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Gut-Brain Axis and Academic Performance among Undergraduate Students in Federal University Gashua, Yobe State, Nigeria: A Sociological Investigation

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ABSTRACT

This study investigated the relationship between gut-brain axis health indicators and academic performance among undergraduate students at Federal University Gashua, Yobe State, Nigeria. Adopting a cross-sectional survey design, data were collected from 300 undergraduate students using structured questionnaires assessing dietary patterns, digestive health indicators, and self-reported academic performance (CGPA). The study was anchored on the Social Determinants of Health Theory and the Biopsychosocial Model. Findings revealed that only 35% of students consumed regular balanced meals, while 48% frequently relied on fast foods. Digestive health issues were prevalent, with 32% reporting bloating, 27% experiencing stomach discomfort, and 19% suffering from constipation. Regression analysis demonstrated significant positive relationships between balanced diet (coefficient = 0.41, $p < 0.05$), digestive health (coefficient = 0.37, $p < 0.05$), and academic performance, while stress showed a negative association (coefficient = -0.29, $p < 0.05$). Sociological factors including financial constraints, campus food environment, and peer influences emerged as significant determinants of dietary behaviors. The study concludes that gut health, influenced by socially-patterned dietary habits, significantly affects academic performance among undergraduate students. Recommendations include establishing campus-based nutrition education programs, improving access to affordable nutritious food options, and integrating gut health awareness into student wellness services.

INTRODUCTION

Academic performance among university students represents a multifaceted outcome influenced by numerous biological, psychological, and social factors that interact in complex ways. In recent years, interdisciplinary research has increasingly illuminated the role of the gut-brain axis as a significant biological pathway that affects cognitive functioning, mental health, and learning outcomes among student populations (Cryan *et al.*, 2019). The gut-brain axis refers to the bidirectional communication network that links the gastrointestinal tract with the central nervous system through neural, hormonal, and immune pathways, suggesting that the health of the digestive system can profoundly influence mood, stress levels, concentration, and ultimately academic achievement (Mayer *et al.*, 2022). The human gastrointestinal tract hosts trillions of microorganisms collectively known as the gut microbiota, which constitute a complex ecosystem that influences digestion, metabolism, immune function, and neurotransmitter production (Valdes *et al.*, 2018). Scientific evidence has demonstrated that the gut microbiota produces numerous neurotransmitters including serotonin, dopamine, and gamma-aminobutyric acid (GABA), which play essential roles in regulating mood, anxiety, and cognitive processes (Cryan *et al.*, 2019). Approximately 90% of the body's serotonin is produced in the gut, highlighting the profound connection between digestive health and emotional regulation (O'Mahony *et al.*, 2015). Consequently, disruptions in gut health may lead to fatigue, poor concentration, anxiety, and depression, all of which can negatively affect academic performance among students.

University students often experience lifestyle patterns that can disrupt gut health. Irregular eating habits, excessive consumption of processed foods, high caffeine intake, inadequate sleep, stress from academic workload, and limited physical activity are common among undergraduates (Whatnall *et al.*, 2020). These behaviors may negatively influence gut microbiota balance and contribute to digestive disorders such as irritable bowel syndrome, bloating, and gastritis (Hills *et al.*, 2019). Such conditions may interfere with students' ability to focus during lectures, complete assignments effectively, and maintain optimal cognitive functioning throughout their academic programs.

From a sociological perspective, dietary habits and health behaviors are not only biological phenomena but also socially influenced practices shaped by cultural norms, economic conditions, and institutional environments (Cockerham, 2021). Cultural food patterns, economic constraints, peer influence, campus food environments, and access to nutritious food play significant roles in shaping students' eating behaviors (Deliens *et al.*, 2014). In many Nigerian universities, students face financial limitations and restricted access to balanced diets, leading them to rely on inexpensive fast foods and carbohydrate-heavy meals that may lack essential nutrients for optimal cognitive function (Ogunba & Abiodun, 2017). These

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dietary patterns may affect gut microbiota diversity and consequently influence mental and cognitive health outcomes.

