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BUILT ENVIRONMENT AS A CORRELATE AND PREDICTOR OF PHYSICAL ACTIVITY BEHAVIOUR AMONG UNIVERSITY STUDENTS IN NIGERIA

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Abstract

Introduction. Adopting an active lifestyle remains one of the most affordable and cost-effective means to reduce the risk of hypertension, cardiovascular disease, metabolic disorders, depression and other chronic diseases that are increasingly reported among students in the modern technology-driven world. This study aimed to explore the contributions of the built environment to the physical activity behaviour of university students in Nigeria. **Material and methods.** Correlational survey research design was adopted. The population was 1,648 university students drawn from three tertiary institutions in Kwara State, Nigeria. The population was stratified into Federal, State and Private institutions, using proportionate and random sampling techniques to select a sample of 412 respondents. Two instruments were used for data collection: the researcher-developed University Built Environment Predictors of Physical Activity Questionnaire (UBE-PPAQ; $r = 0.85$) and the standardised International Physical Activity Questionnaire (IPAQ). The IPAQ established concurrent reliability ranging from 0.78 to 0.92 in the Nigerian context. Ethical approval was obtained from the University of Ilorin. The Statistical Package for Social Sciences (SPSS) version 21.0 software was used for data analysis which comprised descriptive and inferential statistical analysis using one-way ANOVA and hierarchical multiple regression at an alpha level of 0.05. **Results.** The findings showed that 234 (56.8%) respondents were physically active. Bike paths and trails were reported as unavailable by all respondents, whereas sidewalks, street lighting, sports/exercise facilities, and sidewalk interconnectivity were reported as available by all respondents. Built environment features significantly predicted physical activity behaviour, explaining 75.1% of its variance ($R = 0.867$, $R^2 = 0.751$, Adjusted $R^2 = 0.747$), $F(4, 404) = 287.450$, $p < 0.001$. Gender ($\beta = 0.161$, $p < 0.001$), sports/exercise facilities ($\beta = 0.552$, $p < 0.001$), sidewalks ($\beta = 0.387$, $p < 0.001$), sidewalk interconnectivity ($\beta = 0.296$, $p < 0.001$), and street lighting ($\beta = 0.286$, $p < 0.001$) were significant positive predictors of physical activity behaviour. **Conclusions.** Improving university built environment features may be an effective strategy for promoting sustainable physical activity among university students in Nigeria.

Keywords: built environment, lifestyle, physical activity, predictor, university students

Introduction

Modern advancements in technology continue to attract humans towards a lifestyle with several options to reduce or even eliminate physical activity. Meanwhile, physical activity is the most accessible cost-effective means and modifiable behaviour for individuals to reduce the risk of chronic diseases that increasingly occur among youths and adults in Nigeria and other countries, while improving physical health, mental well-being, and overall quality of life [1]. In today's society, where sedentary lifestyles and poor diets are becoming more prevalent, it is more important than ever to prioritise proper physical activity [2]. Numerous interdisciplinary studies, including preventive medicine, public health and urban planning, have highlighted the positive role of daily physical activity in the prevention and control of chronic diseases [3, 4, 5].

Amidst the myriads of benefits to be derived from physical activity, many college students struggle to make it a part of their

routine [6]. This may be due to a lack of time, access to facilities, or simply a lack of motivation. It has been observed that students in tertiary institution undergo certain emotional, physiological and environmental modification that influences their consumption and physical activity behaviour [7]. This seems to be one of the important reasons why low adherence to physical activity recommendations is fast becoming a challenge among tertiary institution students in Nigeria. The study of Dominic et al. [8] reported that the majority of university students engaged in sedentariness, whilst that of 2017 found that 45% of the tertiary institution students in Kwara State did not meet the WHO recommendation for physical activity with the majority of them engaging in sedentariness for over 14 hours per day [9].

There has been a remarkable level of association between the built environment and the lifestyle of individuals. Specifically, it has been discovered that one's living environment is a major correlate of physical activity which, in most cases, serves as a key barrier, or facilitator, to being physically active [10, 11].

According to Peachey and Baller [12], built environment refers to the design and layout of physical structures of the environment that have been constructed or modified by people ranging from buildings, open spaces, street connectivity, walkways, cycle lanes, parks, trails, street lights to sports facilities, aesthetic quality, and safety. According to the World Health Organisation [13], the school environment can provide quality physical education and supportive environment for a long-lasting healthy and active lifestyle.

Since physical activity is one of the most important concepts to maintain a healthy lifestyle, understanding how the built environment impacts Nigerian university students' ability to get proper levels of activity is critical. Other developed countries have created systems for physical activity and integrate the use of activity into their citizens' lives, such as accessible and vast biking lanes to promote biking as a primary form of transportation [14]. Under the high-intensity and fast-paced lifestyle, university students have been observed to face significant health challenges including obesity and depression, with the rapid expansion of transportation and logistics sectors coupled with the pervasive use of the Internet, further fostering a sedentary lifestyle among university students [15]. This sedentary behaviour leads to inadequate physical activity, increasing various health risks [16, 17].

