

Article

The Impact of the Built Environment on Urban Residents' Physical Activity in Tropical Coastal Regions

Liwei Zhu , Lin Jiang  and Yilin Jiang 

School of Civil Engineering and Architecture, Hainan University, Haikou 570228, China; 996146@hainanu.edu.cn (L.J.); 995044@hainanu.edu.cn (Y.J.)

* Correspondence: 996057@hainanu.edu.cn

Abstract

This study aims to analyze how the built environment influences urban residents' physical activity in tropical coastal regions, and to identify the relative weights of key environmental factors. Through semi-structured interviews with 31 residents in Hainan, China, and qualitative analysis using NVivo 14, five core categories influencing physical activity were identified. A conceptual model with the built environment as its central node was then developed to elucidate the interrelationships among these categories. To further weight the sub-categories, a follow-up Analytic Hierarchy Process survey was conducted with 12 experts. Integrating the two stages, it was found that the safety and site conditions are prerequisite conditions to ensure residents' physical activity. On this basis, residents have the strongest perception of the incentive effect of site conditions and landscape. The findings provide a theoretical basis and practical reference for systematically evaluating the impact of the built environment on residents' health and well-being, and offer guidance for planning and designing health-promoting places in tropical regions.

Keywords: tropical coastal city; built environment; physical activity; health-supporting environment; climate-adaptive design



Academic Editor: Yung Yau

Received: 7 October 2025

Revised: 23 November 2025

Accepted: 25 November 2025

Published: 26 November 2025

Citation: Zhu, L.; Jiang, L.; Jiang, Y. The Impact of the Built Environment on Urban Residents' Physical Activity in Tropical Coastal Regions. *Buildings* **2025**, *15*, 4289. <https://doi.org/10.3390/buildings15234289>

Copyright: © 2025 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Resident health is a core component of public well-being. Substantial evidence confirms a significant positive correlation between the frequency and quality of physical activity (PA) and residents' overall health. According to the recommendations from the World Health Organization (WHO), adolescents should engage in at least 60 min of moderate-to-vigorous PA daily, while adults should complete 150 to 300 min of moderate-intensity activity per week [1]. However, the 2024 WHO report shows that approximately 80% of adolescents and 31% of adults globally fail to meet these targets [2]. Physical inactivity has thus become a critical public health issue, contributing to approximately 5.3 million deaths annually from non-communicable diseases, such as cardiovascular diseases, cancers, obesity, and diabetes [3].

Under this background, how to effectively promote PA has become a key focus in academic research. Existing studies indicate that, beyond individual factors such as age, gender and health status, external factors including the social and built environment also exert a significant influence on PA behaviors [4]. Therefore, systematically analyzing the mechanisms through which the environment interacts with PA is essential for improving public health.

In studies related to the built environment, attention has been paid to specific functional environmental areas, such as residential and housing areas [5], campuses [6], and workplaces [7]. A large body of studies shows that factors in the built environment, such as destination accessibility [8], street connectivity [9], environmental quality [10], green landscapes [11], aesthetic characteristics, and safety [12], are all considered to be associated with daily PA levels. From a behavioral perspective, the built environment enhances autonomy [13], expands activity opportunities [14] and specifically fosters walking and cycling [15], leisure activities [16], and moderate-to-vigorous physical activity [17].

In tropical regions, a lot of evidence indicating that extreme climate conditions have an obvious inhibition on PA [18]. High temperature is widely reported as the primary factor hindering outdoor activity, especially in summer when residents reduce outdoor activity frequency and shift to indoor sedentary behavior [19]. Exercising in high ambient temperatures raises the risk of heat stroke and heat exhaustion. Intense solar radiation also increases the difficulty of engaging in physical activity. The public has concerns about potential skin sunburn and even skin cancer resulting from outdoor walking [20]. Residents therefore tend to limit outdoor activities to short distances within 15 min, and schedule activity in the cooler early morning or evening. The participation rate from noon to mid-afternoon is significantly lower than in temperate regions [21]. One study further indicates that, in tropical settings, the built environment, microclimate design, health awareness, and self-efficacy are the key influencing factors for promoting PA [22]. Moreover, due to the differences in climate, residents' attitudes towards safety, accessibility, landscape, and some other environmental factors diverge from the findings in temperate regions [21].