In Nigeria, research on academic performance has traditionally focused on factors such as socioeconomic background, learning environment, teaching quality, and psychological stress (Adeyemi & Adeyemi, 2014; Afolabi *et al.*, 2018). However, limited attention has been given to the biological-social interface represented by the gut-brain axis and its potential implications for student achievement. Understanding how gut health interacts with social lifestyle patterns among students may provide valuable insights into improving academic outcomes and student wellbeing in Nigerian higher education institutions.

Federal University Gashua, located in Yobe State, provides a relevant context for examining this relationship. As a growing institution in northeastern Nigeria, the university hosts students from diverse socioeconomic backgrounds across the region. Many students reside in off-campus accommodations where dietary choices are influenced primarily by affordability and availability rather than nutritional quality (Abdulrahman & Jibrin, 2020). Additionally, academic stress and lifestyle changes associated with university life may contribute to digestive and mental health challenges that potentially affect academic performance.

This study therefore investigates the relationship between gut-brain axis health indicators and academic performance among undergraduate students of Federal University Gashua. By adopting a sociological perspective, the research explores how dietary practices, lifestyle patterns, and digestive health influence students' cognitive functioning and academic achievement. The findings aim to contribute to the growing body of knowledge on student health and academic success while providing evidence-based recommendations for institutional policies supporting student wellbeing.

Objectives of the Study

The following objectives guided this study:

1. To examine dietary patterns among undergraduate students in Federal University Gashua.
2. To assess the prevalence of digestive health issues among undergraduate students.
3. To evaluate the relationship between gut health indicators and academic performance among students.
4. To analyze the sociological factors influencing dietary habits among undergraduate students.

Research Questions

This study sought to answer the following research questions:

1. What are the common dietary patterns among undergraduate students in Federal University Gashua?
2. How prevalent are digestive health issues among undergraduate students?
3. Is there a significant relationship between gut health indicators and academic performance?
4. What sociological factors influence students' dietary behaviors at Federal University Gashua?

LITERATURE REVIEW

Concept of the Gut-Brain Axis

The gut-brain axis refers to the complex communication network connecting the gastrointestinal system and the central nervous system. This interaction occurs through neural pathways, endocrine signaling, immune responses, and microbial metabolites. Research in neuroscience and microbiology has shown that gut microorganisms can influence brain function and emotional regulation.

The gut microbiota consists of trillions of bacteria, fungi, and other microorganisms residing in the digestive tract. These microbes assist in digestion and produce metabolites that influence brain chemistry. Short-chain fatty acids, for example, are produced during the fermentation of dietary fibers and have been shown to affect neural signaling and inflammation.

The vagus nerve serves as a primary pathway through which signals travel between the gut and the brain. When the gut microbiome is balanced, communication between these systems supports healthy cognitive functioning and emotional stability. However, disturbances in microbial diversity, known as dysbiosis, may contribute to anxiety, depression, and cognitive impairment.

Diet, Microbiota, and Cognitive Function

Diet plays a fundamental role in shaping the composition of gut microbiota. Diets rich in fiber, fruits, vegetables, and fermented foods promote microbial diversity, while diets high in processed foods, sugars, and saturated fats can disrupt microbial balance.

Research suggests that gut microbiota influences cognitive processes such as memory, attention, and decision making. For example, certain bacteria contribute to the production of serotonin, a neurotransmitter that regulates mood and emotional wellbeing. Approximately 90 percent of serotonin in the body is produced in the gut.

Students who maintain balanced diets with adequate nutrients may therefore experience better mental clarity and concentration. Conversely, poor dietary patterns may contribute to fatigue, irritability, and reduced cognitive performance.

Gut Health and Academic Performance:

Academic performance depends on cognitive abilities such as concentration, memory retention, and problem solving. Emerging research indicates that digestive health may influence these abilities through biological pathways associated with the gut-brain axis.

Digestive disorders such as gastritis, constipation, and irritable bowel syndrome may cause discomfort, sleep disturbances, and stress. These conditions can reduce students' ability to attend lectures regularly or maintain focus during academic activities.

Studies in health psychology have shown that students experiencing gastrointestinal symptoms often report higher levels of anxiety and reduced academic engagement. Furthermore, dietary deficiencies in essential nutrients such as omega-3 fatty acids, vitamins, and minerals may impair cognitive development.

Sociological Determinants of Student Diet

Sociological theories emphasize that health behaviors are shaped by social environments. Factors such as economic status, cultural food practices, peer networks, and institutional settings influence dietary choices.