Although a substantial body of literature in Nigerian universities has examined physical activity among students, previous studies have largely focused on behavioural interventions and individual-level determinants, such as social and psychological factors influencing exercise participation [18, 19]. Consequently, limited empirical attention has been given to the influence of university built environment features including pedestrian infrastructure, recreational facilities, land-use mix, street connectivity, and campus design on students' physical activity behaviour. This represents a significant gap as ecological models of health behaviour established that the physical environment is a fundamental determinant of health behaviours by either facilitating or constraining opportunities for regular physical activity [20]. Without empirical evidence on how campus built environment features influence students' physical activity, university administrators and policymakers may lack the information needed to implement environmental strategies that encourage active lifestyles and improve student health. Addressing this gap, the present study examined the correlation between existing university built environment features and self-reported physical activity among university students in Kwara State, Nigeria, and determined the extent to which these environmental features predict students' physical activity behaviour.

Material and methods

A correlational survey design was employed to examine the relationships among existing built environment features and self-reported physical activity behaviour and to determine the extent to which built environment features predict self-reported physical activity behaviour among university students in Kwara State, Nigeria. To ensure a representative survey of respondents, a multi-stage sampling procedure utilising stratification by institutional ownership and functional units, proportionate allocation, and simple random sampling was adopted. In the first stage, universities in Kwara State were stratified based on institutional ownership into three distinct strata: federal, state, and private. Purposive sampling was subsequently used to select one institution from each stratum to ensure balanced insti-

tutional representation. The combined population of students across the three selected universities was 1,648.

In the second stage, each selected university was stratified by its functional units (faculties). To determine the sample size from each faculty, a proportionate sampling frame of one-quarter (25%) was applied. Within each selected faculty, simple random sampling was used to recruit the actual participants. This proportionate allocation was arranged from the most populated to the least populated institution resulting in a total sample size of 412 students, distributed as follows: Federal University ($n = 204$), State University ($n = 122$) and Private University ($n = 86$). To verify the statistical adequacy of this sample size for a multiple regression analysis, Green's (1991) criterion, as cited by Field [21], was applied in which the minimum sample size for testing individual predictors within a regression model was determined using the following equation: $N = 104 + k$; where k represents the number of independent predictors. Given that the regression model evaluated in this study comprised six predictors ($k = 6$), the minimum required sample size was 110 ($104 + 6$). The valid sample of 412 participants obtained in this study substantially exceeded this minimum threshold, ensuring adequate statistical power.

Eligible participants comprised male and female undergraduate students in their penultimate or final years of study, as they were deemed to have been properly integrated into the university system and built environment. Conversely, lower-level undergraduate students, part-time students, and postgraduate students were excluded from the study. Prior to data collection, participants were fully briefed on the purpose, procedures, and potential benefits of the research. All participants voluntarily completed and signed an informed consent form. The study was conducted in strict accordance with the ethical principles of the Declaration of Helsinki. Ethical clearance and approval were granted by the University of Ilorin Ethical Review Committee (UERC/ASN/2016/588).

Two instruments were used for data collection. The first instrument was a researcher-developed questionnaire titled University Built Environment Predictors of Physical Activity Questionnaire (UBE-PPAQ). The questionnaire consisted of three sections: A, B, and C. Section A elicited information on respondents' demographic characteristics, including gender, age range, and type of school attended. Section B assessed the availability and effectiveness of built environment features that support physical activity engagement. This section contained 12 items. The first six items examined the availability of six key built environment features commonly found in a well-planned university environment: sidewalks, exercise/sports facilities, street lighting, bike paths, trails, and sidewalk interconnectivity. Responses were recorded as Yes or No, with scores of 1 and 0 assigned, respectively. The remaining six items assessed the perceived effectiveness of each built environment feature in promoting physical activity engagement. Responses were rated on a four-point Likert scale: Strongly Agree (4), Agree (3), Disagree (2), and Strongly Disagree (1). Items 4 and 6 were reverse scored. The maximum obtainable score for Section B was 30, with higher scores indicating greater availability and effectiveness of the university built environment in promoting physical activity.

Section C examined the extent to which built environment features influence respondents' intention to modify their physical activity behaviour. Responses were rated on a five-point scale: Not Likely (0), Likely (1), Fairly Likely (2), More Likely (3), and Most Likely (4). The maximum obtainable score for this section was 24, with higher scores indicating a stronger intention toward physical activity behaviour modification. The scores

from sections B and C were combined to derive the overall built environment score for each respondent.

