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Assessment of the Relationship Between Student Population Growth and Clinical Facility Adequacy in Gombe State Higher Institutions, Nigeria

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Abstract

This study assessed the relationship between student population growth and the adequacy of clinical facilities in six higher institutions in Gombe State, Nigeria. A descriptive cross-sectional design with trend analysis was adopted, integrating quantitative and qualitative techniques. A total of 400 students were surveyed using structured questionnaires, while institutional enrollment records covering 2015-2023 were analysed. Findings revealed that 58% of respondents were male, 68% were aged 21-25 years, and 27% were married. Enrollment showed steady growth, with Gombe State University reaching 4,581 students in 2023 and the Federal University of Kashere admitting 6,632 students in 2022. Newer institutions, such as Federal Polytechnic Kaltungo, experienced rapid growth, increasing from 236 students in 2021 to 731 in 2023. Facility Adequacy Scores indicated significant deficiencies across all institutions, with scores ranging from 42.8% to 55.6%, all below the 60% adequacy threshold. Impact Index analysis based on students' perceptions showed that waiting time for treatment (88%) and availability of clinic space (87%) were the most critically strained indicators, followed by medical personnel adequacy (81%), drug availability (77%), and emergency response (75%). Pearson correlation analysis showed a statistically significant negative relationship between student population growth and facility adequacy scores ($r = -0.74$, $p < 0.05$), indicating that rising enrollment is associated with declining clinical facility performance. The study concludes that enrollment growth has outpaced healthcare infrastructure investment across the selected institutions and recommends targeted clinic expansion, strategic staffing, improved drug procurement systems, and long-term health-resource planning aligned with enrollment projections.

Keywords: Student Population Growth, Clinical Facility Adequacy, Higher Institutions, Facility Adequacy Score, Impact Index, Gombe State

INTRODUCTION

The rapid growth of student populations globally has significantly reshaped higher education systems and placed increasing pressure on institutional support services, particularly clinical and healthcare facilities. University health centres play a crucial role in safeguarding students' physical and mental well-being, which directly influences academic performance, retention, and overall institutional effectiveness. However, in many countries, the expansion of student enrollment has not been matched by proportional investment in campus healthcare infrastructure, personnel, and medical equipment. This mismatch has resulted in overstretched clinical facilities and reduced quality of care (Singh *et al.*, 2020; Holon, 2023). In developed regions such as North America, Europe, and Australia, rising domestic and international student numbers have intensified demand for campus healthcare services. The sharp increase in international student enrollment in Canada, for instance, has placed considerable strain on student clinics, leading to longer waiting times and limited access to essential medical services (Global Affairs Canada, 2023; WENR, 2023). Similar challenges have been reported in the United Kingdom and Australia, where university health services struggle to cope with growing student populations amidst constrained funding and staffing levels (Holon, 2023). The situation is considerably more severe in sub-Saharan Africa, where higher education institutions frequently operate under conditions of limited funding, inadequate infrastructure, and critical shortages of healthcare professionals. Studies from Ethiopia and Tanzania reveal that university clinics often lack sufficient capacity to serve expanding student populations, resulting in overcrowded facilities, inadequate medical supplies, and limited access to timely healthcare (Tsegaye & Abebe, 2018; Nyanda *et al.*, 2019). These deficiencies heighten students' vulnerability to preventable illnesses and undermine campus health and safety. In Nigeria, rapid population growth and expanding access to higher education have significantly increased student enrollment across public institutions without a corresponding expansion of clinical facilities. Empirical studies indicate that many university health centres are characterized by high student-to-healthcare staff ratios, inadequate diagnostic equipment, and limited drug availability, contributing to delayed treatment and compromised health outcomes (Onyebuchi & Eze, 2019; Okebukola, 2018). In northeastern Nigeria, the situation is particularly critical, as institutions face chronic shortages of clinical infrastructure amidst continuously rising student populations (Abdullahi & Yusufu, 2021). In Gombe State, the growth and redistribution of student populations have further intensified pressure on already limited institutional clinical facilities. Many campus clinics struggle to meet increasing healthcare demands, resulting in congestion, insufficient medical personnel, and reduced quality of healthcare delivery. Despite the importance of clinical services to student welfare and institutional sustainability, limited empirical research has examined the relationship between student population growth and clinical facility adequacy in Gombe State. Existing studies have not systematically analysed how enrollment dynamics across institutions of 2 different types, sizes, and spatial locations relate to observed deficiencies in campus healthcare capacity. Against this backdrop, this study pursues three specific objectives: first, to examine student enrollment trends across selected higher institutions in Gombe State between 2015 and 2023; second, to assess the adequacy of existing clinical facilities using a structured Facility Adequacy Score; and third, to analyse students' perceptions of the strain exerted by population growth on clinical service delivery using an Impact Index. A geographical perspective is adopted to support the spatial interpretation of institutional distribution and healthcare-demand patterns. By generating evidence-based insights, the study seeks to support improved healthcare planning, resource allocation, and sustainable management of clinical facilities in higher education institutions in Gombe State.

