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Assessment of Risks Associated With Street-Based Physical Exercise and Planning Strategies for Active Liveability in Port Harcourt, Nigeria

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Abstract - Urban neighbourhood planning enhances the active liveability of urban residents. The study assessed risks associated with street-based physical exercise and planning strategies for active liveability in Port Harcourt, Nigeria. The study adopted a quantitative approach and employed a cross-sectional research design. A multistage sampling technique was employed to select respondents. A total sample size of 384 was determined using the standard minimum sample size formula at 0.05 error margin and 10% non-response was added to have a total of 427 respondents. A structured questionnaire and environmental observation checklist were used to collect data. After sampling, a total 397 were retrieved and considered valid for analysis. Descriptive statistics, including frequencies, percentages, means and standard deviations, and inferential statistics such as Chi-square tests, Pearson correlation and multiple regression analysis were employed to analyse the data collected. The study found that residents mostly partake in walking, jogging and running as forms of physical exercise in the street at least 4-6 times per week. Furthermore, the study found that drainage condition, pedestrian walkway availability, waste accumulation, street lighting, traffic volume, flooding incidents, road surface condition, street connectivity, security conditions and land use compatibility are conditions and concerns affecting physical exercise participation in neighbourhoods. These have caused traffic and transportation, pedestrian-infrastructure, environmental-quality, and safety and security risks which affect residents active liveability and wellbeing. The study findings revealed from the provision of continuous pedestrian walkways, traffic-calming measures, improved street lighting, construction of safe pedestrian crossings and drainage improvement, flood control and creation of green/open spaces and exercise parks are planning strategies to improve street-based physical activity. Pearson Correlation test results indicated overall risk score and planning strategy importance have a significant positive relationship as the r=0.426 and p-value is 0.000. To address the findings, the study recommended that various forms of street-based activity should be encouraged for residents to partake to enhance social bond and cohesion; the streets should be provided with all necessary street facilities including pedestrian walkway, cycle lane and street light which is separated from carriageway to improve residents' accessibility, security and safety, social benefits, and financial concerns; street-based physical exercise should engage in such activities during the early and late hours of the day to avert traffic and transportation risks; and open and green spaces should be provided in the neighbourhoods to enhance residents' engagement in physical exercise to improve liveability.

Keywords: Street-based physical exercise, environmental risk, urban environmental quality, active liveability, urban planning

1. Introduction

Urban physical environments play an important role in determining the safety, accessibility and sustainability of outdoor physical activities. Streets serve as public spaces for walking, jogging, cycling, running and other recreational exercises. However, their suitability depends on street design, pedestrian infrastructure, environmental quality, traffic conditions and neighbourhood safety. Street connectivity, sidewalk availability, road conditions, lighting, drainage and traffic

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management are important considerations for creating environments that encourage regular physical activity. Abusaada and Elshater (2024) identified street planning and design as important factors in promoting physical activity, while Kouthouris et al. (2021) emphasised the role of environmentally sustainable urban policies in supporting active living. Similarly, Helbich et al. (2026) highlighted the influence of healthy living environments on physical activity habits. These perspectives underscore the importance of creating urban environments that support physical activity while minimising environmental and safety risks.

Street-based exercise in rapidly urbanising cities may expose participants to several environmental and infrastructural hazards, including vehicular collisions, traffic congestion, roadside trading, obstructed pedestrian pathways, deteriorated road surfaces, inadequate lighting, flooding, poor drainage and neighbourhood insecurity. Additional concerns include exposure to vehicular emissions, particulate matter, dust, smoke and excessive noise. These conditions may compromise exercise safety, comfort and health benefits. In particular, increased breathing rates during physical exertion may heighten exposure to traffic-related air pollutants, while potholes, uneven surfaces and roadside obstructions may increase the risk of falls and injuries. Consequently, environmental risk assessment is essential to integrating public health considerations into active-living and urban planning policies.

These concerns are particularly relevant to Port Harcourt, where urban expansion, increasing vehicular movement, roadside commercial activities and variations in infrastructure provision create different environmental and safety challenges. Ogboeli et al. (2026), in their assessment of roadside trading, traffic congestion and accident risk in Port Harcourt metropolis, highlighted the implications of informal commercial activities and traffic-related hazards for urban public-space safety. Such conditions may restrict pedestrian movement and compromise the availability and safety of streets for outdoor exercise. Similarly, inadequate pedestrian facilities, poor road maintenance, drainage deficiencies and environmental pollution may discourage residents from using neighbourhood streets for physical activities. Ferreira et al. (2022) also identified traffic speed, traffic density, collision risks, crime, air pollution and noise as important considerations in pedestrian and cyclist safety. The World Health Organization (WHO, 2025) further recognises the contribution of poorly designed urban transport environments to road traffic injuries, pollution and barriers to active living.

Despite increasing recognition of the relationship between urban environments and physical activity, important research gaps remain. Existing Nigerian studies have examined neighbourhood environmental characteristics, physical activity participation and related health outcomes (Oyeyemi et al., 2019; Akosile et al., 2023; Odeyemi et al., 2023). However, limited context-specific evidence exists on the combined influence of infrastructural deficiencies, traffic hazards, environmental pollution, drainage conditions and neighbourhood security on street-based physical exercise in Port Harcourt. In particular, the relationship between these environmental conditions, perceived safety, exercise accessibility and participation requires further investigation. Understanding these relationships is necessary for developing evidence-based planning strategies that minimise environmental risks and improve neighbourhood liveability.

Against this background, this study assesses the environmental and safety risks associated with street-based physical exercise in selected neighbourhoods of Port Harcourt, Rivers State.

