



Health-Promoting Architectural Design for Nigerian Public Universities: A Scoping Review of Global and Regional Evidence

Terfa Swem*

Department of Educational Foundations, University of South Africa, Preller Street, PO Box 392, Pretoria, South Africa.

*Corresponding author's e-mail: swemt@unisa.ac.za

DOI: [10.35898/ghmj-931369](https://doi.org/10.35898/ghmj-931369)

ABSTRACT

Background: The physical architecture of university campuses is increasingly recognized to influence the health, cognitive performance, and psychological well-being of students and staff. In Nigerian public universities, deteriorating infrastructure, inadequate ventilation, poor water and sanitation systems, and limited green spaces are thought to amplify the burden of communicable disease and poor mental well-being. Evidence on which design features matter for health on Nigerian university campuses has not been mapped.

Aims: This scoping review aimed to (1) map the evidence linking architectural and built-environment features to health and well-being outcomes in educational settings; (2) classify that evidence by origin (Nigeria, other sub-Saharan Africa, or elsewhere); and (3) derive prioritised, context-appropriate recommendations for Nigerian public universities.

Methods: A scoping review was conducted in accordance with the PRISMA Extension for Scoping Reviews (PRISMA-ScR) guidelines to identify and select relevant literature published between 2015 and 2025. Literature was retrieved from PubMed, Scopus, Web of Science, and Google Scholar. A total of 86 sources that met the predefined eligibility criteria were included and synthesised thematically. The evidence was further categorised by geographical origin: Nigeria, other sub-Saharan African countries, and regions beyond sub-Saharan Africa.

Results: Studies from non-Nigerian settings, mainly schools and hospitals, associate natural ventilation, green space, improved water, sanitation and hygiene (WASH), and house screening with fewer infections or better mental well-being. Nigerian university data were largely absent. Explicit health-related design standards appear lacking in Nigerian regulation.

Conclusion: Health-focused design is a plausible but largely untested strategy for Nigerian universities. Priority should go to low-cost measures with the strongest regional support (WASH, passive ventilation), with local measurement and piloting before standards are mandated. Limitations include no study-level appraisal.

Keywords: *Health-promoting architecture; Indoor environmental quality; Water, Sanitation and Hygiene (WASH); University built environment; Student health and well-being.*

Received: 03 September 2026

Reviewed: 11 October 2026

Revised: 20 October 2026

Accepted: 29 October 2026.

1. Introduction

University campuses are unique ecosystems in which thousands of people live, learn and interact within confined built spaces for extended periods. Their architectural configuration, including spatial layout, ventilation, materials, sanitation and the integration of natural elements, has implications for infection risk and psychosocial well-being (WHO, UNICEF & UNESCO, 2023; Udomiaye, 2020), but attention to these links in sub-Saharan African higher education appears limited.

Nigeria has one of Africa's largest and fastest-expanding university systems: in 2023 the National Universities Commission reported 222 universities, 111 public (50 federal and 61 state) and 111 private (National Universities Commission [NUC], 2023a). These institutions are widely reported to face chronic underfunding, overcrowded lecture theatres (Oteniya et al., 2023), poorly maintained hostels (Yakub & Zaid, 2017) and inadequate water and sanitation (Nnaji, 2023, a survey of schools); evidence on green space on Nigerian campuses was not identified. These deficiencies are likely to affect health through respiratory and gastrointestinal infections, meningococcal outbreaks, poor mental health and reduced academic performance, although direct measurements in Nigerian university students are scarce.

Evidence-based design (EBD), which originated in healthcare facility planning, uses health-outcomes research to inform the layout and material specification of buildings, and interest in applying it to educational settings is growing (Brambilla et al., 2019). Its application within African higher education appears under-documented, a premise this review tests: it remains unclear which interventions shown to affect disease transmission and well-being elsewhere are applicable, adaptable or absent in the Nigerian public university evidence base, and what direct Nigerian evidence exists.

This review maps global and regional evidence on health-promoting architectural design and classifies it by geographic origin to indicate how far it can inform Nigerian public universities. Prior reviews have examined green space and student mental health (Yang et al., 2022; Ribeiro et al., 2024; Aghabozorgi et al., 2024) and indoor air quality in schools (Sadriazadeh et al., 2022; Shree et al., 2024; Lazzara et al., 2026), but, to our knowledge, none has assembled this evidence for Nigerian higher education or classified it by origin. "Health-promoting architecture" means deliberate design of the built environment (ventilation, layout, materials, sanitation and nature integration) to prevent disease and support well-being, and "public university settings" include lecture halls, hostels, laboratories, clinics, canteens and open spaces. Given the sparsity of Nigeria-specific studies, the broader evidence is a necessary starting point, provided that transferability is made explicit rather than assumed.

2. Theoretical Framework

Evidence-Based Design in Built Environments

Evidence-Based Design (EBD) holds that the physical environment of any occupied building can be deliberately configured to improve health-related outcomes. Since its formalisation in the 1990s, EBD research has associated spatial organisation, daylight, ventilation, acoustics, materials and access to nature with occupant health, stress, recovery and cognitive performance (Ulrich, 1984; Ulrich et al., 2008; Brambilla et al., 2019; see also Liu, 2024; Deemer & Hercules, 2024). Interest has grown in applying EBD beyond healthcare, although most empirical work remains healthcare-based; Cho (2023), for example, surveyed designers on therapeutic criteria in healthcare facilities but measured no occupant outcomes. The WHO health-promoting schools concept likewise treats the physical environment, including water, sanitation and hygiene, as a determinant of student health (World Health Organisation, & United Nations Educational, Scientific and Cultural Organisation, 2021; Macnab et al., 2014), and the Okanagan Charter for Health Promoting Universities and Colleges (2015) extends this healthy-settings approach to campuses.

Salutogenic Design Philosophy

The salutogenic model (Antonovsky, 1979, 1987), later expanded in architectural discourse, shifts design attention from removing hazards to creating salutary conditions. In educational buildings it seeks spaces that enhance comprehensibility, manageability and meaningfulness while supporting comfort, social interaction and psychological well-being, through spatial clarity, daylight, ventilation and the mitigation of stressors such as noise and thermal discomfort (Lauria et al., 2020, a design proposal; Minhas & Nair, 2022, a practice guide; Lee & Kim, 2026, a single case study; see also Albatici et al., 2026; Golembiewski, 2022; Roskams & Haynes, 2020; Dilani & Armstrong, 2008).

The Results draw on three mechanisms: Stress Reduction Theory (Ulrich, 1984), in which nature exposure reduces physiological stress; Attention Restoration Theory (Kaplan & Kaplan, 1989), in which nature restores directed attention; and exposure–pathway reasoning for infection, in which ventilation, occupancy density and sanitation determine the dose and route of pathogen exposure. Together these link design features to exposure pathways and health outcomes, moderated by Nigerian context factors such as climate, maintenance and resourcing.

Applied to Nigerian public universities, salutogenic design calls for the proactive creation of health-supporting environments, but because basic hazards in water, sanitation, ventilation and overcrowding remain unresolved (Section 5.5.3), it is best sequenced alongside, rather than instead of, remediation.

3. Methodology

Review Design

This study was a scoping review following the PRISMA extension for scoping reviews (PRISMA-ScR; Tricco et al., 2018) and the Arksey and O'Malley (2005) framework. A scoping design suited evidence spanning several disciplines (architecture, epidemiology, environmental health, psychology) and study designs, and the aim was to map the extent and origin of the evidence and identify gaps rather than estimate effects or rate certainty. Consistent with this methodology, no formal risk-of-bias or quality appraisal was undertaken and no protocol was registered; sources were instead characterised by design and setting (Table 2), and the geographic origin of the evidence for each theme is reported in the Results. The completed PRISMA-ScR checklist is provided as supplementary material.