LITERATURE REVIEW

Student Population Growth in Higher Education

Student population growth has become a defining feature of contemporary higher education systems worldwide. Expanding access to tertiary education, internationalisation, and demographic growth have collectively contributed to increasing enrollment across universities and colleges (Holon, 2023). While this expansion has improved educational opportunities, it has also intensified pressure on institutional support services, particularly healthcare facilities that were originally designed to

serve smaller populations (Singh *et al.*, 2020). Research consistently demonstrates that rapid enrollment growth, when not supported by commensurate infrastructure expansion, leads to service congestion, reduced quality of care, and declining student satisfaction with campus facilities.

Clinical Facilities in Higher Institutions

Clinical facilities within higher institutions provide essential preventive and curative healthcare services, including medical consultations, emergency care, mental health support, and health education. These facilities are vital for maintaining student well-being and uninterrupted academic engagement (Okebukola, 2018). Adequate campus healthcare services require sufficient medical personnel, functional infrastructure, essential medicines, diagnostic equipment, emergency-response capacity, and reliable water and power supply. However, studies indicate that many university clinics, particularly in developing countries, operate with limited capacity and inadequate resources, making them vulnerable to demand pressures generated by growing student populations (Onyebuchi & Eze, 2019). Recent evidence from Nigeria further confirms that students' perceptions of healthcare service quality are shaped by waiting time, staff attitude, medicine availability, and the physical condition of clinic facilities (Orok *et al.*, 2024).

Impact of Student Population Growth on Clinical Facilities

Empirical evidence from different regions consistently documents a strong relationship between student population growth and strain on clinical facilities. In India, Singh *et al.*, (2020) found that increased student enrollment led to overcrowding in campus clinics, extended waiting times, and reduced access to healthcare services. In Canada, rising international student numbers have been associated with increased utilization of campus health centres, stretching existing clinical capacity and staffing levels beyond sustainable limits (Global Affairs Canada, 2023; WENR, 2023). In sub-Saharan Africa, the relationship between enrollment growth and clinical facility strain is more pronounced due to structural and financial constraints. Tsegaye and Abebe (2018) reported that Ethiopian public universities experienced chronic clinic congestion and shortages of medical supplies as student populations expanded. Nyanda *et al.* (2019) similarly observed that Tanzanian universities were unable to adequately meet student healthcare needs, with clinics serving only a fraction of enrolled students. These challenges contribute to increased health risks, absenteeism, and reduced academic performance. Studies on healthcare utilization among Nigerian university students have further confirmed that physical accessibility, perceived service quality, and institutional responsiveness are critical determinants of whether students seek care through campus clinics or bypass institutional services entirely (Obiechina & Ekenedo, 2013; Ogundele *et al.*, 2014). These behavioral dimensions are important contextual factors in understanding observed facility strain.

Clinical Facilities in Nigerian Higher Institutions

In Nigeria, several studies have documented the effects of increasing student enrollment on campus healthcare services. Onyebuchi and Eze (2019) reported high student-to-healthcare staff ratios in Nigerian universities, resulting in delayed treatment and limited medical access. Okebukola (2018) emphasized that inadequate funding and weak institutional planning have constrained clinical facility expansion despite rising student numbers. In northeastern Nigeria, Abdullahi and Yusufu (2021) found that university clinics face persistent shortages of infrastructure and personnel, further exacerbating the strain on healthcare service delivery. Orok *et al.* (2024) more recently demonstrated in a cross-sectional study of a Nigerian university that students' perceptions of healthcare services are significantly shaped by facility conditions, personnel attitudes, and structural access barriers — findings that reinforce the importance of both objective assessment and perception-based measures in evaluating clinical facility adequacy.

Research Gap

Although existing studies have examined the relationship between student population growth and clinical facilities in several national and regional contexts, empirical evidence specific to Gombe State remains limited. In addition, few studies combine objective facility assessment with student perception analysis to evaluate clinical facility adequacy relative to enrollment dynamics.

This gap necessitates a focused investigation into how growing and fluctuating student populations affect clinical facility adequacy in higher institutions across Gombe State's three senatorial zones.

STUDY AREA

Location and Extent

Gombe State is located in the North-Eastern region of Nigeria, lying approximately between Latitudes 9°30′N and 11°30′N and Longitudes 10°45′E and 11°45′E (Nafisat, 2020). The state shares boundaries with Bauchi State to the west, Yobe State to the north, Borno and Adamawa States to the east, and Taraba State to the south (Figure 1). It covers a land area of approximately 20,256.5 km², with an average elevation ranging from 400 to 500 metres above mean sea level. The terrain is generally undulating, with hilly and mountainous areas in the southeastern part and open plains across the central and northern sections.