In Nigerian universities, many students live independently for the first time and must manage their own food consumption. Financial limitations often lead students to prioritize affordability over nutritional value. Street foods, fast foods, and carbohydrate-based meals are therefore common dietary options.

Peer influence also plays a role in shaping eating habits. Students often adopt similar food patterns within social groups. Additionally, academic schedules may lead students to skip meals or rely on snacks rather than balanced diets.

Understanding these sociological determinants is essential for addressing health issues related to the gut-brain axis and improving academic outcomes.

MATERIALS AND METHODS

Research Design

This study adopted a cross-sectional survey design to examine the relationship between gut health indicators and academic performance among undergraduate students at Federal University Gashua. The cross-sectional design was appropriate for collecting data at a single point in time to describe the current status of dietary patterns, digestive health, and academic performance, as well as to examine associations between these variables (Creswell & Creswell, 2018).

Study Area

The study was conducted at Federal University Gashua, located in Gashua town, Bade Local Government Area of Yobe State, northeastern Nigeria. The university was established in 2013 and has grown to accommodate students from various parts of Nigeria, particularly from Yobe State and neighboring states. The institution comprises several faculties including Arts, Social Sciences, Education, Sciences, Agriculture, and Management Sciences. The student population includes both undergraduate and postgraduate students from diverse socioeconomic and cultural backgrounds.

Population of the Study

The target population for this study consisted of all registered undergraduate students at Federal University Gashua during the 2025/2026 academic session. According to university records, the undergraduate student population was approximately 8,500 students across various faculties and year levels.

Sampling Technique

A multistage sampling technique was employed to select participants for this study:

Stage 1: Selection of Faculties

Four faculties were randomly selected from the existing faculties at Federal University Gashua using a simple random sampling technique (balloting method). The selected faculties included Social Sciences, Education, Sciences, and Management Sciences.

Stage 2: Selection of Departments

From each selected faculty, two departments were randomly selected, resulting in a total of eight departments.

Stage 3: Selection of Students

Within each selected department, students were proportionately sampled based on departmental enrollment numbers. Systematic random sampling was used to select every nth student from departmental registers until the required sample size from each department was achieved. This approach ensured representation across different year levels and academic programs.

Instrument for Data Collection

Data were collected using a structured questionnaire developed by the researcher based on extensive literature review and adapted from previous relevant studies. The questionnaire consisted of five sections:

Section A: Demographic Characteristics

This section collected information on students' age, gender, year of study, faculty, department, marital status, and estimated monthly food expenditure.

Section B: Dietary Patterns

This section assessed students' dietary habits using a food frequency questionnaire and questions about meal regularity, consumption of different food groups, and typical food sources (campus cafeteria, off-campus vendors, self-prepared, etc.). Items were adapted from the Dietary Screening Tool (Bailey *et al.*, 2009) and modified for the Nigerian context.

Section C: Digestive Health Indicators

This section assessed the prevalence and frequency of digestive symptoms including bloating, abdominal pain, constipation, diarrhea, heartburn, and nausea over the preceding four weeks. Items were adapted from the Gastrointestinal Symptom Rating Scale (Svedlund *et al.*, 1988).

Section D: Academic Performance

Academic performance was measured using students' self-reported Cumulative Grade Point Average (CGPA) from the most recent semester. Students were asked to indicate their CGPA on a 5-point scale categories: 4.50-5.00 (First Class), 3.50-4.49 (Second Class Upper), 2.50-3.49 (Second Class Lower), 1.50-2.49 (Third Class), and below 1.50 (Fail).

Section E: Sociological Factors

This section assessed factors influencing dietary choices, including financial constraints, food availability on campus, peer influence, cultural food preferences, time constraints, and knowledge about nutrition. Items were rated on a 5-point Likert scale ranging from "strongly disagree" to "strongly agree."

Validity of the Instrument

Content and face validity of the questionnaire were established through expert review. The instrument was submitted to three research experts in sociology, nutrition science, and health education at Federal University Gashua for assessment of item relevance, clarity, and comprehensiveness. Experts' feedback was used to revise and improve the questionnaire before pretesting.