In tropical coastal areas, the compound climatic stressors of high temperature, high humidity, strong winds and heavy precipitation substantially increase the barriers to residents' outdoor physical activity. High humidity impedes sweat evaporation, exacerbating thermal discomfort and leading residents to shorten or cancel even low-intensity activities [23]. Wind and rain introduce safety concerns and disrupt physical activities, further complicating the situation.

Owing to distinctive climatic conditions, socio-cultural contexts and environmental tolerance formed by residents' long-term habitation, tropical coastal regions may display significant differences in the impact mechanism of the built environment on residents' PA compared with temperate or inland regions. Countries such as Singapore and Malaysia have accumulated abundant findings on the impact of the built environment on specific population groups [24,25] or specific spatial settings [26]. These studies have clearly demonstrated how certain distinctive built-environment attributes affect specific population groups, establishing their link to physical activity. In China, however, relevant findings remain insufficient in this domain.

Based on this, this study focuses on the following core research questions: (1) Within the constraints imposed by China's tropical coastal setting, what are the key built environment elements affecting residents' physical activity? (2) Theoretically, how does the built environment function within the broader causal chain linking climate, social context and PA when these external factors are treated as moderators? (3) Among the full set of potential built environment elements, which exert relatively strongest impacts on PA?

Therefore, this study selects Hainan Island of China which is entirely located in the tropical region as the research location, to expand the regional research spectrum of built environment-PA research. It systematically sorts out and analyzes the built environment elements affecting physical activity in China's tropical coastal regions. and integrates climate and socio-cultural factors to construct a multi-factor environmental framework tailored to this context. By quantifying the relative influence of individual environmental

elements, the study provides guidance for health-oriented urban planning and design, enabling practitioners to prioritize interventions when resources are limited.

2. Materials and Methods

This study mainly went through three phases (see Figure 1). The first phase was data collection, during which raw data were obtained through semi-structured interviews and online data collection. In the second phase, guided by grounded theory, the collected materials were systematically coded to construct a theoretical framework consisting of core categories and their subcategories. In addition, categories pertaining to the built environment were further explored to assign index weights. At last, the results were synthesized and interpreted, leading to the final research conclusions.