Search Strategy

Four databases (PubMed, Scopus, Web of Science and Google Scholar) were searched for literature published between January 2015 and February 2025, supplemented by grey literature retrieved from the repositories of the World Health Organisation (WHO), UNICEF, the Nigerian National Universities Commission (NUC), the Nigeria Centre for Disease Control (NCDC) and the Tertiary Education Trust Fund (TETFund) using the terms below and the criteria in Section 3.3. Search terms were organised around four clusters: built environment (“health-promoting architecture,” “evidence-based design,” “biophilic design,” “salutogenic design,” “indoor environmental quality”); health outcomes (“disease prevention,” “infection control,” “mental well-being,” “respiratory infection,” “communicable disease”); infrastructure systems (“WASH infrastructure,” ventilation, “water sanitation hygiene,” “vector control,” “indoor air quality”); and setting (“learning environments,” “university campuses,” “higher education,” “Nigerian universities,” “sub-Saharan Africa”). Terms were combined with OR within and AND between clusters, adapted to each database, and searches were run on 4 August 2026.

Eligibility Criteria

Inclusion criteria: peer-reviewed articles, systematic or scoping reviews and authoritative grey literature published 2015–2025, in English, addressing architectural, spatial or built-environment determinants of health, disease

transmission or psychological well-being in educational institutions; indirect evidence from healthcare, residential, retail or office settings judged to address a mechanism relevant to occupied educational or residential buildings (labelled as indirect); or the Nigerian or other sub-Saharan African higher-education infrastructural context. Exclusion criteria: no identifiable link between built-environment variables and a health or well-being outcome; opinion pieces, editorials and non-peer-reviewed blog content without an evidence base; duplicates and conference abstracts with a full version available; and pre-2015 studies unless foundational to the theoretical framework (e.g., Antonovsky, Wilson). Theoretical foundations, editorials, commentaries, a conference abstract and a preprint retained for context are cited but not counted among the included sources.

Study Selection Process

The search returned 412 records. After removal of duplicates ($n = 67$), 345 were screened by title and abstract and 198 excluded as irrelevant to the built-environment or health-outcome dimension. Of 147 full-text articles assessed, 61 were excluded (no clear health outcome measure, insufficient reporting detail or redundancy), leaving 86 sources for synthesis (Table 1). The author screened at both stages, with a second reviewer independently screening a 20% sample; disagreements were resolved by consensus, with unresolved cases referred to a third reviewer.

Table 1. Flow of records through study identification, screening, and selection (PRISMA-ScR).

Stage	N
Records identified through database searching (PubMed, Scopus, Web of Science, Google Scholar) and grey literature (WHO, UNICEF, NUC, NCDC, TETFund)	412
Duplicate records removed	67
Records screened by title and abstract	345
Records excluded at title/abstract screening (not relevant to built-environment or health-outcome dimension)	198
Full-text articles assessed for eligibility	147
Full-text articles excluded (no clear health-outcome measure, insufficient reporting detail, or redundancy)	61
Sources included in synthesis	86

Data Extraction and Thematic Synthesis

Extracted data comprised study design, setting, architectural variable(s), health or well-being outcome and key findings. Given methodological heterogeneity, thematic synthesis rather than meta-analysis was used: data were coded inductively, grouped into themes and cross-checked against the theoretical framework, and each source was classified by the geographic origin of its evidence (Nigeria; other sub-Saharan Africa; or extrapolated from outside sub-Saharan Africa) and setting (university, school, healthcare facility or other). Five themes structure the Results: (1) indoor environmental quality and disease/cognitive risk; (2) biophilic design and mental well-being; (3) WASH and communicable disease prevention, with architectural malaria control as a sub-theme; (4) architectural infection prevention and control; and (5) the Nigerian public university context, drawn from institutional documents rather than included studies.

Limitations of the Methodology

Limitations common to scoping reviews apply. No effects were pooled and quality was not appraised, so certainty could not be graded. The search was restricted to English; Embase, CINAHL and African Journals Online were not searched; Google Scholar results are not fully reproducible; and the search window ended in February 2025 although searches were run in August 2026. Screening was largely by one reviewer (a second checked 20%), with no independent verification of data extraction. Direct Nigerian campus data are sparse, so international evidence was

extrapolated without local validation, and many sources report surrogate outcomes (for example CO₂ level, mosquito density and perceived restorativeness) rather than disease in university populations; several are conceptual, non-peer-reviewed or from healthcare, retail or rural-housing settings, which may introduce publication, language and citation-chasing bias.

4. Results

Consistent with the Methodology (Section 3.5), the evidence underpinning each theme below is characterised by its geographic origin: evidence generated directly within Nigeria; evidence from other Sub-Saharan African settings; and evidence extrapolated from global (typically high-income, non-African) studies. Table 2, available on the Zenodo Repository at <https://doi.org/10.5281/zenodo.23688163>, summarizes the design, setting, architectural factor, and health outcome reported by all included sources.

Indoor Environmental Quality, Ventilation, and Disease Risk

The literature associates indoor environmental quality (IEQ) with health and performance in educational settings (Brink et al., 2021; Sadrizadeh et al., 2022; Shree et al., 2024; Toyinbo, 2023; Di Loreto et al., 2025; Ferraz et al., 2026). Ventilation, indoor pollutants and thermal comfort were reported as interrelated factors associated with communicable disease transmission, cognitive performance, absenteeism and productivity (Brink et al., 2021; Grassie et al., 2025). Overcrowded, poorly ventilated rooms allow airborne pathogens such as *Mycobacterium tuberculosis*, influenza viruses and SARS-CoV-2 to accumulate as aerosols (Elsaid & Ahmed, 2021), whereas *Neisseria meningitidis* spreads mainly by respiratory droplets and close, prolonged contact, as in crowded hostels.

Carbon dioxide (CO₂) can serve as a practical indicator of ventilation adequacy. A university classroom study examined associations between indoor air exposures, including CO₂, and cognitive test scores (Dedesko et al., 2025), but these are associational findings and a critical review described the evidence at typical indoor concentrations as inconsistent (Du et al., 2020). Pulimeno et al. (2020) advocated CO₂ below 1,000 ppm and at least 15 L/s of fresh air per occupant, which are guideline values for schools in temperate climates, not evidence of effect in naturally ventilated tropical lecture halls. Indoor pollutants, including volatile organic compounds, particulate matter, formaldehyde and mould, were repeatedly associated with Sick Building Syndrome (headaches, respiratory irritation, fatigue and reduced productivity) (Brink et al., 2021; Fisk et al., 2019; Kabirikopaei et al., 2021; Mannan & Al-Ghamdi, 2021; Niza et al., 2024), and thermal comfort was similarly implicated (Grassie et al., 2025), although fixed thresholds from temperate climates may not apply to naturally ventilated tropical buildings.

Evidence-origin note: this evidence is predominantly from non-Nigerian, high- and middle-income settings (e.g., Egypt, Italy, China); it is directionally consistent but ungraded, and direct confirmation from Nigerian lecture halls is not currently available.

Biophilic Design, Green Spaces, and Mental Well-Being

The reviewed literature associates biophilic design and campus green space with better student mental well-being (Yang et al., 2022; Ribeiro et al., 2024), and a general built-environment review reached similar conclusions for plants and biophilic elements (Gaekwad et al., 2022). Nature-integrated features, including indoor vegetation, daylight, green walls, landscape views and water elements, were associated with lower perceived stress, better attention and restoration, and fewer anxiety and depression symptoms, although many outcomes were self-reported. Ribeiro et al. (2024) reported that access to well-maintained green environments was associated with lower anxiety, depression, perceived stress and emotional exhaustion, and Browning and Determan (2024) reported that biophilic strategies in schools are associated with reduced stress, improved mood, lower absenteeism and enhanced learning outcomes.