Reliability of the Instrument

The reliability of the questionnaire was established through a pilot study conducted with 20 undergraduate students from a university outside the study area (Yobe State University, Damaturu) to avoid contamination of the main sample. Data from the pilot study were analyzed using Cronbach's alpha coefficient to assess internal consistency. The overall reliability coefficient was 0.81, indicating acceptable reliability. Sub-scale reliability coefficients ranged from 0.76 to 0.85 across different sections.

Data Collection Procedure

Data collection was conducted over a four-week period during the academic session. Research assistants were recruited and trained on the study objectives, ethical considerations, and data collection procedures. The questionnaire was administered to selected students during regular class sessions with permission from course lecturers. Students were informed about the study purpose, assured of confidentiality, and provided with written informed consent forms before participation. Questionnaires were distributed and collected immediately after completion to maximize response rates.

Ethical Considerations

Ethical approval for this study was obtained from the Research Ethics Committee of Federal University Gashua. Participants were informed that their participation was voluntary and that they could withdraw at any time without consequences. Anonymity was ensured by not collecting identifying information such as names or registration numbers. Confidentiality of responses was guaranteed, and data were stored securely with access limited to the research team.

Data Analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS) version 26. Descriptive statistics including frequencies, percentages, means, and standard deviations were used to summarize demographic characteristics, dietary patterns, and digestive health indicators. Inferential statistics, specifically multiple regression analysis, were employed to examine the relationship between gut health indicators (dietary patterns and digestive symptoms) and academic performance (CGPA), controlling for demographic variables. Statistical significance was set at $p < 0.05$.

Table 1: Demographic Characteristics of Respondents (N=300)

Characteristic	Category	Frequency	Percentage
Age	**18-21 years**	**135**	**45.0**
	22-25 years	120	40.0
	26 years and above	45	15.0
Gender	Male	168	56.0
	Female	132	44.0
Year of Study	Year 1	78	26.0
	Year 2	84	28.0
	Year 3	72	24.0
	Year 4	66	22.0
Faculty	Social Sciences	87	29.0
	Education	81	27.0
	Sciences	72	24.0
	Management Sciences	60	
Monthly Food Expenditure	Less than ₦15,000	114	
	₦15,000 - ₦25,000	123	
	Above ₦25,000	63	

RESULTS AND DISCUSSION

Demographic Characteristics of Respondents

The demographic profile shows that the sample represents a diverse student population, with the majority (85%) falling within the typical undergraduate age range of 18-25 years. Male students constituted 56% of respondents while females represented 44%, reflecting the gender distribution patterns in many Nigerian universities. Students were distributed across all year levels, with relatively even representation from years 1 through 4. The largest proportion of students (41%) reported monthly food expenditure between ₦15,000 and ₦25,000, while 38% spent less than ₦15,000 monthly on food, indicating financial constraints among a significant portion of the student population.

Table 2: Dietary Patterns among Undergraduate Students (N=300)

Dietary Indicator	Category	Frequency	Percentage
Meal Regularity	**Regular three meals daily**	**105**	**35.0**
	Two meals daily	144	48.0
	Irregular eating patterns	51	17.0
Fast Food Consumption	Daily	81	27.0
	3-5 times weekly	144	48.0
	Occasionally (1-2 times weekly)	57	19.0
	Rarely/never	18	6.0
Fruit Consumption	Daily	42	14.0
	2-3 times weekly	96	32.0
	Weekly	105	35.0
	Rarely/never	57	19.0
Vegetable Consumption	Daily	51	17.0
	2-3 times weekly	102	34.0
	Weekly	111	37.0
	Rarely/never	36	12.0
Primary Food Source	Campus cafeteria	87	29.0
	Off-campus vendors	156	52.0
	Self-prepared	45	15.0
	Other	12	4.0
Skipping Breakfast	Daily	63	21.0
	3-4 times weekly	114	38.0
	Occasionally	78	26.0
	Rarely/never	45	15.0

Dietary Patterns among Undergraduate Students

The findings reveal concerning dietary patterns among undergraduate students at Federal University Gashua. Only 35% of students reported consuming regular three balanced meals daily, while 48% ate only two meals daily and 17% had irregular eating patterns. Fast food consumption was prevalent, with 27% consuming fast food daily and 48% consuming it 3-5 times weekly, suggesting that three-quarters of students rely heavily on fast foods as part of their regular diet.