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Specifically, it examines street conditions and accessibility, identifies traffic-related, infrastructural, environmental and security hazards, assesses participants' perceptions of safety and investigates how neighbourhood environmental conditions influence outdoor exercise participation. It also evaluates planning strategies for reducing identified risks and improving the suitability of streets for active living. The study is expected to provide empirical evidence for urban planners, environmental health practitioners, transport authorities and public health professionals in developing safer and more accessible neighbourhood environments through improved pedestrian infrastructure, traffic-calming measures, effective drainage, road maintenance, street lighting, roadside activity regulation and pollution control. Ultimately, it promotes an integrated approach to active liveability in which streets function not only as transportation corridors but also as safe, healthy and inclusive spaces for physical activity and sustainable urban development.

The specific objectives of the study are to:

i. Describe the socio-demographic characteristics of the respondents;
ii. Nature and pattern of street-based physical exercise of respondents;
iii. Assess the environmental conditions and concerns of the study area; and
iv. Identify planning strategies for promoting active liveability.

2. Theoretical Framework

2.1 Social Ecological Model

The Social Ecological Model (SEM) was developed from Bronfenbrenner's (1979) ecological perspective and adapted to health behaviour by McLeroy et al. (1988). The model explains behaviour as the interaction of individual, interpersonal, organisational, community and policy factors. It has been widely applied to physical-activity research, including Sallis et al. (2006), who examined ecological influences on physical activity. The SEM is relevant to this study because street-based exercise is influenced not only by individual motivation but also by neighbourhood safety, pedestrian infrastructure, traffic conditions, environmental quality, accessibility and urban planning policies. It therefore provides a framework for examining how physical and social environmental conditions in Port Harcourt may facilitate or constrain safe participation in street-based physical exercise and how planning interventions can promote active living and quality of life of residents.

2.2 Health Belief Model

The Health Belief Model (HBM) was introduced by Rosenstock (1966) and subsequently developed by Rosenstock et al. (1988). It explains health behaviour through perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action and self-efficacy. The model has been applied to physical-activity behaviour, including research by Juniper et al. (2004) on beliefs influencing physical activity. In the present study, the HBM provides a basis for understanding how exercisers perceive environmental hazards and risks associated with street-based physical activity. Perceived risks such as traffic exposure, poor pedestrian facilities, insecurity, falls and environmental pollution may discourage exercise, whereas perceived health benefits may encourage participation despite these perceived hazards and risks. The model therefore helps explain the relationship between perceived environmental risks, exercise behaviour and the need for safer urban planning measures through sustainable neighbourhood design strategies that provide spaces for street-based physical activity to improve active liveability.

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2.3 Theory of Planned Behavior

The Theory of Planned Behaviour (TPB) was proposed by Ajzen (1991) to explain behavioural intention through attitude, subjective norms and perceived behavioural control. The theory has been widely applied to physical-activity research, including studies examining determinants of exercise intention and participation. Qiao et al. (2021) applied TPB alongside the HBM to examine beliefs concerning physical activity among older adults. The theory is relevant to this study because participation in street-based exercise may depend on individuals' attitudes toward exercise, social influences and their perceived ability to exercise safely. Poor streets, traffic hazards, insecurity and inadequate pedestrian infrastructure may reduce perceived behavioural control, whereas accessible and well-planned environments may facilitate participation. TPB therefore supports the assessment of behavioural factors alongside environmental and planning conditions affecting active living in Port Harcourt to enhance residents' quality of life and their well-being.

3 Methodology

3.1 Research Approach and Design

The study adopted a quantitative research approach using a cross-sectional environmental health and urban planning design to assess environmental and safety risks associated with street-based physical exercise and identify planning strategies for promoting active living in Port Harcourt, Rivers State, Nigeria. The cross-sectional design enabled the collection of data within a defined study period, providing an assessment of participants' physical exercise practices, perceived environmental risks, observed neighbourhood conditions and preferred planning interventions. The integration of questionnaire administration and structured environmental observations provided complementary information on the relationship between neighbourhood environmental characteristics and the suitability of streets for outdoor physical activities.

3.2 Study Area

The study was conducted in Port Harcourt, the capital of Rivers State, Nigeria. The city is a major urban centre characterised by residential, commercial, institutional and transportation activities. Its urban structure comprises neighbourhoods with varying levels of development, population density, road infrastructure, land-use characteristics and environmental conditions. Streets, neighbourhood roads and adjoining public spaces are frequently used by residents for walking, jogging, running, cycling and other forms of physical exercise.

However, variations in pedestrian infrastructure, traffic intensity, street lighting, drainage, environmental sanitation, neighbourhood security, street connectivity and land-use compatibility may influence the accessibility, safety and attractiveness of these spaces for physical activity. These characteristics make Port Harcourt an appropriate setting for investigating environmental risks associated with street-based physical exercise and identifying urban planning interventions for improving active living.

3.3 Study Population

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The study population comprised adults aged 18 years and above who participated in street-based physical exercise within selected neighbourhoods of Port Harcourt. Eligible participants included residents and other adult users of selected streets and neighbourhood routes who engaged in walking, jogging, running, cycling, street workouts or other outdoor physical activities.

The study also considered the physical and environmental characteristics of streets and exercise routes used by participants. Consequently, environmental observations were conducted along selected routes to document infrastructure conditions, environmental hazards, accessibility and neighbourhood safety characteristics that could influence outdoor exercise.

3.4 Sample Size Determination

The minimum sample size was determined using Cochran's formula for estimating a single population proportion:

$$n = \frac{Z^2 p(1-p)}{d^2}$$

Where $n$is the minimum sample size, $Z$is the standard normal deviate at 95% confidence level (1.96), $p$is the estimated proportion of the target population with the characteristic of interest, and $d$is the margin of error (0.05). In the absence of a sufficiently comparable local estimate, $p = 0.50$was adopted to provide the maximum sample size.

$$n = \frac{(1.96)^2(0.50)(0.50)}{(0.05)^2} = 384.16$$

Thus, the minimum sample size was 384 respondents. Allowing 10% for non-response or incomplete questionnaires:

$$n_a = \frac{384}{1 - 0.10} = 426.67$$

The value was rounded up, giving a final target sample size of 427 respondents.