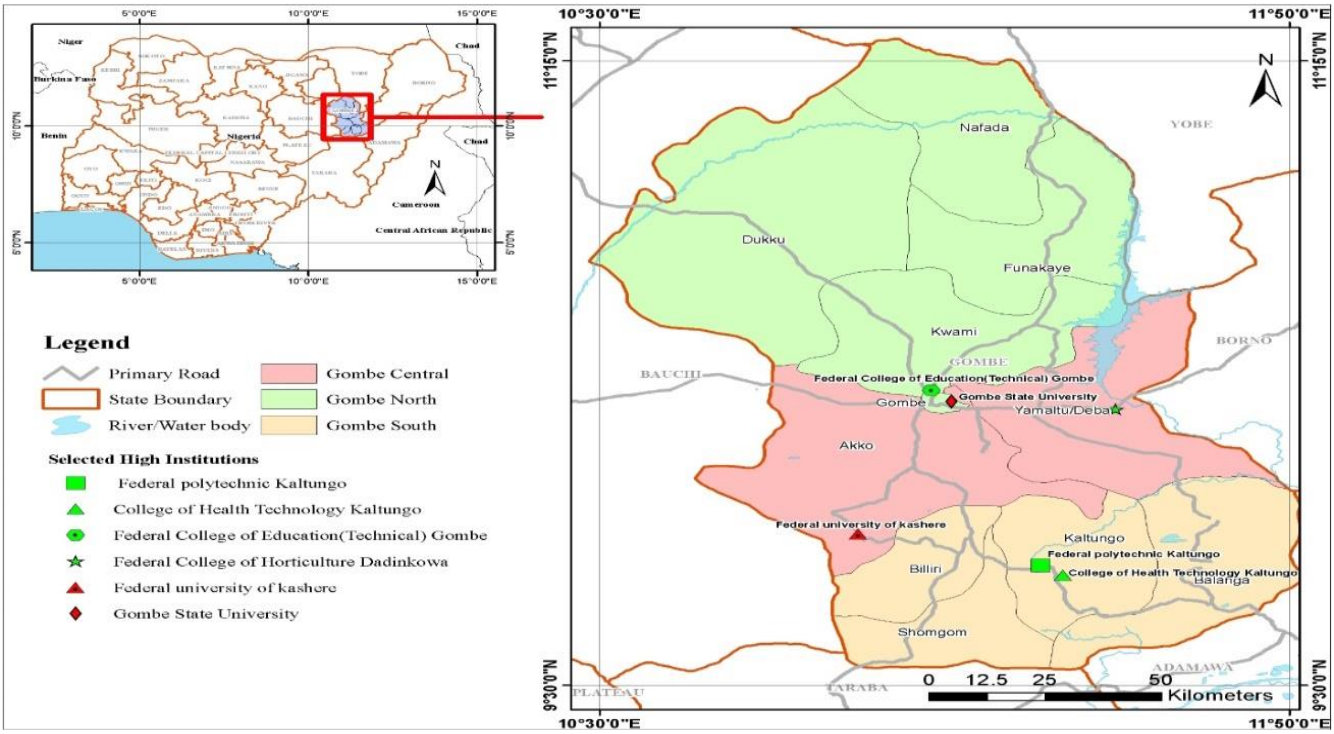

Figure 1: Study Area
Source: Remote Sensing and GIS Unit, Department of Geography, Gombe State University (2024)

The geographical location and spatial accessibility of Gombe State have contributed to the establishment and expansion of higher institutions, thereby influencing student population distribution and the spatial demand for institutional services, including healthcare facilities.

Population Characteristics

According to the 2006 National Population Census, Gombe State had a population of 2,353,000. Projecting forward at an annual growth rate of 3.2%, the estimated population for 2024 is approximately 4.15 million. This rapid population growth has contributed to increasing demand for higher education and a corresponding rise in student enrollment across institutions in the state. Gombe State is ethnically diverse, comprising groups such as the Fulani, Hausa, Tangale, Tera, Bolewa, Tula, Waja, and Cham, among others, with Islam and Christianity as the dominant religions (Zaccheous, 2023). This demographic diversity has implications for healthcare demand patterns within higher institutions that host students from varied socio-cultural and economic backgrounds.

Spatial Distribution of Higher Institutions

Gombe State hosts several public higher institutions distributed across its three senatorial zones: Gombe North, Gombe Central, and Gombe South. These zones collectively account for rising

student populations and associated demand for campus healthcare services. In Gombe North, major institutions include Gombe State University, Federal College of Education (Technical) Gombe, State Polytechnic Bajoga, College of Education and Legal Studies Nafada, and the College of Nursing and Midwifery Gombe. Gombe Central accommodates Federal University Kashere and the Federal College of Horticulture Dadinkowa, both of which attract students from within and outside the state. Gombe South hosts the Federal Polytechnic Kaltungo, College of Education Billiri, and College of Health Technology Kaltungo. The spatial distribution of these institutions across three distinct zones creates variation in access to clinical services, competitive enrollment dynamics, and differential facility development trajectories — all of which are analytically relevant to this study.

Socio-Economic Characteristics

The economy of Gombe State is largely agrarian, with a significant proportion of the population engaged in farming and small-scale trading. The state also serves as a regional commercial centre due to its strategic location linking neighbouring states in the North-East and North-Central regions (Umar *et al.*, 2018). These socio-economic characteristics are relevant to students' health seeking behaviour: many students depend primarily on institutional clinics for medical care due to limited financial capacity to access private healthcare services. This financial dependency on campus health facilities means that deficiencies in clinical infrastructure have direct and disproportionate consequences for student welfare.