The UBE-PPAQ was subjected to expert validation by three specialists in Exercise and Sport Science, Health Promotion and Environmental Health Education, and Urban and Regional Planning at the University of Ilorin. The experts confirmed the suitability of the instrument's content and construct for assessing built environment features and physical activity participation. To establish reliability, the instrument was administered twice using the test–retest method, with a two-week interval between administrations. The scores from the two administrations were correlated using the Pearson Product Moment Correlation Coefficient (PPMC). A reliability coefficient of $r = 0.85$ was obtained, indicating that the instrument was reliable for the study.

The second instrument was the International Physical Activity Questionnaire Short Form (IPAQ-SF), which was adopted to determine the physical activity levels of the participants. The IPAQ-SF is a 7-item standardised instrument for assessing self-reported physical activity over a 7-day recall period. It examines the frequency (days per week) and duration (minutes per day) of physical activity across three intensities, walking, moderate and vigorous intensities as well as daily sitting duration to capture sedentary behaviour. The instrument is globally recognised and specifically recommended by the World Health Organization (WHO) [22] and the American College of Sports Medicine (ACSM) [23].

The psychometric properties of the IPAQ-SF are acceptable globally and within the sub-Saharan African context. The 12-country validation of IPAQ indicated a test-retest reliability coefficient (Spearman's ρ) of 0.75, with criterion validity ($r \cong 0.30$) which indicates a fair correlation against objective accelerometer data [24]. A cross-cultural adaptation and psychometric evaluations within Nigeria have confirmed it has a strong concurrent validity ($\rho = 0.78$ to 0.92) and a good test-retest reliability, with the Intraclass Correlation Coefficients (ICC) ranging from 0.61 to 0.73 [25].

Based on the IPAQ scoring protocol, physical activity data were converted to energy expenditure in Metabolic Equivalent of Task (MET) values, which were assigned to each activity intensity level. One MET represents an individual's resting metabolic rate, estimated at an oxygen consumption of $3.5 \text{ mL} \cdot \text{kg}^{-1}$. The standardised constant MET multipliers assigned to each intensity level are as follows: walking = 3.3 METs, moderate physical activity = 4.0 METs and vigorous physical activity = 8.0 METs. The calculation of the total physical activity volume in metabolic equivalent minutes per week (MET-minutes/week), the frequency (days), duration (minutes), and respective MET multiplier for each intensity of activity were calculated and summed as follows:

- Walking MET-minutes/week = $3.3 \times \text{walking minutes} \times \text{walking days}$

- Moderate MET-minutes/week = $4.0 \times \text{moderate minutes} \times \text{moderate days}$
- Vigorous MET-minutes/week = $8.0 \times \text{vigorous minutes} \times \text{vigorous days}$
- Total Physical Activity = Walking + Moderate + Vigorous MET-minutes/week.

Based on the classification of cumulative MET-minutes/week and the specific combinations of frequency and duration, participants' physical activity levels were categorised into three distinct categories: (i) low (physically inactive) < 600 MET-minutes/week, (ii) moderate (minimally active) = any of: ≥ 3 days of vigorous activity of at least 20 minutes per day; ≥ 5 days of walking or moderate activity of at least 30 minutes per day; or ≥ 5 days of any combination of walking, moderate, or vigorous activities achieving a minimum of 600 MET-minutes/week. (iii) High (HEPA/Active) health-enhancing physical activity (HEPA) standards through any of the following: vigorous-intensity activity on at least 3 days achieving a minimum of 1,500 MET-minutes/week; or ≥ 7 days of any combination of walking, moderate, or vigorous activity achieving a minimum of 3,000 MET-minutes/week.

Descriptive statistical analyses were conducted; frequency and percentage were used for gender distribution, while mean and standard deviation were calculated for reported physical activity levels. Inferential statistics of One-Way ANOVA was employed to ascertain the differences in the built environment among the institutions and hierarchical multiple regression analysis was used to predict the correlation between the built environment and physical activity lifestyle behaviour modification. Data analysis was conducted with SPSS 21.0 software with a p-value of 0.05 adopted for statistical significance. A preliminary assessment of the data was conducted before analysis. The dataset was screened for missing values, normality, and multicollinearity, and the results indicated that all underlying assumptions were satisfactorily met.

Results

The demographic characteristics of the respondents showed that the majority were male, 219 (53.20%). Regarding institutional type, 204 (49.50%) respondents were from federal university, 122 (29.60%) were from state university, and 86 (20.90%) were from private university. In terms of age, most respondents, 292 (70.9%), were aged 22–25 years, while 61 (14.80%) were aged 18–21 years and 59 (14.30%) were aged 26–30 years. The descriptive analysis of PAL of university students in Kwara State, Nigeria (Tab. 1) shows that out of 412 participants, the majority, 234 (56.80%), were physically active. When compared by type of institution, students of Kwara State University (State, $n = 122$) were more physically active than the others. By percentage, there were more physically inactive students in the private university,

Table 1. Descriptive analysis of physical activity level of university students in Kwara State, Nigeria ($n = 412$).