3.5 Sampling Procedure

A multistage sampling technique was adopted to ensure the inclusion of participants from neighbourhoods with different land-use characteristics and street environments.

Stage 1: Selection of neighbourhoods

Neighbourhoods were purposively selected to reflect variations in urban land use, development patterns and environmental conditions. The selection considered three broad neighbourhood categories:

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- Residential neighbourhoods, characterised predominantly by housing and associated local streets.
- Commercial neighbourhoods, characterised by markets, business premises and relatively intensive human and vehicular activities.
- Mixed-use neighbourhoods, characterised by the combination of residential, commercial and other urban activities.

These seven neighbourhoods (Old GRA, Woji, Trans-Amadi, Diobu, Peter Odili Road corridor, Ada George and Obiri Ikwerre) were chosen because they represent the range of street environments in which residents of Port Harcourt commonly engage in street-based physical exercise.

Stage 2: Selection of streets and exercise routes

Within each selected neighbourhood, streets and routes commonly used for outdoor physical exercise were identified through preliminary reconnaissance and consultation with local users. Route selection considered accessibility, frequency of exercise activities, street connectivity, pedestrian infrastructure, traffic conditions and variations in environmental quality.

A total of fourteen (14) streets or exercise routes were selected for environmental assessment. Each route was assigned an identification code to facilitate field documentation, data organisation and subsequent analysis.

Stage 3: Recruitment of respondents

Eligible participants were recruited from the selected streets and exercise routes. Data collection was conducted at different periods of the day, including morning and evening exercise periods, to capture variations in exercise activities and street-use patterns.

Systematic recruitment involved identifying eligible exercisers at designated observation points and approaching them at predetermined intervals. Where a reliable estimate of the number of eligible exercisers was available, a sampling interval was established by dividing the estimated eligible population by the required number of respondents for the relevant location. A random starting point was selected, after which every eligible participant was approached. Where an approached individual declined participation or was ineligible, the next eligible individual was considered in accordance with the recruitment protocol.

The recruitment process continued across the selected neighbourhoods and routes until the target sample of 427 respondents was achieved. Only individuals who met the eligibility criteria and voluntarily consented to participate were administered the questionnaire.

3.6 Data Collection Instruments

Data were collected using two principal instruments: a structured questionnaire and an environmental observation checklist.

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3.6.1 Structured questionnaire

The questionnaire was designed to obtain quantitative information from participants and comprised the following sections:

Section	Information collected
A	Socio-demographic characteristics, including age, sex, educational attainment, occupation and neighbourhood of residence.
B	Physical exercise characteristics, including type, frequency, duration, time of exercise and preferred exercise locations.
C	Perceived environmental conditions, including road conditions, pedestrian infrastructure, traffic, drainage, sanitation and accessibility.
D	Environmental and safety risks, including traffic hazards, poor lighting, insecurity, flooding, air pollution and other environmental concerns.
E	Planning strategies for active living, including pedestrian walkways, street lighting, traffic-calming measures, green spaces and improved neighbourhood infrastructure.

3.6.2 Environmental observation checklist

A structured environmental observation checklist was developed to document the physical and environmental characteristics of selected exercise routes. The checklist covered five major assessment dimensions:

1. Traffic and transportation conditions.
2. Pedestrian infrastructure and accessibility.
3. Environmental quality and sanitation.
4. Safety and security conditions.
5. Urban planning and neighbourhood characteristics.

The checklist provided a standardised framework for documenting the presence, absence and condition of relevant environmental features along the selected routes.

3.7 Environmental Observation Procedure

Environmental observations were conducted along the selected streets and exercise routes to complement the questionnaire responses and provide direct evidence of the environmental conditions encountered by street-based exercisers.

A total of fourteen (14) exercise routes across seven (7) neighbourhoods were assessed. Each route was assigned a unique identification code, and observations were conducted using the same structured checklist to ensure consistency across locations.

The routes were assessed systematically from their designated starting points to their endpoints. Where routes were sufficiently long, they were divided into identifiable sections or observation

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segments to facilitate the recording of environmental conditions. The following indicators were documented:

Assessment dimension	Environmental indicators
Traffic and transportation	Traffic intensity, vehicular movement, pedestrian-vehicle conflict, road condition and availability of safe crossings.
Pedestrian infrastructure	Presence and condition of walkways, walkway obstructions, pedestrian accessibility and street connectivity.
Environmental quality	Waste accumulation, drainage condition, stagnant water, flooding evidence, visible air pollution sources and general environmental sanitation.
Safety and security	Street lighting, visibility, security infrastructure, abandoned spaces and other observable safety concerns.
Urban planning	Land-use compatibility, street layout, availability of open spaces, green infrastructure and integration of pedestrian facilities.

Each indicator was recorded according to its observed condition, using the predefined categories on the observation checklist. Photographic documentation and field notes were used, where applicable, to support the recording of environmental deficiencies and potential hazards.

To maintain consistency, observations were undertaken using the same assessment criteria across all selected routes. The findings were subsequently coded and organised according to neighbourhood, route and environmental assessment dimension.

3.8 Measurement Scales and Assessment of Environmental Risks

Environmental risks were assessed using information obtained from the structured questionnaire and direct field observations. The assessment covered five dimensions: traffic and transportation risks, pedestrian-infrastructure risks, environmental-quality risks, safety and security risks, and urban-planning risks.

3.8.1 Measurement of perceived environmental risks

Participants' perceptions of environmental risks were measured using a five-point Likert scale, with the following response categories:

Response category	Score
Very High Risk (VHR)	5
High Risk (HR)	4
Moderate Risk (MR)	3
Low Risk (LR)	2
Very Low Risk (VLR)	1

The mean score for each environmental risk indicator was computed using the formula:

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$$\bar{X} = \frac{\sum f\, x}{N}$$

where

- $\bar{X}$= mean response score,
- f= frequency of responses,
- x= assigned Likert-scale score, and
- N= total number of valid responses.

