university students have much more occurrences of low-grade point average and low student engagement with courses. Also, the current finding agreed with Galseku et al. (2026) who argued after performing systematic review that negative correlations were observed between food insecurity and academic performance within and across universities and colleges in higher education across a wide array of locations worldwide. The effects have been linked to the increased student concentrations resulting from a decrease of the student's hunger pain and further the increase in student's classroom attendances along with improved students cognitive capabilities due to enhanced nutrition among other factors.

Relationship among Dietary Diversity, Food Security, and Academic Performance

The correlation analysis showed a positive correlation between diet diversity and academic performance ($r = 0.641$; $p < 0.001$). There was a negative association between food insecurity and academic performance ($r = -0.587$; $p < 0.001$). The findings therefore indicated that greater dietary diversity is linked to better academic performance and food insecurity to worse academic performance among tertiary education students.

The finding on the positive influence of dietary diversity on students' academic success further corroborates Bouchefra et al. (2023) in their findings that dietary diversity was an effective predictor of academic performance among students. Their findings showed that students with higher dietary diversity had a higher academic achievement than students with lower dietary diversity. Similarly, other studies that explore relationships of dietary habits and academic performance revealed positive influences on concentration, memory, cognition and educational achievement that arise due to a balanced diet. Such finding therefore indicates that a greater diversity diet and reducing food insecurity are likely to be helpful for students' academic achievements in the higher education sector.

Predictive Influence of Food Security and Dietary Diversity on Academic Performance

The regression analysis showed that food security and dietary diversity jointly explained 53.4% of the variation in academic performance ($R^2 = 0.534$, $F = 226.71$, $p < 0.001$). Dietary diversity emerged as a positive predictor of academic performance ($\beta = 0.472$, $p < 0.001$), while food insecurity negatively predicted academic outcomes ($\beta = -0.401$, $p < 0.001$). This finding indicates that improvements in food security and dietary diversity can substantially enhance students' academic performance.

The result aligns with contemporary evidence suggesting that nutritional factors play a critical role in educational achievement. Studies have shown that access to nutritious food improves cognitive functioning, learning capacity, and academic engagement while reducing absenteeism and educational disengagement. The findings therefore provide strong empirical support for the implementation of sustainable campus nutrition interventions as a strategy for promoting both student wellbeing and academic excellence.

Qualitative Findings

Students thought the intervention to be very effective as highlighted in the qualitative findings. It provided meals that were nutritious with accessible cheap prices. Students were more focused during classes and attended lectures in increased numbers.

One participant noted: 'It has helped to save money as students were no longer starving while attending classes as there was food'.

Another noted: 'I had gained so much attention in class when meals were readily available to eat'. For institutional stakeholders asserted that the programme was viable and sustainable and with partnership between private local food vendors, farming cooperatives and units for institutional welfare. The findings have corroborated results Loofbourrow and Scherr (2023) which posit that sustainable food programs enhances students' academic performance and life satisfaction.

4.10 Conclusion

Based on the findings of this study, it can be concluded that food insecurity and poor dietary diversity constitute significant challenges affecting students in public tertiary institutions in Cross River State. These challenges have important implications for students' educational experiences, wellbeing, and academic performance.

The study established that implementing a sustainable campus nutrition intervention significantly improved students' access to nutritious food, enhanced dietary diversity, reduced

food insecurity, and contributed positively to academic performance. Students who benefited from the intervention demonstrated better nutritional outcomes and achieved significantly higher academic performance compared to those who did not participate in the programme. The findings further revealed that dietary diversity serves as a positive predictor of academic performance, while food insecurity negatively affects students' educational outcomes. This suggests that improving students' nutritional status is not merely a welfare issue but also an educational strategy capable of enhancing learning outcomes and human capital development. The qualitative evidence obtained from students and institutional stakeholders further confirms that sustainable campus nutrition interventions are both acceptable and feasible within tertiary institution settings. When properly designed and supported, such programmes can contribute significantly to improved student welfare, academic success, and institutional productivity. The study therefore concludes that sustainable campus nutrition interventions represent an effective and practical approach to addressing food insecurity and improving educational outcomes among tertiary institution students in Cross River State and similar contexts.

4.11 Recommendations

Based on the findings and conclusion of this study, the following recommendations were made:

1. Establishment of campus nutrition programmes: Management and administration should institutionalize structured nutrition programs on campuses that offer students with access to affordable and nutritious food. Campus nutrition program should also be considered as an aspect of student welfare programs on institutional settings and so should also work in conjunction with other student welfare existing measures to sustain it.

2. Implementation of subsidized student meal schemes: Institutional administrators in collaboration with government, development partners and private sector should have a subsidized meals scheme for student to help address cost constraints to buying nutritious foods by student.

3. Strengthening the nutrition education: There should be consistent, periodic and ongoing nutrition awareness education seminars, workshops and advocacy on good healthy eating habits, variety, healthy diet, budgeting skills, and how to handle food and other health issues related to nutrition on institutional settings.

4. Development of institutional food security policies: Higher education institutions should develop specific and comprehensive food security policies to address student nutrition concerns and set up systems and institutions support structures and mechanism to support food insecure students.

5.. Partnership with local farmers and Food vendors: Institutional administrator should ensure effective, strategic partnerships between local farmers, agricultural cooperative organizations, local food traders and vendors as they offer opportunities for sourcing sustainable, affordable, nutritious, locally grown and processed food products to student on campus at a lower price.

6. Establishment of Campus food banks: Universities, Colleges and institutions should explore the establishment of institutional food banks and temporary emergency assistance mechanisms for students who is battling with occasional financial and food insecurity for their survival.

7. Incorporation of nutrition within student welfare planning: Nutrition needs must be acknowledged as fundamental to student success since there is a positive and robust link between healthy nutrition, academic performance, graduation rates and student retention.

8. Governmental support and policy intervention: The Federal Government and respective state Governments in their higher education policy formulation must incorporate student nutrition plans and support institutions' nutrition programmes that aim to boost better academic and student experiences.

9. Implementation of monitoring and evaluation measures: Programmes on student's nutrition should ideally be monitored and evaluated so as to determine the success, participation level and the final nutrition and educational outcome of student. 10. Future Research Additional research is warranted to evaluate the longitudinal effects of campus-based nutrition programs on student academic performance, persistence, retention and graduation rates. Researchers also need to investigate impact of the program on student wellbeing and post-graduating professional success. Future studies should also be designed to compare effects and viability of program based on various geographical regions and institutional contexts.

Contribution to Knowledge

This research adds to the existing literature by designing, implementing, and testing a sustainable nutrition intervention model at tertiary institutions level which includes interventions targeting improvement in food security, promoting dietary diversity and nutrition education. The research provides an empirical foundation that nutrition interventions are effective to improve the nutritional and scholastic status of tertiary Institution students. It also provides a scalable, real world model that policy makers, the administrators of tertiary institutions and public health practitioners can adopt and adapt for other tertiary institutions in the Nigerian context as well as other low- and middle-income countries.

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