METHODOLOGY

Research Design

This study adopted a descriptive cross-sectional design with integrated trend analysis. The descriptive component assessed the current condition, adequacy, and capacity of institutional clinical facilities at the time of data collection (2023–2024), while the trend analysis component 6 7 examined changes in student enrollment patterns across the selected institutions between 2015 and 2023. Qualitative data collected through key informant interviews complemented the quantitative findings by providing contextual explanations for observed enrollment trends and facility conditions. The study does not claim to establish causal relationships between enrollment growth and clinical strain; rather, it systematically assesses their co-occurrence and association through Pearson correlation analysis.

Study Population

The study population comprised students enrolled in six purposively selected public higher institutions in Gombe State during the 2023-2024 academic session. The total student population across the six institutions was 39,964 (Table 1). Key informants, comprising heads of clinical services, institutional administrators, and senior health personnel, were also included as a supplementary population for qualitative inquiry.

Sample Size Determination

The required sample size was determined using the Taro Yamane (1967) formula at a 5% margin of error.

Taro Yamane Formula

$$n = \frac{N}{1 + N(e)^2} \quad \text{1}$$

Where:

n - required sample size
N - total population size
e - margin of error (0.05)

Given: (N = 39,964), (e = 0.05)
Substituting the values into Equation 1;

Substitution

$$n = \frac{39,964}{1 + 39,964(0.05)^2} \quad \text{2}$$

Substitute (N = 39,964) and (e = 0.05) into Equation (1).

Square the margin of error

$$n = \frac{39,964}{1 + 39,964(0.0025)}$$

$$(0.05)^2 = 0.0025 \quad \text{3}$$

Multiplication

$$n = \frac{39,964}{1 + 99.91}$$

$$n = \frac{39,964}{100.91} \quad \text{4}$$

$$n = 396.03 \quad \text{5}$$

Rounded sample size

$$n \approx 396 \quad \text{6}$$

Thus, the minimum required sample size was 396 respondents. To enhance statistical reliability, ensure adequate representation across the six institutions, and accommodate possible non-response, the sample size was rounded up to 400 respondents (Creswell, 2014).

The 400 questionnaires were distributed proportionately among the six institutions using the proportional allocation formula:

Proportional Allocation Formula

$$n_i = \frac{N_i}{N} \times SS \quad \text{7}$$

Where:

n_i = number of questionnaires allocated to institution i

N_i = student population of institution i

N = total student population (39,964)

SS = total sample size (400)

This proportional allocation ensured that each institution was represented according to its proportion of the total student population.

Sampling Technique

A purposive sampling technique was employed to select the six institutions based on three criteria: student population size, presence of a functional campus health centre, and spatial representation across Gombe State's three senatorial zones. From Gombe North, Gombe State University (GSU) and Federal College of Education (Technical), Gombe (FCE-T) were selected; Gombe Central was represented by Federal University of Kashere (FUK) and Federal College of Horticulture, Dadinkowa (FCHD); and Gombe South included Federal Polytechnic Kaltungo (FPK) and College of Health Technology, Kaltungo (CHTK). Within each institution, students were selected using systematic random sampling from institutional enrollment registers to ensure representativeness across faculties and departments.

Table 1: Sample Frame and Proportional Allocation by Institution

S/N	Institution	Students' Population (N_i)	Proportion (N_i/N)	Sample Allocated (n_i)	% of Sample
1	Gombe State University (GSU)	12,678	0.317	127	31.8
2	Federal College of Education (Tech.) Gombe	4,961	0.124	50	12.5
3	Federal University of Kashere (FUK)	15,826	0.396	158	39.5
4	Federal College of Horticulture, Dadinkowa	1,021	0.026	10	2.5
5	Federal Polytechnic Kaltungo	1,708	0.043	17	4.3
6	College of Health Technology Kaltungo	3,770	0.094	38	9.5
	Total	39,964	1.000	400	100

Source: Field Work, 2024

Research Instruments

Student questionnaire: A structured questionnaire was administered to student respondents to collect data on socio-demographic characteristics, patterns of clinical facility use, and perceptions of the impact of enrollment growth on clinical service quality. The questionnaire comprised closed-ended items using a five-point Likert scale (Strongly Agree to Strongly Disagree) for the perception-based Impact Index items. The questionnaire was pilot-tested with 30 students not included in the main sample, and a Cronbach's alpha reliability coefficient of 0.79 was obtained, indicating acceptable internal consistency (Nunnally, 1978).

Clinical facility observation checklist: A structured checklist was used during on-site assessments to evaluate the adequacy of clinical facilities across ten standardized components: clinic space, consultation rooms, inpatient beds, availability of essential drugs, diagnostic equipment, medical personnel numbers, nursing staff, laboratory services, emergency 8 preparedness infrastructure, and water and power supply. Each component was scored on a five-point scale (0 = completely absent/non-functional to 5 = fully adequate and functional), yielding a Maximum Facility Score (MFS) of 500 per institution. Two trained research assistants independently completed the checklist at each institution; inter-rater agreement was assessed using Cohen's Kappa ($\kappa = 0.81$), confirming strong consistency between observers (Landis & Koch, 1977).