A decision threshold of 3.00 was adopted, corresponding to the midpoint of the five-point Likert scale:

$$\frac{5+4+3+2+1}{5} = 3.00.$$

Mean scores of 3.00 or higher were interpreted as indicating moderate-to-high perceived environmental risk, whereas scores below 3.00 indicated relatively low perceived risk.

3.8.2 Construction of the Environmental Risk Index

To obtain an overall assessment of perceived environmental risk, the mean scores of the indicators belonging to each risk dimension were first averaged to produce a dimension-level score:

$$ERI_j = \frac{\sum_{i=1}^{m} X_i}{m}$$

where

- ERI_j= environmental risk score for dimension j,
- X_i= mean score of indicator i, and
- m= number of indicators within dimension j.

The five dimension scores were then combined into a single overall environmental risk index (OERI):

$$OERI = \frac{ERI_1 + ERI_2 + ERI_3 + ERI_4 + ERI_5}{5}$$

where

- ERI_1= traffic and transportation risk,
- ERI_2= pedestrian-infrastructure risk,
- ERI_3= environmental-quality risk,
- ERI_4= safety and security risk, and

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- ERI_5= urban-planning risk.

The resulting index ranges from 1.00 to 5.00, with higher values indicating greater perceived environmental risk associated with street-based physical exercise.

3.9 Assessment of Planning Strategies for Active Living

Planning strategies for promoting active living were assessed using participants' responses to the structured questionnaire. The assessment examined the extent to which different urban planning and environmental improvement measures could enhance the safety, accessibility, convenience and attractiveness of neighbourhood streets for physical exercise.

The planning measures assessed included:

1. Provision and maintenance of pedestrian walkways.
2. Installation of safe pedestrian crossings and traffic-calming facilities.
3. Improvement of street lighting and neighbourhood security.
4. Provision of functional drainage and flood-control infrastructure.
5. Regular environmental sanitation and waste management.
6. Development of neighbourhood parks, green spaces and recreational facilities.
7. Improvement of street connectivity and pedestrian accessibility.
8. Integration of pedestrian and cycling infrastructure into urban development.
9. Appropriate land-use planning and control of incompatible activities.
10. Improvement of road surfaces and maintenance of neighbourhood streets.

Participants rated the importance of these measures using a five-point Likert scale:

Response	Score
Very Important	5
Important	4
Moderately Important	3
Less Important	2
Not Important	1

The mean score for each planning strategy was calculated, and a criterion mean of 3.00 was adopted. Strategies with mean scores of 3.00 and above were considered important planning interventions for promoting active living, while those below 3.00 were considered relatively less important.

The ranking of the mean scores was subsequently used to identify priority planning interventions based on participants' assessments.

3.10 Validity and Reliability of Research Instruments

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The questionnaire and environmental observation checklist were subjected to expert review to establish their content and face validity. The review considered the relevance, clarity and adequacy of the instruments in addressing the research objectives. Necessary modifications were made to improve the appropriateness and comprehensibility of the assessment items.

A pilot test was conducted among [insert number] eligible participants in a neighbourhood outside the selected study locations to identify ambiguities and assess the suitability of the questionnaire. Internal consistency was assessed using Cronbach's alpha coefficient, with a value of 0.70 or above considered acceptable.

For the environmental observation checklist, standardised assessment criteria were used to improve consistency in recording environmental conditions across the selected routes.

3.11 Data Analysis

Data obtained from the questionnaires and environmental observation checklists were coded, entered and analysed using IBM Statistical Package for the Social Sciences (SPSS), Version (25).

Descriptive statistics, including frequencies, percentages, means and standard deviations, were used to summarise respondents' socio-demographic characteristics, physical exercise patterns, perceived environmental risks and preferred planning strategies.

Mean scores were used to assess the relative importance of environmental risk indicators and proposed planning interventions. The overall environmental risk index was calculated from the five environmental risk dimensions.

Environmental observation findings were summarised using frequencies, percentages and descriptive comparisons across the selected neighbourhoods and exercise routes.

Where appropriate, inferential statistical techniques, including the chi-square test and correlation analysis, were employed to examine associations between participants' characteristics, physical exercise practices and perceived environmental risks. Statistical significance was established at $p < 0.05$.

Multiple linear regression analysis was employed to examine the predictive relationship between environmental risk indicators and the frequency of street-based physical exercise. Exercise frequency was specified as the dependent variable, while traffic risk, pedestrian-infrastructure risk, drainage and flooding risk, street-lighting risk and security risk were entered as explanatory variables. The model's explanatory power was assessed using the coefficient of determination (R^2), while individual predictors were evaluated using regression coefficients, t-statistics, confidence intervals and associated p-values.

3.12 Ethical Considerations

Participation in the study was voluntary. Participants were informed about the purpose of the research, and informed consent was obtained before questionnaire administration. Respondents'

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identities and personal information were treated confidentially, and collected data were used exclusively for academic research purposes. Environmental observations were conducted in public spaces without interfering with the normal activities of street users.

4 Results and Discussions

4.1 Response Rate and Socio-Demographic Characteristics of Respondents

Of the 427 questionnaires administered, 397 were validly completed and retrieved, representing a 93.0% response rate. As shown in Table 1, respondents aged 31–45 years constituted the largest group (39.3%), followed by those aged 18–30 years (35.8%), 46–60 years (19.6%) and above 60 years (5.3%). This age distribution is relevant because neighbourhood conditions may influence physical activity differently across age groups, particularly among older adults (Akosile et al., 2023; Oyeyemi et al., 2019).

Males accounted for 54.9% of respondents and females 45.1%. Regarding education, 37.3% held OND/NCE/HND qualifications, 28.2% had secondary education, 27.2% possessed university degrees or higher, while 7.3% had no formal or primary education. Occupationally, private-sector employees represented 25.7%, civil servants 23.7%, self-employed individuals and traders 22.4%, students 21.9%, and retired or unemployed respondents 6.3%.