Physical Activity Rating	All Participants $n = 412$ MET-min/wk Mean $\pm$ SD	n (%)	Federal University $n = 204$ MET-min/wk Mean $\pm$ SD	n (%)	State University $n = 122$ MET-min/wk Mean $\pm$ SD	n (%)	Private University $n = 86$ MET-min/wk Mean $\pm$ SD	n (%)
Physically Active	618.23 $\pm$ 34.2.00	234 (56.80)	663.51 $\pm$ 27.45	117 (57.35)	671.71 $\pm$ 25.27	74 (60.66)	665.65 $\pm$ 24.63	44 (51.16)
Physically Inactive	562.74 $\pm$ 26.8.00	178 (43.20)	476.22 $\pm$ 25.40	87 (42.65)	575.90 $\pm$ 21.50	48 (39.34)	502.10 $\pm$ 20.30	42 (48.84)

42 (48.84%), than the federal, 178 (43.20%), and state universities, 48 (39.34%).

Table 2 shows the availability/effectiveness of built environment components in contributing to the physical activity of university students in Kwara State, Nigeria. Sidewalks were perceived as effective by 326 (79.1%) respondents, while 86 (20.9%) considered them not effective. Bike paths and trails were reported as unavailable by all respondents (100.0%). Street lights were perceived as effective by only 29 (7.0%) respondents, whereas the majority, 383 (93.0%), rated them as not effective. Sports facilities were considered effective by all respondents (100.0%). Similarly, interconnectivity was perceived as effective by only 17 (4.1%) respondents, while 395 (95.9%) indicated that it was not effective. The current built environment exhibited mixed support for physical activity, with effective sidewalks and sports facilities contrasted by the complete absence of bike paths and trails and the perceived inadequacy of street lighting and interconnectivity. The descriptive findings in table 3 indicate relatively similar ratings of sports/exercise facilities and interconnectivity across university types, while greater variation was observed in participants' ratings of sidewalks and street lights, particularly among private universities.

Table 2. Availability/effectiveness of the built environment for physical activity of university students in Kwara State, Nigeria.

	Response	Frequency	Percentage
Sidewalk	Effective	326	79.10
	Not Effective	86	20.90
	Total	412	100.00
Bike Path	Not available	412	100.00
Trails	Not available	412	100.00
Street light	Effective	29	7.00
	Not effective	383	93.00
	Total	412	100.00
Sports Facilities	Effective	412	100.00
Interconnectivity	Effective	17	4.10
	Not effective	395	95.90
	Total	412	100.00

Table 3 shows the one-way ANOVA results comparing participants' ratings of built environment variables across federal, state, and private universities in Kwara State, Nigeria. There was no statistically significant difference in the ratings of sports/exercise facilities among the three university types, $F(2, 409) = 0.02$, $p = 0.982$. However, a statistically significant difference was observed in sidewalk ratings, $F(2, 409) = 24.65$, $p < 0.001$. The Tukey post hoc analysis indicated that there was no significant

difference in sidewalk ratings between the state and the federal university ($MD = 0.03$, $SE = 0.14$, $p > 0.094$). However, the private university had significantly lower sidewalk ratings than both the state university ($MD = 1.04$, $SE = 0.17$, $p < 0.001$, 95% CI [0.64, 1.44]) and the federal university ($MD = 1.02$, $SE = 0.16$, $p < 0.001$, 95% CI [0.65, 1.38]).

Table 3. One-Way ANOVA of differences in built environment ratings of the universities in Kwara State, Nigeria.

Built Environment Model	n	Sum of squares	df	Mean Square	F	Sig
Sports/exercise facilities						
Between groups	412	1.28	2	0.64	0.02	0.982
Within groups		1730.75	409	4.23		
Total		1732.03	411			
Sidewalk						
Between groups	412	72.04	2	36.02	24.65	0.000
Within groups		567.57	409	1.46		
Total		669.60	411			
Street lights						
Between groups	412	25.22	2	12.61	13.55	0.001
Within groups		380.80	409	0.93		
Total		406.03	411			
Interconnectivity						
Between groups	412	0.08	2	9.04	0.04	0.906
Within groups		154.63	409	2.43	0.38	
Total		154.71	411			

$p \leq 0.05$

Street light ratings differed significantly across the university types, $F(2, 409) = 13.55$, $p = 0.001$. In contrast, there was no statistically significant difference in interconnectivity ratings among the three university types, $F(2, 409) = 0.04$, $p = 0.906$. The Tukey post hoc analysis indicated that state university had significantly higher street light ratings than federal university ($MD = 0.42$, $SE = 0.11$, $p < 0.001$, 95% CI [0.16, 0.68]) and private university ($MD = 0.68$, $SE = 0.14$, $p < 0.001$, 95% CI [0.36, 1.00]). However, there was no significant difference in street light ratings between federal and private universities ($MD = 0.26$, $SE = 0.12$, $p > 0.094$).