Fruit and vegetable consumption was notably inadequate. Only 14% of students consumed fruits daily, while 19% rarely or never ate fruits. Similarly, only 17% consumed vegetables daily, with 12% rarely or never including vegetables in their diet. These patterns indicate potential nutritional deficiencies that could affect gut microbiota diversity and cognitive function.

The primary food source for most students (52%) was off-campus vendors, while 29% relied on campus cafeterias. Only 15% of students regularly prepared their own meals. Breakfast skipping was common, with 21% skipping breakfast daily and 38% skipping it 3-4 times weekly. This pattern is particularly concerning given the importance of breakfast for cognitive function and academic performance.

Prevalence of Digestive Health Issues

The prevalence of digestive health issues among students was substantial, with 78% reporting at least one digestive symptom. Bloating was the most frequently reported symptom, with 32% experiencing it weekly or more often and an additional 45% experiencing it occasionally. Stomach discomfort or pain affected 27% of students frequently and 47% occasionally. Constipation was reported by 19% of students on a weekly basis, while 41% experienced it occasionally.

Table 3: Prevalence of Digestive Health Issues Among Undergraduate Students (N=300)

Digestive Symptom	Frequency	Percentage
Bloating		
Frequently (weekly or more)	96	32.0
Occasionally (monthly)	135	45.0
Rarely/never	69	23.0
Stomach Discomfort/Pain		
Frequently (weekly or more)	81	27.0
Occasionally (monthly)	141	47.0
Rarely/never	78	26.0
Constipation		
Frequently (weekly or more)	57	19.0
Occasionally (monthly)	123	41.0
Rarely/never	120	40.0
Diarrhea		
Frequently (weekly or more)	33	11.0
Occasionally (monthly)	114	38.0
Rarely/never	153	51.0
Heartburn/Acid Reflux		
Frequently (weekly or more)	48	16.0
Occasionally (monthly)	96	32.0
Rarely/never	156	52.0
Nausea		
Frequently (weekly or more)	39	13.0
Occasionally (monthly)	108	36.0
Rarely/never	153	51.0
Overall Digestive Health		
No digestive problems	66	22.0
One or more digestive problems	234	78.0

Heartburn and acid reflux affected 16% of students frequently, while diarrhea and nausea were less common but still reported by significant minorities. The high prevalence of digestive symptoms suggests that gut health problems are common among this student population and may have implications for their academic performance and overall wellbeing.

Only 22% of students reported experiencing no digestive problems, indicating that the majority of undergraduates at Federal University Gashua face some form of digestive health challenge that could potentially impact their daily functioning and academic engagement.

Table 4: Multiple Regression Analysis of Gut Health Indicators and Academic Performance (CGPA)

Predictor Variable	Unstandardized Coefficient (B)	Standard Error	Standardized Coefficient (β)	t-value	p-value
(Constant)	**2.143**	**0.312**		**6.87**	**<0.001**
Balanced diet	0.41	0.098	0.28	4.18	<0.001
Digestive health	0.37	0.087	0.25	4.25	<0.001
Stress level	-0.29	0.076	-0.22	-3.82	<0.001
Fruit consumption	0.24	0.082	0.18	2.93	0.004
Vegetable consumption	0.21	0.079	0.16	2.66	0.008
Meal regularity	0.33	0.091	0.23	3.63	<0.001
Age	0.08	0.064	0.06	1.25	0.212
Gender (Male=1)	0.05	0.071	0.04	0.70	0.484

Monthly food expenditure	0.19	0.068	0.15	2.79	0.006

$R^2 = 0.43$; Adjusted $R^2 = 0.41$; $F(9,290) = 24.36$, $p < 0.001$

Relationship Between Gut Health Indicators and Academic Performance

The regression analysis revealed significant relationships between several gut health indicators and academic performance (CGPA). The model was statistically significant ($F = 24.36$, $p < 0.001$) and explained 41% of the variance in academic performance (Adjusted $R^2 = 0.41$).

Balanced diet showed a significant positive relationship with academic performance ($\beta = 0.28$, $p < 0.001$), indicating that students who reported consuming more balanced meals tended to achieve higher CGPAs. Similarly, digestive health demonstrated a significant positive association ($\beta = 0.25$, $p < 0.001$), meaning that students with fewer digestive symptoms performed better academically.