Most participants (90.9%) were Port Harcourt residents, while 9.1% were non-residents, indicating that the findings largely reflect the experiences of individuals familiar with the study-area neighbourhoods. The inclusion of diverse population groups provides a useful basis for examining neighbourhood environmental conditions and physical activity, consistent with previous Nigerian studies (Odeyemi et al., 2023; Oyeyemi et al., 2019)..

Table 1: Socio-Demographic Characteristics of Respondents

Table 1: Socio-Demographic Characteristics of Respondents

Variables	Categories	Frequency	Percentage
Age	18–30years	142	35.8
	31–45years	156	39.3
	46–60years	78	19.6
	Above 60years	21	5.3
Gender	Male	218	54.9
	Female	179	45.1
Educational Level	No formal/Primary	29	7.3
	Secondary	112	28.2
	Tertiary (OND/NCE/HND)	148	37.3
	University degree and above	108	27.2
Occupation	Student	87	21.9
	Civil servant	94	23.7
	Private sector employee	102	25.7
	Self-employed/Trader	89	22.4
	Retired/Unemployed	25	6.3

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Residential Status	Resident in Port Harcourt	361	90.9
	Non-resident (visitor)	36	9.1

Researchers' Field Survey, 2026

4.2 Nature and Pattern of Street-Based Physical Exercise

Walking (42.3%) and jogging (31.2%) were the predominant forms of street-based exercise among respondents. Most participants exercised four to six times weekly (34.5%) or daily (22.4%), with 53.9% spending 30–60 minutes per session. Early morning was the most preferred period (51.1%). Notably, 47.1% used neighbourhood streets because of the absence of formal sports facilities, indicating that streets serve as important informal recreational spaces in Port Harcourt.

These findings align with Oyeyemi et al. (2019), who established associations between neighbourhood environmental characteristics and physical activity among older Nigerians. Adebusoye et al. (2022) similarly identified the relevance of built-environment characteristics to physical activity among African children and adolescents, while Abusaada and Elshater (2024) emphasised the importance of street design in promoting walking. Collectively, these studies demonstrate that participation in physical activity depends partly on the availability and suitability of neighbourhood environments. The reliance on streets for exercise therefore highlights the need to integrate pedestrian safety, environmental quality and recreational considerations into urban planning.

Table 2: Nature and Pattern of Street-Based Physical Exercise

Variables	Categories	Frequency	Percentage
Type of exercise	Walking	168	42.3
	Jogging	124	31.2
	Running	71	17.9
	Combination (walk + jog/run)	34	8.6
Frequency of exercise	Daily	89	22.4
	4–6 times per week	137	34.5
	2–3 times per week	126	31.7
	Once a week or less	45	11.3
Duration per session	Less than 30 minutes	78	19.6
	30–60 minutes	214	53.9
	More than 60 minutes	105	26.4
Exercise days per week (mean)	Mean = 4.1 days (SD = 1.6)	–	–
Preferred time of exercise	Early morning (5–8 a.m.)	203	51.1
	Evening (5–8 p.m.)	142	35.8
	Other times	52	13.1
Duration of participation	Less than 1 year	97	24.4
	1–3 years	156	39.3
	More than 3 years	144	36.3
Main reasons for using streets	Lack of formal sports facilities	187	47.1
	Convenience/proximity	142	35.8

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	Social interaction	41	10.3
	Cost-free	27	6.8

Researchers' Field Survey, 2026

4.3 Environmental Conditions and Perceived Risks Along Exercise Routes

The environmental assessment revealed substantial deficiencies along the selected exercise routes. Poor drainage was the most frequently observed problem (62%), followed by high traffic volume (59%), inadequate walkways (48%), waste accumulation (48%) and poor street lighting (47%). Flooding and perceived poor air quality were also reported. These conditions indicate that several neighbourhood streets lack the infrastructure and environmental quality required to support safe and comfortable outdoor exercise.

Respondents identified traffic-related hazards as their most prominent concerns, particularly high traffic volume and speeding (mean = 4.21), risk of being hit by vehicles (4.08) and inadequate pedestrian crossings (3.94). Other concerns included discontinuous walkways (3.87), poor drainage and flooding (3.81), inadequate lighting (3.76), deteriorated road surfaces (3.72) and obstruction of walkways by traders and vehicles (3.65).

The prominence of traffic hazards is consistent with Ogboeli et al. (2026), who identified roadside trading, traffic congestion and accident risks as interconnected public-space challenges in Port Harcourt. Such conditions may create conflicts between vehicular movement, commercial activities and pedestrian exercise, particularly where dedicated walkways are unavailable or obstructed. The findings also support Abusaada and Elshater's (2024) emphasis on pedestrian-oriented street design and Kouthouris et al.'s (2021) advocacy of environmentally responsive urban policies for active living.

Drainage, flooding and poor road surfaces further compromise route accessibility and may expose exercisers to slips and falls. Similarly, inadequate lighting may discourage outdoor activity during periods of reduced visibility. These concerns reflect Akosile et al. (2023), who highlighted the relevance of neighbourhood safety to physical activity and social participation among older adults in Nigeria. Overall, the findings demonstrate that exercise-route suitability depends on the combined provision of safe pedestrian infrastructure, effective drainage, environmental sanitation and adequate lighting.