Gulwadi et al. (2019), in a cross-sectional study in Turkey and the USA, related greenness around academic buildings to students' perceived restorativeness, and a Malaysian campus study, a tropical setting, linked perceived sensory qualities of green space with restoration and mental health (Malekinezhad et al., 2020). Studies from the USA and elsewhere likewise link nature-based interventions and biophilic design with student well-being (DeLauer et al., 2022; Rakow & Ibes, 2022; Abu Omar et al., 2026; Li et al., 2025).

Evidence-origin note: this evidence is non-Nigerian, largely cross-sectional or perception-based, and no reviewed study measured these effects on a Nigerian university campus.

WASH Infrastructure and Communicable Disease Prevention

Inadequate water, sanitation and hygiene (WASH) is a well-recognised driver of enteric disease in educational settings in low-resource contexts (WHO, UNICEF & UNESCO, 2023; Morgan et al., 2017), consistent with studies of school WASH in sub-Saharan Africa and low- and middle-income countries (Achi et al., 2025; Ngcongco & Tekere, 2025; Abdullahi et al., 2025; Seroney et al., 2025) and of health-facility WASH during COVID-19 (Kanyangarara et al., 2021). Nigerian evidence is largely indirect: deficient school WASH in Enugu State (Nnaji, 2023), WASH-associated malnutrition among under-five children in an Ibadan slum (Aleru et al., 2023) and poor toilet functionality in Ibadan motor parks (Adedayo et al., 2023, preprint). Studies from Nigerian university hostels are few and mostly address occupancy density, hostel management and menstrual-waste facilities (Adegoke, 2014; Idiang et al., 2022; Yakub & Zaid, 2017; Ikogho & Onoharigbo, 2025); none measured WASH-related disease among Nigerian university students.

Architectural malaria control is a distinct sub-theme whose evidence comes mainly from rural housing. A Cochrane review found that house screening probably reduces malaria infection (Furnival-Adams et al., 2021); field studies in rural Gambia and Mozambique examined house designs for reducing mosquito entry and density (Jatta et al., 2018; Jawara et al., 2018; Francisco & Watanabe, 2024); and a cluster-randomised trial of a sustainable house design for child health in rural Africa has been reported (Mshamu et al., 2026; protocol: Mshamu et al., 2022). An architects' survey identified screened windows, ceiling boards, improved drainage, raised floors and elimination of stagnant water as perceived effective features (Chisumbe et al., 2024). These findings matter given Nigeria's large share of global malaria cases (WHO, 2023), but their transferability to university hostels is untested.

Evidence-origin note: WASH evidence is regional and indirect, with no included study measuring WASH-related disease among Nigerian university students; malaria-control evidence is from rural housing and untested in university hostels.

Architectural Strategies for Infection Prevention and Control

Architectural design may contribute to infection prevention and control as a non-pharmaceutical measure. Healthcare case-study evidence proposes that overcrowded rooms, poorly ventilated corridors and inefficient circulation facilitate spread, whereas improved circulation, cross-ventilation, reduced density and flexible spaces may reduce transmission risk (Lesan et al., 2021; Łukasik & Porębska, 2022). Copper surfaces have shown promise: a randomised trial in US intensive care rooms associated copper-alloy surfaces with lower rates of a combined outcome of healthcare-associated infection and MRSA/VRE colonisation (Salgado et al., 2013), and hospital studies report antimicrobial activity or reduced bioburden (Bryce et al., 2022; Idelevich et al., 2025), but systematic reviews report limited or low-certainty evidence of fewer infections (Albarqouni et al., 2020; Aillón-García et al., 2023). COVID-19 prompted wider discussion of natural ventilation, outdoor learning, touch-free fixtures and real-time air quality monitoring, mostly from hospital evidence (Sherif & Iskandar, 2025).

Evidence-origin note: this evidence is wholly non-Nigerian and largely from healthcare or high-income settings; its extension to Nigerian university buildings is untested extrapolation (Section 5.5.2).

Application to the Nigerian Public University Context

Nigerian public universities are portrayed as facing severe infrastructural deficiencies, including overcrowding, deteriorating buildings, inadequate sanitation, poor ventilation and unreliable water, although the sources are institutional reports and a school survey rather than university measurements (National Universities Commission, 2023b; Nnaji, 2023). No Nigerian student health-outcome data on respiratory infection, malaria, gastrointestinal disease, meningitis or mental health were identified, so the link to student health is inferred. The tropical climate is said to offer opportunities for passive design (cross-ventilation, rainwater harvesting, solar energy, thermal mass, shaded courtyards, indigenous principles), as discussed for healthcare facilities (Udomiaye, 2020), but passive-design studies in Nigerian educational buildings were not identified, and Nigerian regulation may lack explicit health-related design requirements, which has not been verified (Section 5.5.1).

Evidence-origin note: unlike the other contexts, the application to the Nigerian Public University rests on Nigerian institutional and policy documents rather than empirical outcome studies and is contextual background, not independent confirmation.

5. Discussion

Indoor Environmental Quality: Ventilation, Air Quality, and Disease Risk

Ventilation adequacy and communicable disease transmission are linked mainly in school and healthcare evidence: overcrowded, poorly ventilated rooms let airborne pathogens persist as aerosols (Elsaid & Ahmed, 2021), and scoping reviews associate poor ventilation in educational buildings with absenteeism, reduced cognitive performance and respiratory symptoms (Grassie et al., 2025; Ezeamii et al., 2025), though university and naturally ventilated tropical evidence is limited. A case study at one Egyptian university reported CO₂ of 1,071 ppm in a poorly ventilated lecture hall against 713 ppm in a naturally ventilated one (Sabry Elattar et al., 2025), but a level only marginally above 1,000 ppm is weak evidence of health risk. No Nigerian lecture-hall CO₂ measurements were identified, so conditions there are unknown (open natural ventilation may keep CO₂ low even at high occupancy), and low-cost CO₂ monitoring is a research priority. Wargocki et al. (2020) linked higher classroom ventilation rates (about 10 L/s per person as a benchmark, which differs from the 15 L/s in Section 4.1) to better performance among schoolchildren; these are guideline-type values, not evidence for university students. Oteniya et al. (2023) document mismatches between enrolment and teaching-space capacity in Nigerian higher institutions; the respiratory implication is our unmeasured inference.

Beyond CO₂, indoor air is compromised by volatile organic compounds, particulate matter, formaldehyde and mould (Brink et al., 2021; Kabirikopaei et al., 2021). Sabry Elattar et al. (2025) reported formaldehyde and nitrogen dioxide in university lecture halls above reference values (for nitrogen dioxide, see WHO, 2021) and linked them to interior finishes, but a case study of few halls cannot establish strong correlations, and pollutant burdens in Nigerian university buildings are unmeasured. In the tropics, thermal comfort through orientation, shading, cross-ventilation and thermal mass is expected to matter, but adaptive comfort models, not temperate thresholds, suit naturally ventilated buildings; Nigerian climate data (for example from NiMet) and lecture-hall surveys were not identified. Passive solar strategies (orientation to prevailing winds, eaves, high ceilings for stack ventilation, thermal mass) may suit Nigeria with lower energy needs than mechanical cooling, though maintenance involves recurrent costs (Udomiaye, 2020, a healthcare-facility study).

Biophilic Design, Green Spaces, and Mental Well-Being

Biophilic design, the intentional incorporation of natural elements and processes into buildings, rests on Wilson's (1984) biophilia hypothesis of an innate human affinity with other life forms, which remains a hypothesis rather than an established mechanism; Stress Reduction Theory (Ulrich, 1984) and Attention Restoration Theory (Kaplan & Kaplan,

1989) offer complementary mechanisms. Campus interventions include indoor plants, green walls, water features, natural landscape views, natural materials, quiet outdoor spaces and tree-lined pathways (Ribeiro et al., 2024; Li et al., 2025); green walls, water features and natural materials are not directly supported by studies in this review.