Key informant interview guide: A semi-structured interview guide was used with five key informants per institution; comprising the Head of Clinical Services, one senior nurse, and three institutional administrators to collect qualitative data on operational challenges, staffing constraints, and perceptions of enrollment-related strain on healthcare services.

Types and Sources of Data

Primary data were collected through student questionnaires, facility observation checklists, and key informant interviews during the 2023–2024 academic session. Secondary data comprised annual student enrollment records obtained from the Students' Affairs Divisions and Statistics Units of each institution, covering 2015–2023. Additional secondary information was drawn from government reports and relevant academic literature. Geospatial data, including GPS coordinates of institutional clinic locations, were collected during field surveys and processed using ArcGIS 10.8 to map the spatial distribution of selected institutions and their clinical facilities across Gombe State's three senatorial zones.

Methods of Data Analysis

Descriptive statistics and trend analysis: Student enrollment data were analysed using descriptive statistics and time-series trend analysis. Line graphs and summary tables were used to present enrollment trajectories across institutions for 2015-2023.

Facility Adequacy Score (FAS): The adequacy of clinical facilities was quantified using the FAS, computed as:

$$FAS\ (\%) = \frac{\text{Observed Facility Score (OFS)}}{\text{Maximum Facility Score (MFS)}} \times 100$$

The OFS represents the aggregate score across the ten facility components assessed through the observation checklist. The MFS of 500 represents the ideal score if all components were fully adequate. FAS values were classified as: adequate (≥60%), moderately strained (50–59%), or inadequate (<50%). These thresholds were derived from established benchmarks in campus health infrastructure assessment literature (WHO, 2022; Adedokun & Adebayo, 2020).

Facility adequacy scores were classified as inadequate (0–59%), moderately adequate (60–79%), and highly adequate (80–100%). The 60% threshold was adopted as the minimum benchmark for adequacy based on established practices in health system performance assessment and institutional infrastructure evaluation. According to the World Health Organization (WHO, 2013), composite scoring systems are commonly used to assess service readiness and functionality, with facilities scoring below 60% generally considered to have insufficient capacity to provide essential services effectively. Similarly, studies on health system performance have interpreted scores below this threshold as indicative of suboptimal readiness requiring improvement, while scores of 60% and above reflect a basic level of functional capacity (Ameh *et al.*, 2012; Kruk *et al.*, 2018). In addition,

infrastructure assessment studies in low- and middle-income countries frequently employ graded adequacy categories to accommodate variations in resource availability and service environments. Therefore, the 60% cut-off serves as a practical benchmark for distinguishing minimally functional facilities from inadequately resourced ones while facilitating meaningful comparisons across institutions.

Impact Index (II): Students' perceived impact of population growth on clinical service indicators was measured using a weighted Impact Index computed from Likert-scale questionnaire responses.

$$Weighted\ Score = (5 \times SA) + (4 \times A) + (3 \times N) + (2 \times D) + (1 \times SD)$$

$$Maximum\ Possible\ Score = n \times 5$$

$$\frac{\text{Weighted Score}}{\text{Maximum Possible Score}} \text{ x } 100$$

Impact Index values were classified as: high impact (≥75%), moderate impact (50–74%), or low impact (<50%).

Pearson Product-Moment Correlation: To examine the statistical association between student population size and clinical facility adequacy, the Pearson correlation coefficient (r) was computed:

$$r = \frac{\sum(x - \bar{x})(y - \bar{y})}{\sqrt{\sum(x - \bar{x})^2 \sum(y - \bar{y})^2}}$$

Here, x represents student population (enrollment size per institution) and y represents the Facility Adequacy Score. Statistical significance was tested at the 5% level ($p < 0.05$).

Thematic analysis: Qualitative data from key informant interviews were analysed using thematic analysis. Responses were transcribed, coded, and grouped into themes reflecting common operational challenges, institutional experiences, and contextual explanations for observed enrollment and facility patterns.

Geospatial analysis: GIS mapping was used to visualise the spatial distribution of institutions and their clinical facilities across the three senatorial zones, enabling the interpretation of locational patterns and their implications for spatial equity in healthcare access.

RESULTS AND DISCUSSION

Socio-Demographic Characteristics of Respondents

Table 2 presents the socio-demographic profile of respondents. Male students constituted 58% of the sample and female students constituted 42%. This pattern is consistent with documented gender enrollment disparities in tertiary institutions in northern Nigeria, where socio-cultural norms, differential access to secondary education, and early marriage continue to constrain female enrollment (Ibrahim & Suleiman, 2022; Musa *et al.*, 2021). However, this study does not directly measure differential clinic utilization by gender; therefore, the finding is presented as a contextual characteristic of the student population rather than as evidence of gender-specific facility pressure.