Table 3: Observed Urban Environmental Conditions of Exercise Routes

Environmental Conditions	Good/Adequate	Fair/Moderate	Poor/Inadequate	Dominant Condition
Pedestrian walkway availability	18%	34%	48%	Poor
Road surface condition	22%	41%	37%	Fair
Traffic volume	12% (low)	29% (moderate)	59% (high)	High
Street lighting	15%	38%	47%	Poor
Drainage condition	11%	27%	62%	Poor
Waste accumulation	19%	33%	48%	Poor
Flooding incidence	21% (rare)	36% (occasional)	43% (frequent)	Frequent

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Perceived air quality	14%	42%	44%	Fair–Poor
Street connectivity	31%	45%	24%	Fair
Accessibility for pedestrians	20%	39%	41%	Fair–Poor
Security conditions	17%	48%	35%	Fair
Land use compatibility	28%	41%	31%	Fair

Researchers' Field Survey, 2026

4.4 Environmental Risk and Its Associations with Respondent Characteristics

Nearly half of the respondents (48.9%) experienced high perceived environmental risks, while 40.8% reported moderate risks and only 10.3% were classified as low-risk. The overall mean score of 3.68 indicates a high level of perceived risk associated with street-based exercise. This suggests that residents' use of neighbourhood streets for physical activity occurs within environments where safety and infrastructure deficiencies remain substantial concerns.

Chi-square analysis revealed significant associations between perceived environmental risk and age ($\chi^2 = 18.47$, $p = 0.005$), gender ($\chi^2 = 6.82$, $p = 0.033$), exercise frequency ($\chi^2 = 24.15$, $p = 0.001$), duration ($\chi^2 = 11.93$, $p = 0.018$) and exercise timing ($\chi^2 = 15.28$, $p = 0.004$). However, the type of exercise was not significantly associated with perceived risk ($\chi^2 = 9.64$, $p = 0.141$).

The age-related association is relevant to the findings of Akosile et al. (2023) and Oyeyemi et al. (2019), which demonstrate the importance of neighbourhood conditions for mobility and physical activity among older Nigerians. Differences by gender may reflect variations in how participants experience traffic exposure, lighting and personal security. Similarly, associations with exercise frequency, duration and timing suggest that perceptions of environmental risk vary across patterns of outdoor activity. However, these statistical relationships do not establish causation or indicate the direction of group differences. They nevertheless demonstrate the importance of considering the characteristics and activity patterns of different street users in neighbourhood planning.

Table 4: Respondents' Assessment of Perceived Environmental Risks

Risk Categories/Indicators	Mean	SD	Risk Level	Rank
Traffic and Transportation Risks				
High traffic volume and speeding vehicles	4.21	0.78	High	1
Risk of being hit by vehicles	4.08	0.85	High	2
Inadequate pedestrian crossings	3.94	0.91	High	3
Pedestrian-Infrastructure Risks				
Absence or discontinuous walkways	3.87	0.89	High	4
Poor road surface/potholes	3.72	0.94	High	5
Obstruction of walkways by traders/vehicles	3.65	0.97	High	6
Environmental-Quality Risks				
Poor drainage and flooding	3.81	0.92	High	7
Waste accumulation and dirty environment	3.58	1.01	High	8
Air pollution/dust/vehicle emissions	3.49	0.98	Moderate	9
Safety and Security Risks				

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Poor street lighting (especially evening)	3.76	0.96	High	10
Risk of crime/harassment	3.42	1.05	Moderate	11
Urban-Planning Risks				
Mixed-land use conflicts (residential/commercial)	3.31	1.02	Moderate	12
Poor street connectivity	3.18	1.08	Moderate	13

Researchers' Field Survey, 2026

4.5 Overall Environmental Risk Classification

Table 5 shows that 194 respondents (48.9%) experienced high perceived environmental risks during street-based exercise, while 162 (40.8%) reported moderate risks and 41 (10.3%) low risks. The overall mean score of 3.68 indicates a high level of perceived environmental risk. This finding suggests that neighbourhood streets in Port Harcourt present considerable environmental and infrastructural challenges for outdoor physical activity. It reinforces the importance of improving pedestrian facilities, traffic conditions, drainage, sanitation and neighbourhood safety. Similar concerns regarding neighbourhood environmental conditions and physical activity have been reported by Oyeyemi et al. (2019) and Akosile et al. (2023).

Table 5: Overall Environmental Risk Classification

Risk Level	Frequency	Percentage	Mean Score Range
Low risk	41	10.3	1.00–2.49
Moderate risk	162	40.8	2.50–3.49
High risk	194	48.9	3.50–5.00
Overall mean risk score	–	–	**3.68 (High)**

Researchers' Field Survey, 2026

4.6 Association between Respondents' Characteristics and Perceived Environmental Risks

The chi-square results in Table 6 reveal significant associations between perceived environmental risks and age ($\chi^2 = 18.47$, $p = 0.005$), gender ($\chi^2 = 6.82$, $p = 0.033$), exercise frequency ($\chi^2 = 24.15$, $p = 0.001$), exercise duration ($\chi^2 = 11.93$, $p = 0.018$) and exercise timing ($\chi^2 = 15.28$, $p = 0.004$). However, type of exercise was not significantly associated with perceived risk ($\chi^2 = 9.64$, $p = 0.141$).

These associations indicate that environmental risk perceptions vary across demographic groups and exercise patterns. Differences by age may reflect varying mobility and safety concerns, particularly among older adults, as highlighted by Akosile et al. (2023) and Oyeyemi et al. (2019). Similarly, exercise timing may influence the environmental conditions encountered, including traffic intensity, lighting and personal security. However, these findings establish associations rather than causal relationships or the direction of differences between respondent groups.

Table 6: Chi-Square Tests of Association between Respondents' Characteristics and Perceived Environmental Risks

Characteristics	χ^2	df	p-value	Decision ($\alpha = 0.05$)

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Age	18.47	6	0.005	Significant
Gender	6.82	2	0.033	Significant
Exercise frequency	24.15	6	0.001	Significant
Exercise duration	11.93	4	0.018	Significant
Type of exercise	9.64	6	0.141	Not significant
Time of exercise	15.28	4	0.004	Significant

Source: Researchers' Field Survey, 2026.

4.7 Relationship between Environmental Risks and Street-Based Physical Exercise

Table 7 indicates significant negative correlations between perceived environmental risk and exercise frequency ($r = -0.312$, $p < 0.001$), duration ($r = -0.267$, $p < 0.001$) and years of participation ($r = -0.184$, $p < 0.001$). Thus, respondents reporting higher environmental risks tended to exercise less frequently, spend less time exercising and report shorter periods of participation.