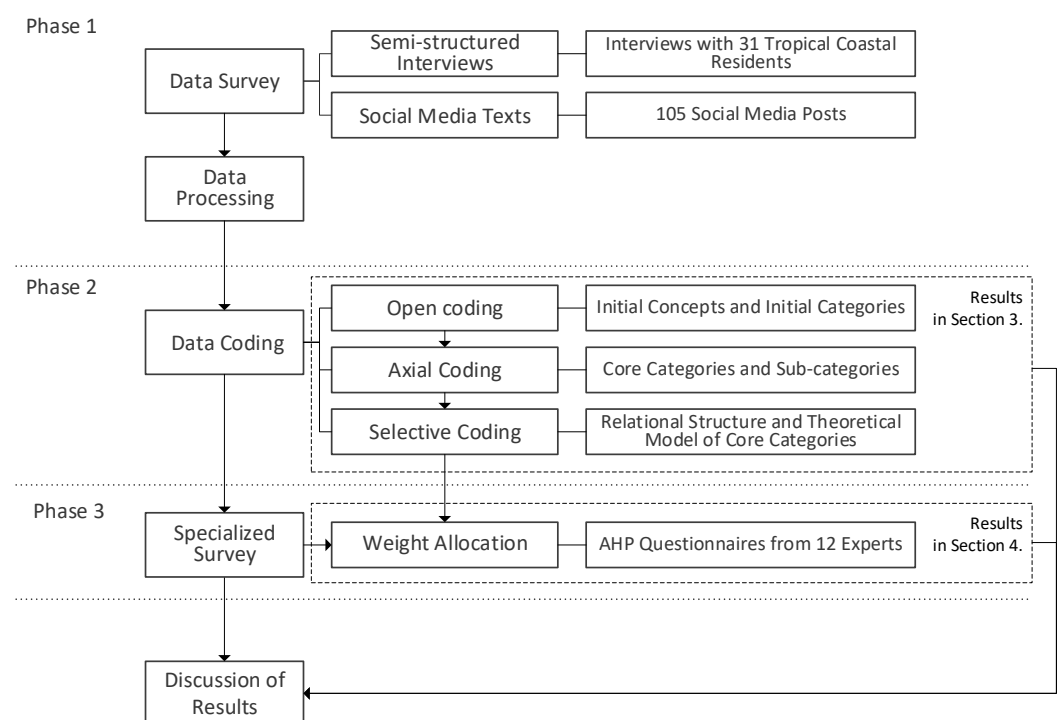


Figure 1. Schematic diagram of the research process.

2.1. Research Location and Climate Context

This study focuses on Hainan Island, China, geographically located between 18°10'–20°10' N and 108°37'–111°03' E (see Figure 2). The region has a typical tropical monsoon-influenced marine climate, characterized by:

- mean annual air temperature 24.9 °C;
- annual sunshine duration 1780–2600 h;
- total annual solar radiation 4500–5800 MJ/m²;
- mean annual precipitation 1500–2500 mm.

Extreme high temperatures (reaching 36.0–39.0 °C) typically occur between April and July, while extreme low temperatures (mostly 6–8 °C) are commonly recorded in January [27].

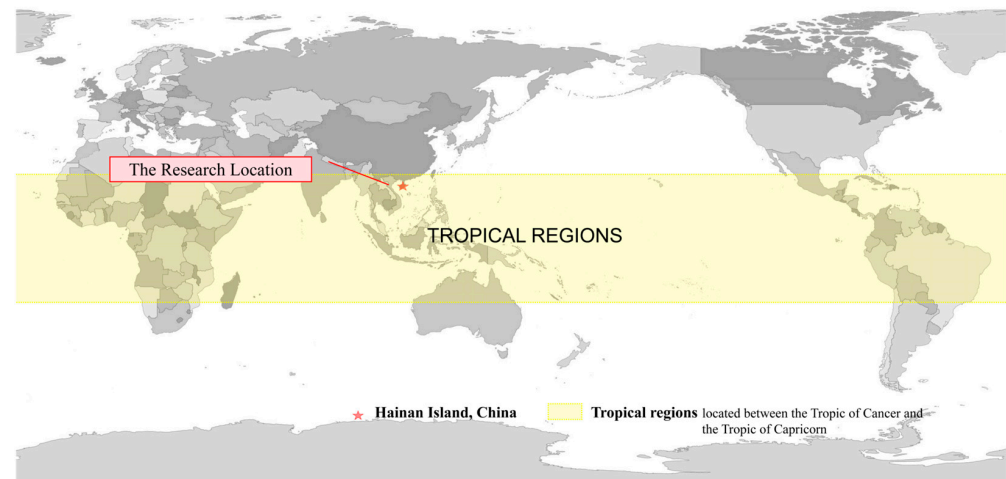


Figure 2. Schematic diagram of the research location (Hainan Island, China). (The world map is sourced from the Standard Map Service Website of the Ministry of Natural Resources, PRC, with the map review number GS (2016) 1664).

2.2. Data Sources

The data were obtained from the following two complementary approaches:

1. Semi-structured interviews

Thirty-one residents living in tropical coastal cities of Hainan Province were interviewed. All respondents had resided in their current communities for more than 3 years and were recruited from four geographically distributed cities: Sanya (south), Haikou (north), Wenchang (east) and Danzhou (west). Within each city, respondents were purposively selected to cover the three dominant local built-environment types: gated communities, non-gated communities and independent residential compounds. Individual participants were then identified by combining random selection with snowball referrals. Interviews lasted 25 to 50 min, were audio-recorded and subsequently transcribed verbatim.

To ensure sample representativeness and effectively control potential biases arising from age and gender perspectives, this study adopted a stratified sampling strategy for theoretical saturation interviews that excluded children and the older-old (≥ 75). The target population was restricted to: young adults (18–44 years old), middle-aged adults (45–59 years old), and young elderly adults (60–74 years old). Calculations based on data from China’s 7th National Population Census [28] show that the proportional structure of young adults, middle-aged adults, and young elderly adults in Hainan Province is approximately 5.8:2.8:1.3. Accordingly, this study set the corresponding proportional composition of interview groups for feasibility as young adults: middle-aged adults: young elderly adults $\approx 6:3:1$. Given the gender ratio of approximately 5.3:4.7, this study designated 5 males and 5 females in each interview group (i.e., 10 respondents per group).