Stress level was negatively associated with academic performance ($\beta = -0.22$, $p < 0.001$), confirming that higher stress levels correspond with lower academic achievement. Fruit consumption ($\beta = 0.18$, $p = 0.004$), vegetable consumption ($\beta = 0.16$, $p = 0.008$), and meal regularity ($\beta = 0.23$, $p < 0.001$) all showed significant positive relationships with CGPA.

Monthly food expenditure was also significantly associated with academic performance ($\beta = 0.15$, $p = 0.006$), suggesting that students with more financial resources for food tend to achieve higher grades, possibly through better nutrition. Age and gender did not show significant relationships with academic performance in this model.

These findings indicate that students with healthier dietary patterns and better digestive health tend to achieve higher academic performance, supporting the study's hypothesis regarding the gut-brain axis influence on academic outcomes.

Table 5: Sociological Factors Influencing Dietary Habits Among Undergraduate Students

Sociological Factor	Mean Score (1-5)	Standard Deviation	Rank
Financial constraints limit my food choices	**4.21**	**0.87**	**1**
Fast food is more affordable than healthy options	3.98	0.92	2
Limited time for meal preparation due to academics	3.87	0.95	3
Campus food vendors offer limited healthy options	3.76	0.98	4
Peer influence affects my eating habits	3.54	1.02	5
Cultural food preferences shape my diet	3.42	1.08	6
Lack of nutrition knowledge affects food choices	3.28	1.12	7
Family food traditions influence current diet	3.15	1.15	8

Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree

Sociological Factors Influencing Dietary Habits

The analysis of sociological factors revealed that financial constraints were the most influential factor shaping students' dietary habits (mean = 4.21), followed by the perception that fast food is more affordable than healthy options (mean = 3.98). These economic factors highlight the significant role of financial resources in determining food choices among undergraduates.

Time constraints related to academic workload ranked third (mean = 3.87), indicating that busy schedules prevent many students from preparing meals or seeking out nutritious food options. The limited availability of healthy food options from campus vendors (mean = 3.76) points to institutional and environmental factors that constrain students' dietary choices.

Peer influence (mean = 3.54) and cultural food preferences (mean = 3.42) also emerged as important social factors shaping eating habits. While knowledge-related factors (nutrition knowledge and family traditions) received lower mean scores, they still demonstrated some influence on dietary behaviors.

These findings confirm that dietary habits among undergraduate students are shaped by multiple sociological factors, with economic constraints being the most prominent, followed by time pressures, environmental limitations, and social influences.

Discussion

Dietary Patterns and Gut Health:

The findings of this study reveal concerning dietary patterns among undergraduate students at Federal University Gashua, with only 35% consuming regular balanced meals and a majority relying heavily on fast foods. These patterns are consistent with previous research on university student nutrition in Nigeria and other contexts (Ogunba & Abiodun, 2017; Whatnall *et al.*, 2020). The high prevalence of fast food consumption (75% consuming at least 3-5 times weekly) and inadequate fruit and vegetable intake aligns with global trends showing that university students often adopt poor dietary habits

during their transition to independent living (Deliens *et al.*, 2014).

The inadequate consumption of fruits and vegetables observed in this study is particularly concerning given the importance of dietary fiber and phytonutrients for maintaining healthy gut microbiota diversity (Singh *et al.*, 2017). Diets low in fiber and high in processed foods have been associated with reduced microbial diversity and increased risk of dysbiosis (David *et al.*, 2014). For students at Federal University Gashua, these dietary patterns may compromise gut health and, through the gut-brain axis, potentially affect cognitive function and academic performance.

Breakfast skipping, reported by 59% of students skipping at least 3-4 times weekly, represents another concerning pattern. Research has consistently demonstrated that regular breakfast consumption supports cognitive function, particularly memory and attention, which are essential for academic success (Adolphus *et al.*, 2016). The combination of irregular meals, fast food dependence, and inadequate fruit and vegetable intake suggests that many students may be operating with suboptimal nutritional status that could impair their learning capacity.