The predominant age group was 21–25 years (68%), consistent with a traditional undergraduate student population. Studies have confirmed that students in this age bracket tend to rely more heavily on institutional healthcare services due to limited financial independence and restricted access to private healthcare (Ogundele *et al.*, 2014; Obiechina & Ekenedo, 2013). Those below 20 years (14%) and above 25 years (18%) represent students with potentially differing healthcare needs, though the dataset does not contain utilization data disaggregated by age, and interpretations of differential demand are therefore presented as contextually informed possibilities rather than empirically demonstrated findings.

Regarding marital status, 55% of respondents were single, while 45% reported being married, divorced, widowed, or separated. This distribution suggests a more heterogeneous student population than might have been anticipated from earlier studies (Abdulkarim *et al.*, 2019), consistent with the observed expansion of postgraduate and part-time programmes in Nigerian institutions (Musa *et al.*, 2022). The implications of this demographic diversity for clinical service planning, particularly in relation to services such as family health, reproductive health, and counselling are noted as areas warranting institutional attention, though they are not empirically tested within this study's dataset.

Table 2: Socio-Demographic Characteristics of Respondents

Variable	Category	Frequency	Percentage (%)
Sex	Male	232	58.0
	Female	168	42.0
	Total	400	100.0
Age (Years)	Below 20	56	14.0
	21–25	272	68.0
	26–30	60	15.0
	31–35	8	2.0
	Above 36	4	1.0
	Total	400	100.0
Marital Status	Single	220	55.0
	Married	108	27.0
	Divorced	48	12.0
	Widow/Widower	20	5.0
	Separated	4	1.0
	Total	400	100

Source: Field Work, 2024

Student Enrollment Trends (2015–2023)

Figure 1 illustrates enrollment trajectories across six institutions between 2015 and 2023, revealing marked variation shaped by institutional age, programme offerings, economic conditions, policy environments, and spatial location. The most pronounced trend is the sustained decline at FCE(T) Gombe, where enrollment fell from approximately 8,500 students in 2015 to 314 in 2023, representing a reduction of over 96%.

Key informant interviews attributed this decline to several converging factors: economic hardship following petroleum subsidy removal, proliferation of competing tertiary institutions within the state, the near-equivalent cost of the NCE programme relative to degree programmes, and limited employment prospects in the education sector. These explanations align with Eze and Okonkwo (2020) and Eneogu *et al.* (2023), who documented declining enrollment in teacher education institutions during periods of economic austerity in Nigeria. In Nigeria, subsidy removal has also been linked to inflationary pressures that reduce household purchasing power and constrain educational participation (National Bureau of Statistics [NBS], 2024). Similarly, expansion in tertiary institutions has intensified competition and redistributed enrollment across programmes rather than producing uniform growth (National Universities Commission [NUC], 2023). These explanations are based primarily on key informant accounts and institutional observations, and are therefore presented as contextually grounded interpretations supported by literature rather than definitive causal evidence.

GSU demonstrated the most resilient growth trajectory, reaching 4,581 students by 2023. Institutional maturity, programme diversification, affordable tuition, and strategic location within the state capital appear to have sustained this growth. This pattern is consistent with Adeoye and Olowookere (2020), who identified programme relevance, affordability, and location as key determinants of institutional enrollment performance in Nigerian universities.

FUK exhibited considerable fluctuation, peaking at 6,632 students in 2022 before declining sharply to 3,347 in 2023. Key informants attributed this decline to a tuition fee increase of over 50%, which, compounded by fuel subsidy removal and the university's distance from the state capital, significantly reduced students' registration capacity. This finding corroborates Eneogu *et al.* (2023), who identified macroeconomic shocks as a primary driver of enrollment instability in Nigerian higher institutions.

FCHD recorded persistently low enrollment throughout the study period, with fluctuations linked to the transition from unregulated admissions to NBTE-regulated intake under UTME requirements, consistent with Yakubu and Suleiman (2022), who noted that accreditation-driven admission controls constrain enrollment in specialised institutions.

CHTK showed moderate but generally positive growth from 651 students in 2015 to 1,269 in 2023, with a notable dip in 2020 attributable to COVID-19 disruptions (UNESCO, 2020). Recovery in 2021–2022 was supported by demand for health-related professional courses, while the slight decline in 2023 reflects renewed economic pressures.

FPK, as a newly established institution, grew rapidly from 236 students in 2021 to 745 in 2022, stabilising at 731 in 2023; a trajectory consistent with early-phase expansion patterns in new polytechnics described by Abdullahi *et al.* (2021).

Spatial Distribution and Clinical Facility Access

GIS mapping of institutional locations across the three senatorial zones revealed an uneven spatial distribution of higher institutions and their associated clinical facilities. Gombe North, which hosts the largest and oldest institutions — GSU and FCE(T) Gombe — benefits from greater geographic concentration of educational and healthcare infrastructure within and around the state capital. In contrast, institutions in Gombe South, including FPK and CHTK, are located in more peripheral areas, where students face greater distances to off-campus healthcare alternatives, heightening their dependence on institutional clinics. FCHD in Gombe Central is situated in a relatively isolated location in Dadinkowa, with limited access to complementary health services in the surrounding area.