Student mental health is a significant global concern: in a US sample, the American College Health Association's 2023 survey found that 23.4% of undergraduates screened positive for serious psychological distress (American College Health Association [ACHA], 2023), and time in nature was associated with more positive mood in a US student survey (Bardhan et al., 2023); these convenience samples cannot be generalised to Nigeria, where comparable data were not retrieved. Ribeiro et al. (2024) discuss green campus infrastructure as potentially cheaper than expanding individual treatment, but economic evaluations were outside this review's evidence base, so cost-effectiveness is unproven.

The extent of green-space loss on Nigerian campuses is unknown because land-use studies were not identified. A conceptual paper on Nigerian urban housing proposes biophilic retrofitting as a regenerative strategy (Enwin & Ikiriko, 2024); its applicability to campuses is untested. Untested co-benefits include shade trees lowering ambient temperatures and permeable landscaping reducing stormwater runoff, a cholera transmission route in the rainy season, but vegetation and water features can create mosquito habitat if poorly managed, so green and blue infrastructure should be designed with vector control in mind.

WASH Infrastructure and Communicable Disease Prevention

WASH is a prominent domain of health-related building design, and Nigerian evidence points to deficits in schools and community settings, but comparative data across design domains and for universities are lacking. Waterborne diseases, including cholera, typhoid, hepatitis A and schistosomiasis, recur nationally (see Moslen et al., 2024); as of 11 June 2024, 1,141 suspected cholera cases (65 laboratory-confirmed) and 30 deaths had been reported across 30 states (Nigeria Centre for Disease Control and Prevention [NCDC], 2024), which illustrates national risk but not campus risk; documented campus outbreaks were not identified.

Proposed WASH interventions include toilets at adequate user-to-toilet ratios (taken from the applicable national or WHO/UNICEF standard, as school and university ratios differ), ablution facilities with natural light and ventilation, handwashing stations in classroom exit flows, and on-site water treatment (rainwater harvesting, solar pasteurisation, point-of-use filtration) where municipal supply is unreliable (WHO, UNICEF & UNESCO, 2023).

Nigeria accounted for an estimated 27% of global malaria cases in 2022 (WHO, 2023). Whether house screening (Furnival-Adams et al., 2021) and the features architects identified (Chisumbe et al., 2024) would reduce malaria in Nigerian university hostels is a hypothesis: the evidence is from rural housing, and no campus incidence data or hostel conditions were identified. Targeted retrofitting trials are needed.

Architectural Strategies for Infection Prevention and Control

Spatial configuration is thought to influence pathogen transmission: corridors, stairwells and shared transition spaces are described as mixing zones where cohorts interact (Udomiaye, 2020; Lesan et al., 2021), although transmission studies in educational buildings are lacking. A survey of design professionals on post-COVID-19 hospital design (Sherif & Iskandar, 2025) reported expert opinion, not demonstrated effect, favouring small-cohort spaces, no dead-end corridors, transitions that minimise dwelling time, natural cross-ventilation, and touchless fixtures and self-closing doors in high-traffic zones.

Copper alloys are antimicrobial in laboratory tests, but kill rates do not establish reduced infection in community settings, and systematic reviews report limited or low-certainty clinical evidence (Albarqouni et al., 2020; Aillón-García et al., 2023). Cost precludes wholesale use in Nigerian institutions, but targeted use on door handles, washroom fixtures and cafeteria surfaces may reduce contact transmission at high-density touchpoints, although this

is untested in university buildings. Other measures (non-porous finishes, anti-mould paint, UV-C irradiation, which carries skin and eye safety risks) were not supported by studies in this review.

Udomiaye (2020), a short article on healthcare facilities, proposed that improved ventilation, reduced density and better sanitation could support pandemic mitigation alongside pharmaceutical measures. Nigerian university buildings could incorporate operable windows in all occupied spaces and outdoor learning areas, and master plans could integrate clinics and isolation facilities; real-time air-quality monitoring is worthwhile only where cost and maintenance allow (Section 5.5.3).

The Nigerian University Context: A Critical Assessment

Infrastructural Deficit, Climate and Regulatory Framework

Nigerian public universities occupy a paradoxical position: they train the professionals expected to solve Nigeria's public health challenges, yet the evidence that their infrastructure undermines occupant health is largely inferential. The NUC's 2023 State of Universities data and accreditation reports identify deficiencies in facilities, office accommodation, laboratory equipment, safety provisions and funding; for example, a 2023 assessment of one University of Ibadan programme noted inadequate offices, fire-safety equipment, facilities and funding (NUC, 2023a, 2023b). These concern office, safety and laboratory provision rather than health-related building features, and one programme cannot represent Nigerian public universities; health-centre morbidity, outbreak investigations, facility audits and TETFund needs assessments were not identified.

Nigeria's tropical climate presents challenges (mould in humid, poorly ventilated spaces, mosquito breeding in rainy seasons, thermal discomfort in poorly shaded buildings, ultraviolet degradation of materials) and opportunities (cross-ventilation and stack-effect design, solar energy, biomass for biophilic design, rainwater harvesting). Vernacular architecture (mud-brick thermal mass in the hot-dry north, lightweight ventilated forms in the humid south) embodied climate-responsive principles that contemporary design may draw upon; this reflects expert judgement, not the included studies.

The regulatory framework appears to lack explicit health-architecture standards, but this was not verified against the National Building Code, the NUC Benchmark Minimum Academic Standards or environmental sanitation regulations; NUC standards are understood to address spatial adequacy mainly. The UK's Building Bulletin 101 and the US EPA's Indoor Air Quality Tools for Schools programme (both for primary and secondary schools) show that comprehensive frameworks are feasible, and the Standards Organisation of Nigeria (SON), the Nigerian Institute of Architects (NIA), the Architects Registration Council of Nigeria (ARCON), NESREA and the Federal Ministry of Education are well positioned to develop analogous standards for educational facilities.

Transferability of Global Evidence to Nigerian Universities

Much of the evidence in Themes 1, 2 and 4 comes from hospitals, offices and schools in high-income settings that differ from Nigerian universities in climate, building typology, occupancy density, maintenance and resourcing. Thresholds from temperate, mechanically ventilated buildings (e.g., Du et al., 2020; Dedesko et al., 2025) may not translate to naturally ventilated tropical lecture halls, and antimicrobial-surface evidence (Salgado et al., 2013) comes from clinical settings with budgets and cleaning regimes not typically available in Nigerian universities. Findings should therefore be treated as hypotheses for local testing rather than design mandates, except where regional evidence exists (WASH and house screening; Theme 3).

Cost, Feasibility, Institutional Capacity and Trade-Offs

Implementation is constrained by the underfunding noted in Section 5.5.1. Copper surfaces and real-time air-quality monitoring cost well above conventional materials and depend on stable electricity, calibration expertise and consumables many universities cannot guarantee, and even lower-cost measures such as WASH provision or green-

space maintenance need recurrent budgets historically treated as discretionary. Implementation should therefore be sequenced by capacity, starting with passive ventilation and basic WASH. Gender-sensitive WASH (including menstrual hygiene management; Ikogho & Onoharigho, 2025), disability access and safety should be built in; cost ranges were unavailable in the included studies.

Trade-offs remain unresolved: natural ventilation reduces airborne pathogens but can raise energy demand where supplementary cooling is needed and admit dust and noise; green space competes with land needed for rising enrolments; advanced materials and monitoring perform better but are less affordable and maintainable; and fixtures face theft and vandalism while green and blue infrastructure may increase mosquito habitat. These statements reflect expert judgement, not the included studies, so context-specific prioritisation rather than uniform adoption is required (Section 6.1).