Prevalence of Digestive Health Issues

The finding that 78% of students reported at least one digestive symptom indicates a high burden of gastrointestinal problems in this population. This prevalence is higher than what has been reported in some general population studies but aligns with research on student populations experiencing stress and lifestyle changes (Tantawy *et al.*, 2017). The most common symptoms—bloating (77% experiencing occasionally or frequently) and stomach discomfort (74%)—are consistent with functional gastrointestinal disorders often associated with stress and dietary factors (Mönnikes *et al.*, 2001).

The high prevalence of digestive issues among students at Federal University Gashua can be understood through the lens of the Biopsychosocial Model (Engel, 1977). Biological factors such as poor diet interact with psychological factors including academic stress, which is known to exacerbate gastrointestinal symptoms through the gut-brain axis (Cryan *et al.*, 2019). Social factors, including the financial constraints and limited food options identified in this study, contribute to the dietary patterns that may underlie these digestive problems.

The relationship between digestive symptoms and academic performance suggested by the regression analysis ($\beta = 0.25$, $p < 0.001$) indicates that students experiencing gastrointestinal problems may face additional barriers to academic success. Physical discomfort, sleep disturbances associated with digestive issues, and the psychological distress of chronic symptoms may all contribute to reduced academic engagement and performance (Gariepy *et al.*, 2016).

Gut Health and Academic Performance

The significant positive relationships between dietary indicators (balanced diet, fruit consumption, vegetable consumption, meal regularity) and academic performance provide empirical support for the gut-brain axis influence on cognitive function and learning outcomes. These findings align with emerging research demonstrating that nutrition affects cognitive processes through multiple mechanisms, including the modulation of gut microbiota (Gómez-Pinilla & Nguyen, 2012).

The association between digestive health and academic performance ($\beta = 0.25$, $p < 0.001$) suggests that the effects of diet on academic outcomes may be mediated, at least in part, through gut health. Students with better digestive health may experience fewer physical distractions, better sleep quality, and more stable mood, all of which support optimal cognitive functioning (Francis *et al.*, 2019).

The negative relationship between stress and academic performance ($\beta = -0.22$, $p < 0.001$) is consistent with extensive literature on the detrimental effects of stress on learning and academic achievement (Richardson *et al.*, 2012).

The variance explained by the regression model (41%) indicates that gut health indicators, along with stress and demographic factors, account for a substantial portion of differences in academic performance among these students. This finding has important implications for interventions aimed at improving student academic success, suggesting that nutritional and digestive health may be important but currently overlooked targets for support services.

Sociological Determinants of Dietary Habits

The sociological analysis revealed that dietary habits among students are shaped by multiple social, economic, and environmental factors, supporting the Social Determinants of Health perspective (Commission on Social Determinants of Health, 2008). Financial constraints emerged as the most influential factor, consistent with research showing that food insecurity and economic pressures significantly impact dietary quality among university students (Owoeye & Akinwumi, 2020; Wolfson *et al.*, 2020).

The perception that fast food is more affordable than healthy options (mean = 3.98) reflects the economic reality facing many Nigerian students. In contexts where fresh fruits, vegetables, and protein-rich foods are relatively expensive compared to carbohydrate-dense processed foods, students with limited budgets may have little choice but to prioritize quantity and affordability over nutritional quality (Abraham *et al.*, 2018).

Time constraints related to academic workload emerged as another significant factor, highlighting how the structure of university life can inadvertently promote poor dietary habits. Students juggling lectures, assignments, and examinations may find convenience foods more compatible with their schedules than meal preparation or seeking out nutritious options (Sprake *et al.*, 2018).

The limited availability of healthy options from campus vendors (mean = 3.76) points to institutional responsibility in shaping student health. When campus

food environments are dominated by vendors selling fried foods, refined carbohydrates, and processed snacks, students' ability to make healthy choices is constrained regardless of their individual preferences or knowledge (Roy *et al.*, 2017; Tsui *et al.*, 2020).

Peer influence (mean = 3.54) and cultural food preferences (mean = 3.42) represent social and cultural dimensions of dietary behavior that must be considered in interventions. Students eat within social contexts, and norms established within friendship groups can either support or undermine healthy eating (Deliens *et al.*, 2014; Sobal & Bisogni, 2009).