These spatial patterns are significant because they affect the criticality of campus health services relative to available alternatives. Students at peripheral institutions who cannot easily access off campus healthcare bear a disproportionate burden when institutional facilities are inadequate. The spatial distribution therefore amplifies the consequences of clinical facility deficiencies identified in subsequent analyses, particularly for students in Gombe South and Central zones. These locational differences should be incorporated into healthcare resource planning, with institutions in more isolated locations prioritized for facility investment given their students' limited access to alternatives.

Adequacy of Clinical Facilities

Table 3 presents Facility Adequacy Scores across the six institutions. The ten components scored through the observation checklist were: clinic space, consultation rooms, inpatient beds, essential drug availability, diagnostic equipment, number of medical doctors, nursing staff, laboratory services, emergency infrastructure, and water and power supply. None of the institutions attained the 60% adequacy threshold, confirming that clinical facilities are inadequate to varying degrees across all study sites.

GSU recorded the highest FAS (55.6%), classified as moderately strained, followed by FUK (52.4%) and CHTK (51.0%). These relatively higher scores reflect the comparatively larger institutional size, longer establishment history, and greater budgetary allocations of these universities. This is consistent with Ajayi and Ekundayo (2019), who reported that older and larger institutions tend to possess better-developed health infrastructure. However, even these scores remain below the adequacy threshold, indicating that existing facilities are overstretched and insufficient relative to current enrollment levels.

FCE(T) Gombe (46.2%), FPK (47.6%), and FCHD (42.8%) recorded FAS values below 50%, classifying their clinical facilities as inadequate. These deficiencies span multiple dimensions: limited consultation space, insufficient staffing, inconsistent drug supply, outdated diagnostic equipment, and unreliable water and electricity. In the case of FCHD, which recorded the lowest FAS despite a specific mandate in health-related education, the finding suggests a disconnect between institutional purpose and healthcare infrastructure investment — supporting Akpan and Ita (2017), who observed that specialized institutions frequently underinvest in clinical facilities due to competing infrastructural demands. Importantly, the inadequacy observed at FCE(T) Gombe despite its dramatically declining enrollment reflects the consequences of institutional neglect, ageing infrastructure, and insufficient maintenance rather than population pressure. This finding illustrates that clinical facility inadequacy is driven by two distinct but co-occurring factors: enrollment-related demand pressure at growing institutions, and infrastructure deterioration at declining institutions. Policy responses must therefore be differentiated accordingly.

Students' Perceptions of Clinical Facility Strain: Impact Index

Table 4 presents the Impact Index values for five clinical service indicators derived from student questionnaire responses. Waiting time for treatment (88%) and availability of clinic space (87%) registered the highest Impact Index values, both classified as high-impact indicators. Medical personnel adequacy (81%) also fell within the high-impact category, while drug availability (77%) and emergency response (75%) were classified at the upper boundary of high impact.

Table 3: Facility Adequacy Scores (FAS) of Clinical Facilities

Institution	Observed Facility Score (OFS)	Maximum Facility Score (MFS)	FAS (%)	Adequacy Classification
Gombe State University (GSU)	278	500	55.6	Moderately Strained
Federal University of Kashere (FUK)	262	500	52.4	Moderately Strained
FCE(T) Gombe	231	500	46.2	Inadequate
Federal College of Horticulture, Dadinkowa	214	500	42.8	Inadequate
Federal Polytechnic Kaltungo	238	500	47.6	Inadequate
College of Health Technology, Kaltungo	255	500	51.0	Moderately Strained

Source: Field Work, 2024

Table 4: Impact Index of Clinical Service Indicators

Clinical Facility Indicator	Weighted Score (WS)	Maximum Score (MS)	Impact Index (%)	Impact Classification
Availability of Clinic	1,740	2,000	87.0	High Impact
Space Medical Personnel	1,620	2,000	81.0	High Impact
Adequacy Availability of Drugs	1,540	2,000	77.0	High Impact
Waiting Time for treatment	1,760	2,000	88.0	High Impact
Emergency response	1,500	2,000	75.0	High Impact

Source: Field Work, 2024

These perception-based findings are consistent with and reinforce the objective FAS results. Institutions with the lowest FAS values, particularly FCHD, FCE(T), and FPK, also generated the most critical perception scores among their student populations, confirming a coherent relationship between observed facility conditions and students lived experience of service inadequacy. The finding that waiting time and clinic space are the most critically perceived indicators aligns with Orok *et al.* (2024), who identified structural access barriers and waiting times as primary determinants of students' satisfaction with university health services in Nigeria. Bello and Tijjani (2020) similarly reported that staff shortages and prolonged waiting times are among the most frequently cited complaints in northern Nigerian campus clinics.

The moderate Impact Index for drug availability (77%) and emergency response (75%) suggests that while these services are strained, they are not entirely absent, consistent with Ibraheem and Salami (2022), who found that inconsistent drug supply and emergency preparedness limitations represent partial rather than complete service failures in Nigerian campus health systems.