6. Conclusion

Campus design is not merely an aesthetic or spatial exercise; it may also act as a public health measure. The evidence indicates, with strength varying by theme and geographic origin (Section 5.5.2), that ventilation, materials, green space, WASH and spatial configuration are associated, mostly in non-Nigerian and non-university settings, with infection risk, mental well-being and performance. The strongest regional evidence concerns WASH and communicable disease (Theme 3), though largely indirect; evidence on indoor environmental quality, biophilic design and antimicrobial/spatial infection control (Themes 1, 2 and 4) remains extrapolated rather than confirmed in Nigerian universities.

Three categories of claim follow. First, plausible and supported by indirect evidence: WASH remediation is supported by regional and international evidence, though Nigerian university outcome data are lacking (Theme 3). Second, reasonable contextual implications: ventilation, thermal comfort, biophilic design and infection-control principles are theoretically grounded for Nigerian universities, given shared physiological and epidemiological mechanisms, but not locally validated (Themes 1, 2 and 4; Section 5.5.2). Third, recommendations requiring local validation: antimicrobial surfaces, real-time air-quality monitoring and numerical thresholds (ventilation rates, green-space ratios) come from non-Nigerian contexts and should be piloted locally before becoming binding standards.

A staged agenda of standard-setting, infrastructure rehabilitation, interdisciplinary design and monitoring is a plausible pathway to improved campus health, although its returns and feasibility were not evaluated here; architecture is one lever among several, alongside vaccination, behaviour change and clinical services. Limitations (Section 3.6) include the absence of study-level appraisal, partial dual screening and heavy reliance on indirect evidence. Priority research gaps are: (1) CO₂ and thermal monitoring in Nigerian lecture halls and hostels; (2) hostel overcrowding in relation to respiratory infection and meningitis; (3) campus WASH audits linked to student morbidity; (4) pilot evaluations of passive-ventilation retrofits; and (5) economic evaluations of design interventions.

Recommendations

Recommendations are ordered by evidence strength and feasibility (Section 5.5.3).

(i) WASH Infrastructure Upgrading (supported by indirect evidence; highest priority): Universities should prioritise functional WASH ratios, reliable water supply (rainwater harvesting, boreholes, point-of-use treatment) and WASH compliance in NUC accreditation standards (Theme 3; WHO, UNICEF & UNESCO, 2023).

(ii) Passive Ventilation and Climate-Responsive Design (plausible extension; moderate cost): Orientation, cross-ventilation and operable windows should be prioritised over costly mechanical or monitoring solutions as a first-line response to Theme 1, pending local validation of air-quality and flow-rate thresholds (Section 5.5.2).

(iii) Biophilic Campus Planning (plausible extension; low-cost, phased): Accessible green space and indoor planting should be expanded incrementally and balanced against enrolment-driven land pressure (Section 5.5.3), not pursued as a fixed percentage target from non-Nigerian master-planning norms.

(iv) Malaria Vector Control Through Design (supported by regional evidence from rural housing): Screened windows, raised thresholds, ceiling boarding and elimination of stagnant water should be incorporated into hostel design (Theme 3; Furnival-Adams et al., 2021; Chisumbe et al., 2024).

(v) Antimicrobial Surfaces and Real-Time Monitoring (requires local piloting): Copper-alloy surfaces and air-quality monitoring should be piloted at a few high-risk sites, starting with low-cost CO₂ sensors in lecture halls and hostels, before wider adoption (Section 5.5.3).

(vi) Regulatory and Financing Framework: The NUC and, for state universities, state governments should incorporate these priorities into accreditation standards; TETFund into its infrastructure financing windows; and SON, ARCON and NESREA into applicable standards, sequenced by evidence strength and feasibility (Section 5.5.3).

Suggested monitoring indicators include toilet-to-student ratios, the percentage of functional handwashing stations, CO₂ concentration (ppm) in lecture halls, and student health-centre cases of respiratory and enteric illness; lead agencies and cost tiers should be specified in a follow-up implementation plan.

References

- Abdullahi, L. H., Were, L. M., Hassan, M. A., & Rithaa, G. K. (2025). Strategies to promote uptake and sustainability of water, sanitation and hygiene (WASH) interventions in basic education institutions in conflict settings: A scoping review of the Horn of Africa. *BMJ Public Health*, 3(2), Article e002050. <https://doi.org/10.1136/bmjph-2024-002050>
- Abu Omar, Q. M. H., Erçin, Ç., & Bardak Denerel, S. (2026). Achieve university students' psychological well-being balance in campuses through the utilization of biophilic design. *Journal of Asian Architecture and Building Engineering*, 25(5), 4781–4813. <https://doi.org/10.1080/13467581.2026.2621566>
- Achi, C. G., Ariyo, O. F., Coker, A. O., Abbey, S. J., Agyekum, K., Booth, C. A., & Horry, R. (2025). A sustainable water management framework for schools in Sub-Saharan Africa. *Green Health*, 1(2), Article 8. <https://doi.org/10.3390/greenhealth1020008>
- Adedayo, O. J., Sokan-Adeaga, A. A., Kehinde, S. A., Olabimiji, B. B., & Oladeji, F. O. (2023). Toilet functionality and cleanliness status of major motor parks in Ibadan Metropolis, Nigeria. SSRN. <https://doi.org/10.2139/ssrn.4678107>
- Adegoke, A. A. (2014). Perceived effects of overcrowding on the physical and psychological health of hostel occupants in Nigeria. *IOSR Journal of Humanities and Social Science*, 19(9), 1–9. <https://doi.org/10.9790/0837-19980109>
- Aghabozorgi, K., van der Jagt, A., Bell, S., & Smith, H. (2024). How university blue and green space affect students' mental health: A scoping review. *Urban Forestry & Urban Greening*, 97, Article 128394. <https://doi.org/10.1016/j.ufug.2024.128394>
- Aillón-García, P., Parga-Landa, B., & Guillén-Grima, F. (2023). Effectiveness of copper as a preventive tool in health care facilities: A systematic review. *American Journal of Infection Control*, 51(9), 1038–1048. <https://doi.org/10.1016/j.ajic.2023.02.010>
- Albarqouni, L., Byambasuren, O., Clark, J., Scott, A. M., Looke, D., & Glasziou, P. (2020). Does copper treatment of commonly touched surfaces reduce healthcare-acquired infections? A systematic review and meta-analysis. *Journal of Hospital Infection*, 106(4), 765–773. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7480678/>
- Albatici, R., Bozzi, Y., Pizzato, M., Torresin, S., & Zaniboni, L. (2026). Ten questions concerning dynamic sensory variation in salutogenic building design. *Building and Environment*, 295, 114451. <https://doi.org/10.1016/j.buildenv.2026.114451>
- Aleru, E. O., Bodunde, I. O., Deniran, I. A., Ajani, O. N., Aleru, O. O., & Fawole, A. O. (2023). WASH practices increased the prevalence of malnutrition among under-five children (6–59 months) in an urban slum area in Ibadan, Nigeria. *Journal of Water, Sanitation and Hygiene for Development*, 13(11), 910–920. <https://doi.org/10.2166/washdev.2023.186>
- American College Health Association. (2023). American College Health Association-National College Health Assessment III: Spring 2023 undergraduate reference group data report. American College Health Association.
- Antonovsky, A. (1979). *Health, stress, and coping*. Jossey-Bass.
- Antonovsky, A. (1987). *Unraveling the mystery of health: How people manage stress and stay well*. Jossey-Bass.
- Arksey, H., & O'Malley, L. (2005). Scoping studies: Towards a methodological framework. *International Journal of Social Research Methodology*, 8(1), 19–32. <https://doi.org/10.1080/1364557032000119616>