Table 4 presents the hierarchical regression analysis examining the relationship between built environment and physical activity lifestyle behaviour. In Model 1, the demographic variables explained 4.3% of the variance in physical activity lifestyle behaviour ($R = 0.208$, $R^2 = 0.043$, Adjusted $R^2 = 0.036$). The model was statistically significant, F change (3, 408) = 6.123,

Table 4. Model summary of hierarchical regression showing correlation analysis of built environment and physical activity lifestyle behaviour.

Model	R	R ²	Adjusted R ² Square	Std. Error of the Estimate	Change Statistics				
					R ² Change	F Change	df1	df2	Sig. F Change
1	.208	.043	.036	3.551	.043	6.123	3	408	.000
2	.867	.751	.747	1.819	.708	287.450	4	404	.000

$p \leq 0.05$

$p < 0.001$, indicating that the demographic variables made a significant contribution to the prediction of physical activity lifestyle behaviour. In Model 2, the inclusion of the built environment variables substantially improved the model, increasing the explained variance to 75.1% ($R = 0.867$, $R^2 = 0.751$, Adjusted $R^2 = 0.747$). The addition of the built environment variables accounted for an extra 70.8% of the variance (Adjusted $R^2 = 0.708$), and this increment was statistically significant, F change (4, 404) = 287.450, $p < 0.001$. Thus, the findings indicate that built environment variables made a substantial and statistically significant contribution to explaining physical activity lifestyle behaviour beyond the influence of demographic characteristics.

Table 5 presents the coefficients of the hierarchical regression model predicting physical activity lifestyle behaviour. In Model 1, gender ($\beta = 0.161$, $t = 3.209$, $p < 0.001$) positively predicted physical activity lifestyle behaviour, whereas type of school ($\beta = -0.113$, $t = -2.310$, $p < 0.021$) was a significant negative predictor. Age range was not a significant predictor ($\beta = -0.050$, $t = -0.994$, $p > 0.321$). In Model 2, after the inclusion of the built environment variables, gender remained a significant positive predictor ($\beta = 0.130$, $t = 5.012$, $p < .001$), while age range became a significant negative predictor ($\beta = -0.061$, $t = -2.289$, $p < 0.023$). Type of school was no longer a significant predictor ($\beta = 0.018$, $t = 0.690$, $p = 0.491$). All four built environment variables significantly and positively predicted physical activity lifestyle behaviour: sports/exercise facilities ($\beta = 0.552$, $t = 21.547$, $p < 0.001$), sidewalks ($\beta = 0.387$, $t = 14.498$, $p < 0.001$), street lights ($\beta = 0.286$, $t = 11.096$, $p < 0.001$), and interconnectivity ($\beta = 0.296$, $t = 11.849$, $p < 0.001$). The findings thus indicate that, after controlling for demographic characteristics, all built environment variables significantly and positively predicted physical activity lifestyle behaviour, with sports/exercise facilities emerging as the strongest predictor based on the standardised regression coefficients ($\beta = 0.552$).

Discussion

The researchers examined the correlation of built environment and physical activity and attempted to predict how improvements in the built environment could be an intervention for sustainable lifestyle behaviour of university students in Nigeria. The participants comprised male and female undergraduates drawn from three universities in Kwara State, Nigeria. The findings revealed that while the university built environment generally meets baseline structural expectations, participants specifically identified ineffective street lighting, poor sidewalk interconnectivity, and the complete absence of dedicated bike paths and recreational trails as major barriers that fail to promote physical activity. This reflects a broader environment trend observed across wider Nigerian urban landscapes, where active transport infrastructure is routinely excluded from developmental frameworks. Historically, only the master-planned capital city of Abuja incorporated explicit bike paths and pedestrian-friendly grid networks into its urban design [26, 27].

Similarly, dedicated trails which often support recreational activities were entirely absent from the municipal layout of most developed Nigerian cities. This macro-level deficit directly manifests at the micro-level within universities' built environment. This finding is further supported by Aluko et al. [28], who reported that south-western Nigerian universities are deficient in active transport facilities with less than two percent of university members engaging in active cycling primarily due to safety concerns and the non-existence of distinct bike paths. Participants expressed positive perceptions towards the provision of bike paths and trails within their universities, indicating that these built environment features would enhance their physical activity lifestyle. This demonstrates that Nigerian universities' built environment requires modification and targeted investment towards encouraging health-enhancing physical activities and improving the overall health of students.