Integration of Findings with Theoretical Framework

The findings of this study collectively support the integrated perspective offered by the Biopsychosocial Model (Engel, 1977) and the Social Determinants of Health Theory (Marmot *et al.*, 2012). Biological factors (gut health, nutritional status) interact with psychological factors (stress) and social factors (financial resources, campus environment, peer influences) to influence academic performance among undergraduate students.

The significant associations between dietary patterns, digestive health, and academic performance provide evidence for the biological pathway linking gut health to cognitive outcomes. The negative relationship between stress and academic performance highlights the psychological dimension. The prominence of financial constraints, time pressures, and environmental limitations in shaping dietary habits demonstrates how social conditions structure students' health behaviors and, consequently, their biological states.

This integrated understanding suggests that interventions targeting academic performance should consider not only traditional academic support services but also strategies addressing student nutrition, digestive health, and the social determinants that shape these biological processes.

CONCLUSION

This study investigated relationship between gut-brain axis health indicators and academic performance among undergraduate students at Federal University Gashua, Yobe State, Nigeria, through a sociological lens. The findings demonstrate that dietary patterns and digestive health are significantly associated with academic achievement, with students who maintain healthier diets and experience fewer digestive symptoms achieving higher CGPAs.

It reveals concerning dietary patterns among the student population, characterized by low consumption of fruits and vegetables, high reliance on fast foods, frequent breakfast skipping, and irregular meal patterns. These dietary behaviors are associated with a high prevalence of digestive health issues, affecting 78% of students. Relationship between these gut health indicators and academic performance suggests that the gut-brain axis represents a significant but previously underrecognized factor in student academic success.

Sociologically, these health behaviors and outcomes are not merely individual choices but are shaped by broader social conditions. Financial constraints emerged as the most powerful determinant of dietary habits, followed by time pressures related to academic workload, limited availability of healthy food options in the campus environment, and social influences from peers and cultural norms. These findings highlight the need for interventions that address not only individual knowledge and behavior but also the structural conditions that constrain students' food choices.

The study concludes that gut health, influenced by socially-patterned dietary habits, significantly affects academic performance among undergraduate students. Improving student nutrition and promoting gut health may therefore contribute to better academic outcomes and overall student wellbeing.

Recommendations

For University Administration

1.Improve Campus Food Environment: The University should work with food vendors to increase the availability of affordable, nutritious food options on campus. This could include subsidizing healthy meal options, establishing a campus farmers' market, or contracting with food service providers committed to nutrition standards.

2.Establish Nutrition Education Programs: The University should integrate nutrition education into orientation programs and student wellness services. These programs should address practical skills such as healthy eating on a budget, meal planning, and understanding the connection between diet, gut health, and academic performance.

3.Create Student Food Support Programs: Given the significant impact of financial constraints on dietary quality, the university should consider establishing programs to support food-insecure students, such as a campus food pantry, meal voucher programs, or emergency food assistance.

4.Incorporate Gut Health Awareness into Health Services: University health services should screen for digestive health issues and provide education about the gut-brain axis connection to cognitive function. Referral pathways for students with chronic digestive symptoms should be established.

For Students

5.Develop Healthy Eating Practices: Students should be encouraged to prioritize regular meals, including breakfast, and increase consumption of fruits, vegetables, and fiber-rich foods that support gut microbiota diversity and cognitive function.

6.Form Peer Support Groups: Students can establish healthy eating groups or cooking cooperatives to share knowledge, resources, and social support for maintaining nutritious diets despite financial and time constraints.

For Policymakers

7.Include Nutrition in Higher Education Policy: Government education policies should recognize the importance of student nutrition for academic success and include provisions for supporting healthy food access in universities.

8.Fund Research on Student Health and Academic Performance: Additional research funding should be directed toward understanding the complex relationships between biological, psychological, and social factors affecting student academic outcomes in Nigerian higher education contexts.

For Future Research

9.Longitudinal Studies: Future research should employ longitudinal designs to establish causal relationships between dietary changes, gut health improvements, and academic performance over time.

10.Intervention Studies: Experimental studies testing the effectiveness of nutrition interventions on both gut health indicators and academic outcomes would provide stronger evidence for causal relationships.

11.Microbiome Analysis: Where resources permit, future studies should include direct analysis of gut microbiota composition to provide more objective measures of gut health beyond self-reported symptoms.

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