These relationships support Oyeyemi et al. (2019), who identified associations between neighbourhood environmental conditions and physical activity among older Nigerians. They also align with Abusaada and Elshater (2024), who emphasised the role of street design in promoting walking. Traffic hazards, inadequate walkways and flooding may therefore represent important constraints on sustained outdoor exercise. Nevertheless, the cross-sectional findings indicate associations and do not establish that environmental risks directly cause reduced participation.

Table 7: Pearson Product-Moment Correlation between Environmental Risks and Physical Exercise Characteristics

Table 7: Pearson Product-Moment Correlation

Variables Correlated	N	r	p-value	Decision
Overall environmental risk score × Exercise frequency	397	–0.312	0.000	Significant (negative)
Overall environmental risk score × Exercise duration	397	–0.267	0.000	Significant (negative)
Overall environmental risk score × Years of participation	397	–0.184	0.000	Significant (negative)

Source: Researchers' Field Survey, 2026.

4.8 Predictors of Street-Based Physical Exercise Frequency

The regression results in Table 8 show that the environmental risk indicators jointly explained 23.1% of the variation in exercise frequency ($R^2 = 0.231$; adjusted $R^2 = 0.221$). The overall model was statistically significant ($F = 23.47$, $p < 0.001$).

Traffic risk was the strongest negative predictor ($\beta = -0.248$, $p < 0.001$), followed by walkway infrastructure ($\beta = -0.187$, $p = 0.001$), drainage and flooding ($\beta = -0.152$, $p = 0.004$), and street lighting ($\beta = -0.119$, $p = 0.028$). Security risk was not statistically significant ($\beta = -0.084$, $p = 0.117$).

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The prominence of traffic risk is consistent with Ogboeli et al. (2026), who identified traffic congestion, roadside trading and accident risks as interconnected public-space challenges in Port Harcourt. The significant walkway-related result also reinforces Abusaada and Elshater's (2024) emphasis on pedestrian-oriented street design. Furthermore, the contributions of drainage and lighting highlight the importance of functional environmental infrastructure for accessible exercise routes. Collectively, the findings identify traffic management, pedestrian facilities, drainage and street lighting as priority areas for improving conditions for street-based exercise. The unexplained 76.9% of variation also indicates that other factors may contribute to exercise frequency.

Table 8: Multiple Linear Regression Analysis of Environmental Risk Predictors of Exercise Frequency

Model summary

Model Summary	Values
R	0.481
R^2	0.231
Adjusted R^2	0.221
F	23.47
p-value	0.000

Regression coefficients

Predictor Variables	β	t	p-value	95% CI
Traffic risk score	–0.248	–4.61	0.000	–0.312 to –0.141
Walkway infrastructure score	–0.187	–3.42	0.001	–0.241 to –0.078
Drainage/flooding risk	–0.152	–2.89	0.004	–0.198 to –0.047
Street lighting risk	–0.119	–2.21	0.028	–0.164 to –0.013
Security risk	–0.084	–1.57	0.117	–0.129 to 0.014

Source: Researchers' Field Survey, 2026

4.9 Respondents' Assessment of Planning Strategies for Promoting Active Living

As presented in Table 9, all ten proposed planning interventions recorded mean scores above the criterion value of 3.00, indicating their perceived importance. Continuous pedestrian walkways received the highest rating (Mean = 4.52, SD = 0.68), followed by traffic-calming measures (4.41 ± 0.74), improved street lighting (4.38 ± 0.71), safe pedestrian crossings (4.29 ± 0.79) and drainage improvement and flood control (4.25 ± 0.82). Other highly rated interventions included environmental sanitation (4.11 ± 0.87), green spaces and exercise parks (4.07 ± 0.91), improved street connectivity (3.94 ± 0.95), compatible land-use planning (3.82 ± 0.98) and dedicated active-transport infrastructure (3.76 ± 1.02).

The strong preference for pedestrian walkways, traffic calming and safe crossings reflects respondents' concerns about traffic exposure and inadequate pedestrian infrastructure. These priorities are consistent with Abusaada and Elshater (2024), who emphasised street design as a determinant of walking environments, and Kouthouris et al. (2021), who highlighted

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environmentally responsive urban policies for active living. The ratings for drainage, sanitation and recreational spaces further demonstrate that exercise-friendly planning should integrate transport infrastructure, environmental management and accessible recreation.

Table 9: Respondents' Assessment of Planning Strategies for Promoting Active Living

Planning Strategies	Mean	SD	Level of Importance
Provision of continuous pedestrian walkways	4.52	0.68	Very High
Traffic-calming measures (speed bumps)	4.41	0.74	Very High
Improved street lighting	4.38	0.71	Very High
Construction of safe pedestrian crossings	4.29	0.79	Very High
Drainage improvement and flood control	4.25	0.82	Very High
Regular environmental sanitation	4.11	0.87	High
Creation of green/open spaces and exercise parks	4.07	0.91	High
Improved street connectivity	3.94	0.95	High
Compatible land use planning	3.82	0.98	High
Dedicated active-transport infrastructure	3.76	1.02	High

Researchers' Field Survey, 2026

4.10 Ranking of Priority Planning Interventions

The ranking in Table 10 confirms that continuous pedestrian walkways were the foremost planning priority (Mean = 4.52), followed by traffic-calming measures (4.41) and improved street lighting (4.38). Safe pedestrian crossings (4.29) and drainage improvement and flood control (4.25) occupied the fourth and fifth positions, respectively. Environmental sanitation ranked sixth (4.11), followed by green spaces and exercise parks (4.07), street connectivity (3.94), compatible land-use planning (3.82) and dedicated active-transport infrastructure (3.76).