The United Nations and the World Health Organization, through the Sustainable Development Goals (SDGs) and Universal Health Coverage (UHC) initiatives, have emphasised the development of pedestrian-friendly environments and the promotion of green mobility, such as walking, as key strategies for

Table 5. Coefficients of regression model.

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	30.151	.879		34.311	.000	28.424	31.879
	gender	1.165	.363	.161	3.209	.001	.451	1.878
	age range	-.332	.334	-.050	-.994	.321	-.988	.324
	type of school	-.519	.225	-.113	-2.310	.021	-.961	-.077
2	(Constant)	4.378	1.089		4.021	.000	2.238	6.519
	gender	.944	.188	.130	5.012	.000	.574	1.314
	age range	-.407	.178	-.061	-2.289	.023	-.756	-.057
	type of school	.082	.120	.018	.690	.491	-.153	.317
	Sports/exercise facilities	.973	.045	.552	21.547	.000	.884	1.062
	Sidewalk	1.096	.076	.387	14.498	.000	.947	1.245
	Street light	1.042	.094	.286	11.096	.000	.857	1.226
	Interconnectivity	1.743	.147	.296	11.849	.000	1.453	2.032

fostering community cohesion, improving public health, and advancing sustainable development [29, 30]. Consistent with these global priorities, participants in the present study reported frequent use of sidewalks and perceived them as effective facilities for supporting physical activity. This perception was similar across institution types. However, participants highlighted poor connectivity within the universities' built environment, noting that existing sidewalk routes did not adequately connect major destinations. While walking was common around lecture areas, pathways linking other important facilities, such as hostels, markets, clinics, and banks, were often incomplete or indirect. Consequently, the considerable distances between these destinations reduced opportunities and motivation for walking as part of daily campus life. This is further backed up by recent empirical studies, including those by Liao et al. [31] and Liu et al. [32], reporting that factors such as connectivity, walking infrastructure, and safety positively influenced physical activity behaviour by enhancing campus walkability and also confirming significant correlations between elements like street greening and accessibility to public facilities with increased walking duration. In line with the submissions of Neel [2], Peachey et al. [12] and Kärmeniemi et al. [33], the participants indicated a high likelihood to engage in physical activity if the interconnectivity is enhanced.

Previous studies have reported inconsistent findings regarding the relationship between the availability of sports facilities and physical activity participation [3, 34]. In the present study, most participants indicated that sports facilities within their universities were concentrated in a single location, often situated far from their faculties. Although participants across the different university types did not differ significantly in their ratings of sports and exercise facilities or campus interconnectivity, they generally perceived these built environment features as important for promoting physical activity. Nevertheless, concerns about the location of sports facilities and poor connectivity between key campus destinations suggest that accessibility remains a barrier to regular participation in physical activity. Improving the spatial distribution of sports facilities and enhancing sidewalk connectivity across campuses may therefore encourage greater physical activity among university students.

The findings also revealed institutional differences in specific built environment attributes. Private university students assigned lower ratings to sidewalks, indicating greater perceived inadequacies in pedestrian infrastructure, while both private and federal university students reported lower ratings for street lighting compared with their counterparts in the state university. These findings suggest that the provision of infrastructure supportive of physical activity may vary across institution types. Although previous studies have often reported that private universities possess superior physical infrastructure compared with public universities [35], the present findings indicate that this advantage may not necessarily extend to the built environment features that facilitate physical activity. This highlights the need for universities to prioritise infrastructure that supports active lifestyles rather than focusing solely on general campus development.

Consistent with findings from previous studies among Nigerian university students [36], demographic characteristics made a modest contribution to the prediction of physical activity. Gender emerged as the most consistent predictor, irrespective of whether built environment variables were included in the regression model, with female students demonstrating less favourable perceptions of physical activity than their male counterparts. This finding aligns with earlier evidence that so-

cio-cultural expectations, gender norms, and concerns about personal safety disproportionately limit physical activity participation among female students [37]. School type independently predicted physical activity irrespective of built environment characteristics, whereas the influence of age varied depending on the inclusion of built environment variables. This suggests that the relationship between the built environment and physical activity differs across age groups, a pattern that has been reported in previous studies [9, 10]. Collectively, these findings indicate that while improvements to the campus built environment are important, they should be complemented by interventions that address gender-specific barriers to physical activity. Furthermore, designing age-responsive campus environments and physical activity programmes may enhance the effectiveness of built environment interventions in promoting active lifestyles among Nigerian university students.