- Bardhan, M., Zhang, K., Browning, M. H. E. M., Dong, J., Liu, T., Bailey, C., McAnirlin, O., Hanley, J., Minson, C. T., Mutel, R. L., Ranganathan, S., & Reuben, A. (2023). Time in nature is associated with higher levels of positive mood: Evidence from the 2023 NatureDose™ student survey. *Journal of Environmental Psychology*, 90, Article 102083. <https://doi.org/10.1016/j.jenvp.2023.102083>
- Brambilla, A., Rebecchi, A., & Capolongo, S. (2019). Evidence-based hospital design: A literature review of recent publications about the EBD impact of the built environment on hospital occupants' and organisational outcomes. *Annali di Igiene*, 31(2), 165–180. <https://doi.org/10.7416/ai.2019.2269>
- Brink, H. W., Loomans, M. G. L. C., Mobach, M. P., & Kort, H. S. M. (2021). Classrooms' indoor environmental conditions affecting the academic achievement of students and teachers in higher education: A systematic literature review. *Indoor Air*, 31(2), 405–425. <https://doi.org/10.1111/ina.12745>
- Browning, W., & Determan, J. (2024). Outcomes of biophilic design for schools. *Architecture*, 4(3), 479–492. <https://doi.org/10.3390/architecture4030026>
- Bryce, E. A., Velapatino, B., Donnelly-Pierce, T., Khorami, H. A., Wong, T., Dixon, R., Asselin, E., McGeer, A., Srigley, J. A., & Katz, K. (2022). Antimicrobial efficacy and durability of copper formulations over one year of hospital use. *Infection Control & Hospital Epidemiology*, 43(1), 79–87. <https://doi.org/10.1017/ice.2021.52>
- Chisumbe, S., Aigbavboa, C., Akinradewo, O., & Mukeya, G. (2024). Effectiveness of housing design features in malaria prevention: Architects' perspective. *Frontiers in Built Environment*, 10, Article 1427836. <https://doi.org/10.3389/fbuil.2024.1427836>
- Cho, M. (2023). Evaluating therapeutic healthcare environmental criteria: Architectural designers' perspectives. *International Journal of Environmental Research and Public Health*, 20(2), Article 1540. <https://doi.org/10.3390/ijerph20021540>
- Dedesko, S., Pendleton, J., Young, A. S., et al. (2025). Associations between indoor air exposures and cognitive test scores among university students in classrooms with increased ventilation rates for COVID-19 risk management. *Journal of Exposure Science & Environmental Epidemiology*, 35, 661–671. <https://doi.org/10.1038/s41370-025-00770-6>
- Deemer, D. A., & Hercules, W. J. (2024). What should health professions trainees learn about built environment activism? *AMA Journal of Ethics*, 26(12), E925–E931. <https://doi.org/10.1001/amajethics.2024.925>
- DeLauer, V., McGill-O'Rourke, A., Hayes, T., Haluch, A., Gordon, C., Crane, J., Kossakowski, D., Dillon, C., Thibeault, N., & Schofield, D. (2022). The impact of natural environments and biophilic design as supportive and nurturing spaces on a residential college campus. *Cogent Social Sciences*, 8(1), Article 2000570. <https://doi.org/10.1080/23311886.2021.2000570>
- Di Loreto, S., Falone, M., Pierantozzi, M., & Montelpare, S. (2025). Field measurements of indoor environmental quality in school buildings post-COVID-19: Systematic review. *Applied Sciences*, 15(10), 5692. <https://doi.org/10.3390/app15105692>
- Dilani, A., & Armstrong, K. (2008). The “salutogenic” approach: Designing a health-promoting hospital environment. *World Hospitals and Health Services*, 44(3), 32–35. <https://pubmed.ncbi.nlm.nih.gov/19181023/>
- Du, B., Tandoc, M. C., Mack, M. L., & Siegel, J. A. (2020). Indoor CO₂ concentrations and cognitive function: A critical review. *Indoor Air*, 30(6), 1067–1082. <https://doi.org/10.1111/ina.12706>
- Elsaid, A. M., & Ahmed, M. S. (2021). Indoor air quality strategies for air-conditioning and ventilation systems with the spread of the global coronavirus (COVID-19) epidemic: Improvements and recommendations. *Environmental Research*, 199, Article 111314. <https://doi.org/10.1016/j.envres.2021.111314>
- Ezeamii, V. C., Egbuchiem, A. N., Obianyo, C. M., Nwoke, P., & Okwuonu, L. (2025). Air quality monitoring in schools: Evaluating the effects of ventilation improvements on cognitive performance and childhood asthma. *Cureus*, 17(5), Article e83306. <https://doi.org/10.7759/cureus.83306>
- Ferraz, M., Santos, J., & Vieira da Silva, M. (2026). A systematic review of indoor air quality in schools settings: Focus on microbiome and their relation to particulate matter and chemical pollutants. *Public Health in Practice*, 11, 100790. <https://doi.org/10.1016/j.puhip.2026.100790>
- Fisk, W. J., Chan, W. R., & Johnson, A. L. (2019). Does dampness and mold in schools affect health? Results of a meta-analysis. *Indoor Air*, 29(6), 895–902. <https://doi.org/10.1111/ina.12588>
- Francisco, M. E., & Watanabe, K. (2024). Innovative house structures for malaria vector control in Nampula district, Mozambique: Assessing mosquito entry prevention, indoor comfort, and community acceptance. *Frontiers in Public Health*, 12, Article 1404493. <https://doi.org/10.3389/fpubh.2024.1404493>
- Furnival-Adams, J., Olanga, E. A., Napier, M., & Garner, P. (2021). House modifications for preventing malaria. *Cochrane Database of Systematic Reviews*, 2021(1), Article CD013398. <https://doi.org/10.1002/14651858.CD013398.pub3>
- Gaekwad, J. S., Mudraya, O., & Stojanovska, F. (2022). The value of plants and biophilic elements in the built environment: A systematic literature review of their effects on wellbeing. *Buildings*, 12(2), Article 109. <https://doi.org/10.3390/buildings12020109>
- Golembiewski, J. A. (2022). Salutogenic architecture. In M. B. Mittelmark, G. F. Bauer, L. Vaandrager, M. M. Pelikan, S. Sagy, M. Eriksson, B. Lindström, & C. Meier Magistretti (Eds.), *The handbook of salutogenesis* (2nd ed.). Springer. https://doi.org/10.1007/978-3-030-79515-3_26