Correlation Between Student Population Growth and Facility Adequacy

Pearson correlation analysis was conducted to examine the statistical relationship between institutional student population size and Facility Adequacy Scores across the six institutions. The computed correlation coefficient was $r = -0.74$ ($p < 0.05$), indicating a statistically significant, moderately strong negative relationship. This finding suggests that as student population increases, clinical facility adequacy tends to decline, a pattern consistent with the observation that enrollment growth has not been accompanied by proportional investment in healthcare

infrastructure.

However, this relationship must be interpreted with caution. The small number of institutions (n = 6) limits the statistical power of the correlation, and the negative association is not uniform across all cases. FCE(T) Gombe, for example, exhibits a low FAS despite significant enrollment decline, indicating that factors beyond population size, including institutional age, maintenance investment, and governance, also determine facility adequacy. These findings reinforce the conclusion that while enrollment growth is an important driver of facility strain, it operates alongside pre-existing resource deficits and institutional underinvestment that must be addressed independently.

CONCLUSION

This study assessed the relationship between student population growth and clinical facility adequacy across six higher institutions in Gombe State, Nigeria. Evidence from Facility Adequacy Scores, Impact Index analysis, and Pearson correlation consistently points to a significant mismatch between enrollment trajectories and healthcare infrastructure investment. No institution achieved the 60% adequacy threshold, and students' perceptions confirmed high levels of strain, particularly in clinic space, waiting time, and medical personnel availability.

The study establishes that clinical facility inadequacy in Gombe State higher institutions is driven by two distinct but reinforcing dynamics. First, at institutions experiencing sustained or rapid enrollment growth, such as GSU, FUK, and FPK, clinical facilities have not expanded proportionately, resulting in demand-driven congestion and service strain. Second, at institutions with declining or stagnant enrollment, such as FCE(T) Gombe and FCHD, inadequacy persists due to ageing infrastructure, chronic underinvestment, and insufficient maintenance rather than population pressure. These two causes require differentiated policy responses.

The spatial analysis further reveals that institutions located in peripheral zones, particularly in Gombe South and Central face compounded challenges, as their students have fewer off-campus healthcare alternatives, making clinical facility deficiencies more consequential for student welfare.

This study has several limitations that should be acknowledged. First, the sample of six institutions, while spatially representative, limits the generalizability of the correlation findings. Second, the Facility Adequacy Score and Impact Index are researcher-constructed indices; although steps were taken to ensure inter-rater reliability and questionnaire validity, independent validation of these instruments against established health-service benchmarks would strengthen future studies. Third, the enrollment trend explanations offered in the discussion draw partly on key informant accounts, which may not fully capture the structural and institutional factors influencing enrollment dynamics. Future research should incorporate longitudinal designs, larger institutional samples, and direct utilization data, including patient-load records and clinic attendance statistics, to move beyond cross-sectional assessment toward more rigorous causal analysis.

RECOMMENDATIONS

Based on the differentiated findings of this study, the following targeted recommendations are proposed:

i. Prioritise expansion of clinic space and consultation infrastructure at GSU. FUK, and CHTK, where enrollment-driven demand is the primary source of strain. Specific interventions should include the construction of additional consultation rooms and waiting areas, the introduction of patient triage systems to manage outpatient flow, and the redesign of appointment scheduling to reduce waiting times, which registered the highest Impact Index score (88%) in this study.
ii. Rehabilitation and maintenance of ageing facilities. At FCE(T) Gombe and FCHD, where inadequacy is driven primarily by infrastructure deterioration rather than enrollment growth. These institutions require targeted maintenance investment, equipment replacement, and structural upgrading independent of enrollment projections.
iii. Improved staffing ratios. Through the recruitment of additional doctors, nurses, pharmacists, and laboratory technicians, particularly at institutions where medical

personnel adequacy registered as a high-impact strain indicator. Minimum staffing ratios aligned with WHO (2022) campus health standards should be established and monitored by regulatory bodies.

iv. Strengthened drug procurement and supply chain systems to eliminate the shortages that contributed to a 77% Impact Index for drug availability. Bulk procurement agreements, collaboration with state health agencies, and digital stock management systems should be established across all institutional clinics.

v. Enhanced emergency preparedness, particularly at peripheral institutions in Gombe South, where spatial isolation increases students' dependence on campus emergency services. Investment in functional emergency treatment rooms, first-aid infrastructure, rapid-response protocols, and regular staff training drills is particularly urgent at FPK and CHTK.

vi. Equity-sensitive spatial planning should guide future facility development, with institutions in geographically isolated zones, where off-campus healthcare alternatives are most limited prioritized for infrastructure investment to address the spatial inequities identified in this study.

vii. Institutionalize long-term health resource planning by requiring all higher institutions to develop rolling five-year clinical infrastructure plans aligned with enrollment projections, demographic diversity data, and minimum facility standards established in collaboration with the National Universities Commission, the National Board for Technical Education, and the Federal Ministry of Health.

Healthcare needs of non-traditional students including married, mature, and postgraduate students who constituted 45% of this study's respondents; should be formally incorporated into institutional health planning, with the introduction of family health services, reproductive health facilities, and mental health counselling programs where these are currently absent.

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