Conclusions

There was a positive correlation between the built environment, physical activity and physical activity lifestyle behaviour modification among university students in Kwara State, Nigeria. Apart from the built environment variable found in the universities, students showed a high likelihood of improving physical activity behaviour if the university environment is built with modern city structures like trails, streetlights, bike paths, and sufficient interconnectivity of roads. Based on the findings, we recommend that the university environment should be redesigned to promote physical activity behaviour among students as physical activity has been proven to enhance health, reduce the occurrence of chronic diseases and improve optimal human performance. Where necessary, university policies should be amended to give greater priorities to a healthy and physical activity-friendly environment.

References

1. WHO (2020). *Physical activity*. Retrieved April 14, 2022 from <https://www.who.int/news-room/fact-sheets/detail/physical-activity>.
2. Neel C.M. (2023). *The associations of built environments on college students' physical activity levels*. Senior Theses. 591. https://scholarcommons.sc.edu/senior_theses/591
3. Clemente F.M., Nikolaidis P.T., Martins F.M.L., Mendes R.S. (2016). Physical activity patterns in university students: Do they follow the public health guidelines? *PLoS ONE* 11(3), e0152516. DOI: 10.1371/journal.pone.0152516
4. McTiernan A., Friedenreich C.M., Katzmarzyk P.T., Powell K.E., Macko R. et al. (2019). Physical activity in cancer prevention and survival: a systematic review. *Medicine and Science in Sports and Exercise* 51(6), 1252-1261. DOI: 10.1249/MSS.0000000000001937
5. Teuber M., Sudeck G. (2021). Why do students walk or cycle for transportation? Perceived study environment and psychological determinants as predictors of active transportation by university students. *International Journal of Environmental Research and Public Health* 18(4), 1390. DOI: 10.3390/ijerph18041390
6. Calistine J., Bopp M., Bopp C.M., Papalia Z. (2017). College student work habits are related to physical activity and fitness. *International Journal of Exercise Science* 10(7), 1009-1017. DOI: 10.70252/XLOM8139
7. Gallardo-Escudero A., Alférez M.J.M., Pozo E.M.P., Aliaga I.L. (2015). The university stage does not favor the healthy