- Grassie, D., Milczewska, K., Renneboog, S., Scuderi, F., & Dimitroulopoulou, S. (2025). Impact of indoor air quality, including thermal conditions, in educational buildings on health, wellbeing, and performance: A scoping review. *Environments*, 12(8), Article 261. <https://doi.org/10.3390/environments12080261>
- Gulwadi, G. B., Mishchenko, E. D., Hallowell, G., Alves, S., & Kennedy, M. (2019). The restorative potential of a university campus: Objective greenness and student perceptions in Turkey and the United States. *Landscape and Urban Planning*, 187, 36–46. <https://doi.org/10.1016/j.landurbplan.2019.03.003>
- Idelevich, E. A., Schlattmann, A., Sauerland, C., Gebert, C., & Becker, K. (2025). Antimicrobial activity of copper-nickel coated door handles: A blinded, randomized controlled study in a clinical setting. *GMS Hygiene and Infection Control*, 20, Article Doc47. <https://doi.org/10.3205/dgkh000576>
- Idiang, M. I., Shuaibu, M. S., Dixit, S., Obong, L. B., & Bala, B. B. (2022). The effects of overcrowding on students living in University of Calabar female hostel, Cross River State, Nigeria. *Journal of Image Processing and Intelligent Remote Sensing*, 2(4), 31–49. <https://www.researchgate.net/publication/360125033>
- Ikiriko, T. D., & Enwin, A. D. (2024). Resilient and regenerative sustainable urban housing solutions for Nigeria. *World Journal of Advanced Research and Reviews*, 20(2), 97–109. <https://doi.org/10.30574/wjarr.2024.21.2.0544>
- Ikogho, D. E., & Onoharigho, F. D. (2025). Menstrual waste management practices among female students in Niger Delta Development Commission hostels in educational institutions in Niger Delta, Nigeria. *BMC Women's Health*, 25, Article 60. <https://doi.org/10.1186/s12905-025-03549-x>
- Jatta, E., Jawara, M., Bradley, J., Jeffries, D., Kandeh, B., Knudsen, J., D'Alessandro, U., Pinder, M., Wilson, A. L., & Lindsay, S. W. (2018). How house design affects malaria mosquito density, temperature, and relative humidity: An experimental study in rural Gambia. *The Lancet Planetary Health*, 2(11), e498–e508. [https://doi.org/10.1016/S2542-5196\(18\)30234-1](https://doi.org/10.1016/S2542-5196(18)30234-1)
- Jawara, M., Jatta, E., Bell, D., Burkot, T. R., Bradley, J., Hunt, V., Kandeh, B., Jones, C., Manjang, A. M., Pinder, M., Stone, S., D'Alessandro, U., Knudsen, J., & Lindsay, S. W. (2018). New prototype screened doors and windows for excluding mosquitoes from houses: A pilot study in rural Gambia. *American Journal of Tropical Medicine and Hygiene*, 99(6), 1475–1484. <https://doi.org/10.4269/ajtmh.18-0660>
- Kabirikopaei, A., Lau, J., Nord, J., & Bovaird, J. (2021). Identifying the K-12 classrooms' indoor air quality factors that affect student academic performance. *Science of the Total Environment*, 786, Article 147498. <https://doi.org/10.1016/j.scitotenv.2021.147498>
- Kanyangarara, M., Allen, S., Jiwani, S. S., & Fuente, D. (2021). Access to water, sanitation and hygiene services in health facilities in sub-Saharan Africa 2013–2018: Results of health facility surveys and implications for COVID-19 transmission. *BMC Health Services Research*, 21, Article 601. <https://doi.org/10.1186/s12913-021-06515-z>
- Kaplan, R., & Kaplan, S. (1989). *The experience of nature: A psychological perspective*. Cambridge University Press.
- Lauria, A., Secchi, S., & Vessella, L. (2020). Acoustic comfort as a salutogenic resource in learning environments: A proposal for the design of a system to improve the acoustic quality of classrooms. *Sustainability*, 12(22), 9733. <https://doi.org/10.3390/su12229733>
- Lazzara, V., Stanisci, I., Malizia, V., Alfano, P., & La Grutta, S. (2026). A scoping review of school indoor air quality and respiratory health in schoolchildren: Evidence available, key concepts and knowledge gaps. *Indoor and Built Environment*. Advance online publication. <https://doi.org/10.1177/1420326X251403351>
- Lee, J., & Kim, J. (2026). A case study of applying the SOC (Sense of Coherence) components of salutogenic design to educational facilities. *Journal of Korea Institute of Spatial Design*, 21(1), 555–566.
- Lesan, M., Khozaei, F., Kim, M. J., & Shahidi Nejad, M. (2021). Identifying contradictions in the health care environment regarding infection control during a pandemic, with a focus on health workers' experiences. *Sustainability*, 13(17), Article 9516. <https://doi.org/10.3390/su13179516>
- Li, K., Perrault, A., DeYoung, W. A., Cameron, E., Miller, C. T., O'Connor, A. S., Gu, M., & Braun, B. (2025). Impact of biophilic design on college student perception of mental health and environmental benefits: A dose-response study. *Building and Environment*, 267, Article 112318. <https://doi.org/10.1016/j.buildenv.2024.112318>
- Liu, J. C. (2024). Healing and caregiving are influenced by the built environments in which health services are delivered or received. *AMA Journal of Ethics*, 26(12), E899–E900. <https://doi.org/10.1001/amajethics.2024.899>
- Łukasik, M., & Porębska, A. (2022). Responsiveness and adaptability of healthcare facilities in emergency scenarios: COVID-19 experience. *Facilities*, 40(3/4), 199–215. <https://doi.org/10.1108/F-05-2021-0045>
- Macnab, A. J., Stewart, D., & Gagnon, F. A. (2014). Health-promoting schools: Initiatives in Africa. *Health Education*, 114(4), 246–259. <https://doi.org/10.1108/HE-11-2013-0057>
- Malekinezhad, F., Courtney, P., bin Lamit, H., & Vigani, M. (2020). Investigating the mental health impacts of university campus green space through perceived sensory dimensions and the mediation effects of perceived restorativeness on restoration experience. *Frontiers in Public Health*, 8, Article 578241. <https://doi.org/10.3389/fpubh.2020.578241>
- Mannan, M., & Al-Ghamdi, S. G. (2021). Indoor air quality in buildings: A comprehensive review on the factors influencing air pollution in residential and commercial structure. *International Journal of Environmental Research and Public Health*, 18(6), Article 3276. <https://doi.org/10.3390/ijerph18063276>