The ranking indicates that respondents placed greatest emphasis on interventions addressing immediate pedestrian safety, traffic exposure and environmental accessibility. These priorities are particularly relevant to Port Harcourt, where traffic and roadside activity have been identified as public-space challenges (Ogboeli et al., 2026). The results provide a basis for prioritising neighbourhood improvements, with pedestrian infrastructure, traffic management, lighting and drainage receiving particular attention.

Table 10: Ranked Priority Planning Measures

Rank	Planning Measures	Mean Score
1	Continuous pedestrian walkways	4.52
2	Traffic-calming measures	4.41
3	Improved street lighting	4.38
4	Safe pedestrian crossings	4.29
5	Drainage improvement and flood control	4.25
6	Environmental sanitation	4.11
7	Green/open spaces and exercise parks	4.07

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8	Improved street connectivity	3.94
9	Compatible land use planning	3.82
10	Dedicated active-transport infrastructure	3.76

Researchers' Field Survey, 2026

4.11 Relationship between Environmental Risks and Planning Strategies for Active Living

The correlation results in Table 11 reveal a significant positive relationship between perceived environmental risk and the importance attached to planning strategies ($r = 0.426$, $p < 0.001$). Respondents reporting higher environmental risks therefore tended to assign greater importance to proposed interventions for improving neighbourhood safety, accessibility and environmental quality.

This relationship suggests that residents' experiences of environmental deficiencies are relevant to determining local planning priorities. It also reinforces the value of participatory environmental assessment in identifying neighbourhood needs, consistent with Odeyemi et al. (2023). Accordingly, planning interventions in Port Harcourt should respond to identified local conditions, particularly inadequate walkways, traffic hazards, poor lighting and drainage deficiencies, rather than relying solely on uniform city-wide interventions.

Table 11: Pearson Correlation between Overall Environmental Risk and Planning Strategy Importance

Variables	N	r	p-value	Decision
Overall environmental risk × Overall planning strategy importance	397	0.426	0.000	Significant (positive)

4.12 Summary of Major Findings

The study assessed environmental and safety risks associated with street-based physical exercise and identified planning interventions for promoting active living in Port Harcourt. The major findings are summarised as follows:

1. Walking (42.3%) and jogging (31.2%) were the predominant forms of street-based physical exercise, while participants exercised an average of 4.1 days per week.
2. The absence of formal sports facilities (47.1%) and convenience or proximity (35.8%) were the leading reasons for using neighbourhood streets for physical exercise.
3. Environmental observations identified substantial deficiencies in drainage conditions (62% poor), traffic conditions (59% high), pedestrian walkway availability (48% poor), waste accumulation (48% poor) and street lighting (47% poor).
4. High traffic volume and speeding vehicles constituted the highest-rated perceived environmental risk (Mean = 4.21), followed by the risk of being hit by vehicles (Mean = 4.08).

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5. The overall perceived environmental risk score was reported as 3.68, with 48.9% of respondents classified within the high-risk category and 40.8% within the moderate-risk category.
6. Age, gender, exercise frequency, exercise duration and time of exercise demonstrated statistically significant associations with perceived environmental risks, while exercise type did not.
7. Overall environmental risk demonstrated significant negative relationships with exercise frequency ($r = -0.312$), exercise duration ($r = -0.267$) and years of participation ($r = -0.184$).
8. Regression analysis identified traffic risk, pedestrian walkway deficiencies, drainage and flooding, and inadequate street lighting as statistically significant negative predictors of exercise frequency. The model explained 23.1% of the variation in exercise frequency.
9. Continuous pedestrian walkways (Mean = 4.52), traffic-calming measures (Mean = 4.41), improved street lighting (Mean = 4.38), safe pedestrian crossings (Mean = 4.29) and drainage improvement (Mean = 4.25) emerged as the highest-ranked planning interventions.
10. Overall environmental risk demonstrated a significant positive relationship with the importance attached to planning strategies ($r = 0.426$), suggesting that respondents reporting greater environmental risks also expressed stronger support for environmental and infrastructural improvements.

Conclusion

Urban planning provides the foundation for quality liveability in urban area. The design and provision of neighbourhood infrastructure encourage street-based physical activity and enhance residents' active liveability and reduce risks during engagement of physical exercises in the street and within the neighbourhood of residents. The study found there are various forms physical exercises that residents partake in the streets of their neighbourhoods mostly walking, jogging and running which is carried out at least 4-6 times per week. Some negative environmental conditions and concerns affecting physical exercise in the neighbourhoods include drainage condition, pedestrian walkway availability, waste accumulation, street lighting, traffic volume, flooding incidents, road surface condition, street connectivity, security conditions and land use compatibility. These conditions have caused traffic and transportation risks, pedestrian-infrastructure risks, environmental-quality risks, and safety and security risks because of non-adherence to urban planning regulations, affecting residents' active liveability and wellbeing. The study findings raise concerns that need to be addressed to promote street-based physical activity, improve residents' quality of life, and sustainably enhance urban liveability.

Recommendations

Thus, to address the findings of the study, the following recommendations are suggested, including:

i. In the neighbourhoods, various forms of street-based activity should be encouraged for residents to partake in them to increase social bond and cohesion to improve active liveability, since most neighborhoods lack formal physical exercise facilities in the study area;
ii. The streets should be provided with all necessary street facilities such as pedestrian walkway, cycle lane and street light which is separated from carriageway to improve

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residents' accessibility, security and safety, social benefits, and financial concerns during engaging in such activities in the study area;

iii. Residents that are involved street-based physical exercise should be advised that to engage in such activities during the early and late hours of the day to avert traffic and transportation risks in the study area;

iv. Other road safety devices should be provided along the streets such as traffic-calming measures (speed bumps) and drainages to improve safety and flood control in the streets that disturb street-based physical activity in the neighbourhoods; and

v. Open and green spaces should be provided in the neighbourhoods to enhance residents' engagement in physical exercise to improve liveability, quality of life and wellbeing in the neighbourhoods.

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