- life style in women students from Granada. *Nutricion Hospitalaria* 31(2), 975-979. DOI: 10.3305/nh.2015.31.2.8303
8. Dominic O.L., Seidina I.Y., Williams D.F., Oyerinde O.O., Olaitan L., Onifade O.A. (2018). ICT use implications for exercise participation and health in the Nigerian university community. *Journal of Physical Education & Health Social Perspective* 7(11), 5-14.
 9. Dominic O.L., Seidina I.Y., Niyi-Odumosu F.A., Owoyele B.V. (2017). ICT use influence on activity pattern and body composition of university students in Kwara State. *Medicine & Science in Sports & Exercise* 49(5S), 971. DOI: 10.1249/01.mss.0000519653.40212.76
 10. Su M., Tan Y.Y., Liu Q.M., Ren Y.J., Kawachi I. et al. (2014). Association between perceived urban built environment attributes and leisure-time physical activity among adults in Hangzhou. *China Preventive Medicine* 66, 60-64.
 11. Jack S.B., Jamie A., Ruth F.H., David P.F. (2016). The effect of changing the built environment on physical activity: A quantitative review of the risk of bias in natural experiments. *International Journal of Behavioral Nutrition and Physical Activity* 13(1), 107. DOI: 10.1186/s12966-016-0433-3
 12. Peachey A.A., Baller S.L. (2015). Perceived built environment characteristics of on campus and off-campus neighborhoods associated with physical activity of college students. *Journal of American College Health* 63(5), 337-342. DOI: 10.1080/07448481.2015.1015027
 13. World Health Organisation (2018). *Global Action Plan on Physical Activity 2018–2030: More Active People for a Healthier World*. World Health Organization: Geneva, Switzerland.
 14. Frerichs L., Smith N.R., Lich K.H., BenDor T.K., Evenson K.R. (2019). A scoping review of simulation modeling in built environment and physical activity research: Current status, gaps, and future directions for improving translation. *Health & Place* 57, 122-130. DOI: 10.1016/j.healthplace.2019.04.001
 15. Wang M. (2019). *A study of strategies for designing campus environments in cold weather universities based on physical activity promotion*. Doctoral dissertation. Harbin Institute of Technology.
 16. Hargens T.A., Scott M.C., Olijar V., Bigman M., Edwards E.S. (2021). Markers of poor sleep quality increase sedentary behavior in college students as derived from accelerometry. *Sleep and Breathing* 25(1), 537-544. DOI: 10.1007/s11325-020-02190-2
 17. Liu W., Yuan Q., Zeng N., McDonough D.J., Tao K. et al. (2021). Relationships between college students' sedentary behavior, sleep quality, and body mass index. *International Journal of Environmental Research and Public Health* 18(8), 3946. DOI: 10.3390/ijerph18083946
 18. Bakinde S.T., Olaitan O.L., Dominic O.L. (2023). Physical activity: A means of enhancing health and well-being of the elderly in the Nigerian populace. *Indonesian Journal of Educational Research and Review* 6(1), 187-194. DOI: 10.23887/ijerr.v6i1.60139
 19. Elshahat S., O'Rourke M., Adlakha D. (2020). Built environment correlates of physical activity in low- and middle-income countries: A systematic review. *PLoS ONE* 15(3), e0230454. DOI: 10.1371/journal.pone.0230454
 20. Sallis J.F., Owen N. (2015). Ecological models of health behavior. In K. Glanz, B.K. Rimer, K.V. Viswanath (eds.), *Health behavior: Theory, research, and practice* (pp. 43-64). Jossey-Bass.
 21. Field A. (2009). *Discovering Statistics Using SPSS* (3rd ed.). London: SAGE.
 22. World Health Organization. (2010). *Global recommendations on physical activity for health*. World Health Organization.
 23. American College of Sports Medicine (2018). *ACSM's guidelines for exercise testing and prescription* (10th ed.). Wolters Kluwer.
 24. Craig C.L., Marshall A.L., Sjöström M., Bauman A.E., Booth M.L. et al. (2003). International Physical Activity Questionnaire: 12-country reliability and validity. *Medicine & Science in Sports & Exercise* 35(8), 1381-1395. DOI: 10.1249/01.MSS.0000078924.61453.FB
 25. Oyeyemi A.L., Oyeyemi A.Y., Adegoke B.O., Oyetoke F.O., Aliyu H.N. et al. (2011). The short international physical activity questionnaire: Cross-cultural adaptation, validation and reliability of the Hausa language version in Nigeria. *BMC Medical Research Methodology* 11(1), 156. DOI: 10.1186/1471-2288-11-156
 26. Mogaji E. (2022). Wishful thinking? Addressing the long-term implications of COVID-19 for transport in Nigeria. *Transportation Research Part D: Transport and Environment* 105, 103206. DOI: 10.1016/j.trd.2022.103206
 27. Ogunsola S.A. (2016). *Social sustainability: Guidelines for urban development and practice in Abuja City, Nigeria*. Doctoral dissertation. Nottingham Trent University.
 28. Aluko O.K., Ogunleye O.S., Aluko O.O. (2025). An evaluation of sustainable mobility pattern in a suburban university. In A. S. Bahaj (ed.), *Proceedings of the 5th International Conference on Evolving Cities* (ID: 1138). Evolving Cities Publications. DOI: 10.55066/proc-icec.2025.1138
 29. Sacks E., Schleiff M., Were M., Chowdhury A.M., Perry H.B. (2020). Communities, universal health coverage and primary health care. *Bulletin of the World Health Organization* 98(11), 773-780. DOI: 10.2471/BLT.20.252445
 30. Siqueira G.D., Adeel A., Pasha P., Balushi A.A., Shah S.A. (2021). Sustainable transportation and policy development: A study for impact analysis of mobility patterns and neighborhood assessment of walking behavior. *Sustainability* 13(4), 1871. DOI: 10.3390/su13041871
 31. Liao B., Xu Y., Li X., Li J. (2022). Association between campus walkability and affective walking experience, and the mediating role of walking attitude. *International Journal of Environmental Research and Public Health* 19(21), 14519. DOI: 10.3390/ijerph192114519
 32. Liu J., Ettema D., Helbich M. (2023). Street view environments are associated with the walking duration of pedestrians: The case of Amsterdam, the Netherlands. *Landscape and Urban Planning* 235, 104752.
 33. Kärmeniemi M., Lankila T., Ikäheimo T., Koivumaa-Honkanen H., Raija K. (2018). The built environment as a determinant of physical activity: A Systematic Review of Longitudinal Studies and Natural Experiments. *Annals of Behavioral Medicine* 52(3), 239-251. DOI: 10.1093/abm/kax043
 34. Reimers A.K., Wagner M., Alvanides S., Steinmayr A., Reiner M., Woll A. (2014). Proximity to Sports Facilities and Sports Participation for Adolescents in Germany. *PLoS ONE* 9(3), e93059. DOI: 10.1371/journal.pone.0093059
 35. Ogunode N.J., Odo M. (2023). Infrastructure development in Nigerian tertiary institutions: Public versus private sector models. *Journal of Educational Realities* 11(2), 45-58.
 36. Maruf F.A., Akinpelu A.O., Salako A.A. (2012). Self-reported physical activity level in a Nigerian university population. *African Journal of Biomedical Research* 15(2), 85-91.

37. Adegoke B.O., Oyeyemi A.L. (2008). Physical activity awareness, level of participation and provisioning among university students in southwestern Nigeria. *Journal of the Nigeria Society of Physiotherapy* 17(1), 1-6.

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