- Minhas, P., & Nair, P. (2022). *The design of learning environments: To promote student health & well-being*. Association for Learning Environments. <https://educationdesign.com/wp-content/uploads/2022/03/The-Design-of-Salutogenic-Learning-Environments-A4LE-Final.pdf>
- Morgan, C., Bowling, M., Bartram, J., & Kayser, G. L. (2017). Water, sanitation, and hygiene in schools: Status and implications of low coverage in Ethiopia, Kenya, Mozambique, Rwanda, Uganda, and Zambia. *International Journal of Hygiene and Environmental Health*, 220(6), 950–959. <https://doi.org/10.1016/j.ijheh.2017.03.015>
- Moslen, M., Miebaka, C. A., & Babatunde, B. B. (2024). Ecological health of freshwater bodies in Nigeria and associated public health implications. *Environmental Science and Pollution Research*, 31(9), 14281–14296. <https://doi.org/10.1007/s11356-024-31801-4>
- Mshamu, S., Mmbando, A., Meta, J., Bradley, J., Bøjstrup, T. C., Day, N. P. J., Mukaka, M., Okumu, F., Olotu, A., Pell, C., Deen, J., Knudsen, J., Lindsay, S. W., & von Seidlein, L. (2022). Assessing the impact of a novel house design on the incidence of malaria in children in rural Africa: Study protocol for a household-cluster randomized controlled superiority trial. *Trials*, 23(1), Article 519. <https://doi.org/10.1186/s13063-022-06461-z>
- Mshamu, S., Mukaka, M., Sanga, C., Kambanga, S., Rutaihua, A. D., Bøjstrup, T. C., Meta, J., Mmbando, A., Pell, C., Adhikari, B., Olotu, A. I., Kapologwe, N., White, N. J., Dondorp, A. M., Day, N. P. J., Imwong, M., Deen, J., Lindsay, S. W., Knudsen, J. B., & von Seidlein, L. (2026). A sustainable house design to improve child health in rural Africa: A cluster-randomized controlled trial. *Nature Medicine*, 32(6), 2294–2301. <https://doi.org/10.1038/s41591-026-04367-w>
- National Universities Commission. (2023a). Report on accreditation of academic programmes in Nigerian universities: University of Ibadan Entrepreneurship. <https://www.nuc.edu.ng/accreditation-tech-report-view/entry/1396/>
- National Universities Commission. (2023b). State of universities 2023. <https://www.nuc.edu.ng/state-of-universities-2023/>
- Ngcongco, M. T., & Tekere, M. (2025). Evaluating knowledge, attitudes and practices related to water, sanitation and hygiene (WASH): A case study of Durban high schools in South Africa. *International Journal of Environmental Research and Public Health*, 23(1), Article 61. <https://doi.org/10.3390/ijerph23010061>
- Nigeria Centre for Disease Control and Prevention. (2024, June 12). *Stop cholera: Public health advisory*. <https://www.ncdc.gov.ng/news/513/stop-cholera-public-health-advisory>
- Niza, I. L., de Souza, M. P., da Luz, I. M., & Broday, E. E. (2024). Sick building syndrome and its impacts on health, well-being and productivity: A systematic literature review. *Indoor and Built Environment*, 33(2), 218–236. <https://doi.org/10.1177/1420326X231191079>
- Nnaji, C. C. (2023). An exploratory investigation into the status of water, sanitation and hygiene (WASH) of schools in Enugu State, Nigeria. *Nigerian Journal of Technology*, 42(3), 414–422. <https://doi.org/10.4314/njt.v42i3.15>
- Okanagan Charter. (2015). *An international charter for health promoting universities and colleges*. International Conference on Health Promoting Universities and Colleges, Kelowna, Canada.
- Oteniya, M. G., Surajo, A., & Ibrahim, Y. (2023). Large class size: Its implications on students and teachers of higher institutions in Nigeria. *European Journal of Educational and Development Psychology*, 11(1). <https://doi.org/10.37745/ejedp.2013/vol11n13752>
- Pulimeno, M., Piscitelli, P., Colazzo, S., Colao, A., & Miani, A. (2020). Indoor air quality at school and students' performance: Recommendations of the UNESCO Chair on Health Education and Sustainable Development & the Italian Society of Environmental Medicine (SIMA). *Health Promotion Perspectives*, 10(3), 169–174. <https://doi.org/10.34172/hpp.2020.29>
- Rakow, D. A., & Ibcs, D. C. (2022). Campus Nature Rx: How investing in nature interventions benefits college students. *Frontiers in Psychology*, 13, Article 960370. <https://doi.org/10.3389/fpsyg.2022.960370>
- Ribeiro, H., Valente de Souza Santana, K., & Lizarralde Oliver, S. (2024). Natural environments in university campuses and students' well-being. *International Journal of Environmental Research and Public Health*, 21(4), Article 413. <https://doi.org/10.3390/ijerph21040413>
- Roskams, M., & Haynes, B. (2020). Salutogenic workplace design: A conceptual framework for supporting sense of coherence through environmental resources. *Journal of Corporate Real Estate*, 22(2), 139–153. <https://doi.org/10.1108/JCRE-01-2019-0001>
- Sabry Elattar, S. M., Abdullah, I. D., & Abbas Saleh Gebriel, A. (2025). Evaluation of the impact of air pollutants on university indoor air quality: A case study. *Frontiers in Built Environment*, 11, Article 1552679. <https://doi.org/10.3389/fbuil.2025.1552679>
- Sadrizadeh, S., Yao, R., Yuan, F., Awbi, H., Bahnfleth, W., Bi, Y., Cao, G., Croitoru, C., de Dear, R., Haghighat, F., Kumar, P., Malayeri, M., Nasiri, F., Ruud, M., Sadeghian, P., Wargocki, P., Xiong, J., Yu, W., & Li, B. (2022). Indoor air quality and health in schools: A critical review for developing the roadmap for the future school environment. *Journal of Building Engineering*, 57, Article 104908. <https://doi.org/10.1016/j.job.2022.104908>
- Salgado, C. D., Sepkowitz, K. A., John, J. F., Cantey, J. R., Attaway, H. H., Freeman, K. D., Sharpe, P. A., Michels, H. T., & Schmidt, M. G. (2013). Copper surfaces reduce the rate of healthcare-acquired infections in the intensive care unit. *Infection Control & Hospital Epidemiology*, 34(5), 479–486. <https://doi.org/10.1086/670207>

- Seroney, G. C., Mchunu, G. G., & Magak, N. A. G. (2025). Water, sanitation, and hygiene interventions in schools for effective pandemic response in low- and middle-income countries: A systematic scoping review. *Journal of Water, Sanitation and Hygiene for Development*, 15(9), 713–731. <https://doi.org/10.2166/washdev.2025.346>
- Sherif, A., & Iskandar, M. (2025). Design of hospitals for the post-pandemic era: An international survey of design professionals on infection control design strategies. *Architectural Engineering and Design Management*, 21(4), 705–720. <https://doi.org/10.1080/17452007.2024.2385689>
- Shree, V., Kaur, H., Mehra, K. S., Goel, V., & Goel, H. (2024). A comprehensive assessment of IAQ role in ensuring environment quality and health in schools and plan for future school environment: A systematic review. *Air Quality, Atmosphere & Health*, 17(11), 2461–2490. <https://doi.org/10.1007/s11869-024-01585-4>
- Toyinbo, O. (2023). Indoor environmental quality, pupils' health, and academic performance — a literature review. *Buildings*, 13(9), 2172. <https://doi.org/10.3390/buildings13092172>
- Tricco, A. C., Lillie, E., Zarin, W., et al. (2018). PRISMA extension for scoping reviews (PRISMA-ScR): Checklist and explanation. *Annals of Internal Medicine*, 169(7), 467–473. <https://doi.org/10.7326/M18-0850>
- Udomiaye, E. E. (2020). Architectural design strategies for infection prevention and control (IPC) in health-care facilities: Towards curbing the spread of COVID-19. *New Microbes and New Infections*, 38, Article 100804. <https://doi.org/10.1016/j.nmni.2020.100804>
- Ulrich, R. S. (1984). View through a window may influence recovery from surgery. *Science*, 224(4647), 420–421. <https://doi.org/10.1126/science.6143402>
- Ulrich, R. S., Zimring, C., Zhu, X., DuBose, J., Seo, H.-B., Choi, Y.-S., Quan, X., & Joseph, A. (2008). A review of the research literature on evidence-based healthcare design. *HERD: Health Environments Research & Design Journal*, 1(3), 61–125. <https://doi.org/10.1177/193758670800100306>
- Wargocki, P., Porras-Salazar, J. A., Contreras-Espinoza, S., & Bahnfleth, W. (2020). The relationships between classroom air quality and children's performance in school. *Building and Environment*, 173, 106749. <https://doi.org/10.1016/j.buildenv.2020.106749>
- Wilson, E. O. (1984). *Biophilia*. Harvard University Press.
- World Health Organisation. (2021). *WHO global air quality guidelines: Particulate matter (PM_{2.5} and PM₁₀), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide*. World Health Organisation.
- World Health Organisation. (2023). *World malaria report 2023*. World Health Organisation.
- World Health Organisation, United Nations Children's Fund, & United Nations Educational, Scientific and Cultural Organisation. (2023). *How school systems can improve health and well-being: Topic brief: Water, sanitation and hygiene (WASH)*. World Health Organisation.
- World Health Organisation, & United Nations Educational, Scientific and Cultural Organisation. (2021). *Making every school a health-promoting school: Global standards and indicators for health-promoting schools and systems*. World Health Organisation.
- Yakub, A. A., & Zaid, Z. M. (2017). Challenges in the management of hostel accommodation in higher institutions of learning in north-western Nigeria. In S. Laryea & E. Ibem (Eds.), *Proceedings of the 7th West Africa Built Environment Research (WABER) Conference, -16–18 August 2017, Accra, Ghana (pp. 417–436)*. https://www.researchgate.net/publication/350772052_Challenges_in_the_management_of_hostel_accommodation_in_higher_institutions_of_learning_in_north-western_Nigeria
- Yang, Y., Lu, Y., Yang, L., & Yin, H. (2022). Green space and mental health in university students: A systematic review. *Urban Forestry & Urban Greening*, 70, Article 127533. <https://doi.org/10.1016/j.ufug.2022.127533>

Cite this article as:

Swem, T. (2026). Health-Promoting Architectural Design for Nigerian Public Universities: A Scoping Review of Global and Regional Evidence. *GHMJ (Global Health Management Journal)*, 9(3), 365–379. <https://doi.org/10.35898/ghmj-931369>