Interviews were conducted continuously in accordance with the above stratified proportions until theoretical saturation was achieved—new interview content could no longer provide additional key information or themes. Preliminary saturation was reached after completing the third group. To better align with the actual population age structure, one additional young-old male was added in a supplementary set. The age structure and gender ratio of the final sample were basically consistent with the preset sampling framework, and the detailed demographic characteristics of the interviewees are shown in Table 1.

Table 1. Demographic profile of the interview sample ($n = 31$).

Demographic Characteristics		Number
Gender	Male	16
	Female	15
Age Group	Young Adults	18
	Middle-Aged Adults	9
	Elderly Adults	4

2. Online User-Generated Content

To triangulate interview findings with naturally occurring public discourse, 105 valid experience narratives from the Chinese social-media platform Xiaohongshu (RED) were extracted. Posts were located within Hainan Province and retrieved with the keywords such as “healthy exercise” and “daily outdoor activities”. After manual screening to remove advertisements and irrelevant material, the retained texts were used to check for group-level meanings or themes not voiced in the interviews. Due to the random nature of online text acquisition, it was difficult to systematically collect the demographic information of the posters. Therefore, no separate demographic statistical analysis was conducted on these supplementary data sources, and the analysis focused on the content-level perspectives expressed.

2.3. Research Methods

The core objective of this study is to structure textual data through hierarchical coding. The study follows the coding theory proposed by Strauss and conducts open coding, axial coding, and selective coding in sequence. The coding work is mainly completed in NVivo 14, with Excel used for ancillary tabulation.

Specifically, the study first commenced with open coding. It disassembled the original statements into discrete semantic units of cognition, behaviors, and environmental characteristics, and other additional elements, then named them with conceptual phrases. On this basis, through axial coding, concepts with similar meanings were clustered to form categories with distinct themes. Subsequently, in the selective coding stage, the relationships among various categories were systematically sorted out to identify the core category that governs the overall structure.

After clarifying the core category and the subsidiary categories, the study proceeded to design an expert consultation questionnaire. Experts in the field were invited to conduct pairwise comparisons and assign values to the relevant indicators. The Analytic Hierarchy Process (AHP) was used to conduct a quantitative analysis of the weights of multi-level indicators under the core category.

2.4. Research Quality Control

During the data coding phase, this study adopted a multi-coder and multi-round coding process to enhance the saturation and validity of the research results. First, 26 interview records and 90 social media posts were randomly selected from the collected textual materials for coding analysis, while reserving 5 records and 15 posts exclusively for saturation testing.

At the beginning of the research, Researcher A carried out open coding on the analysis samples, disassembling and refining the text data into specific concepts. Subsequently, Researcher B and Researcher A engaged in a two-person discussion regarding the results of the open coding, jointly reviewing and precisely defining the meanings of each initial code. Based on the precise definition, Researcher A continued to perform axial coding, aggregat-

ing relevant initial concepts to form higher-level categories. Researcher C independently coded the reserved saturation testing samples (accounting for approximately 15% of the original samples). By comparing the coding results with the previously formed concept and category system, no new concepts or categories were identified. The consistency of the coding was verified with a Kappa value of 0.88, indicating a high level of consistency. Then, it was confirmed that the coding system constructed in this study had reached theoretical saturation. Finally, all three researchers participated in a group discussion, conducting an in-depth analysis of the internal logical relationships among the established core categories and constructing the theoretical model of this study accordingly.

3. Coding and Analysis Results

3.1. Open Coding

Open coding consisted of a sentence-by-sentence analysis of raw textual data to extract initial concepts and categories. Drawing on the interview transcripts and the online posts, this study comprehensively extracted the conceptual content related to PA of urban residents in tropical coastal context. To limit researcher bias, the original sentences of the respondents were used as much as possible to construct the initial concepts, and initial categories that could truly reflect the data information and the relationships between concepts were refined accordingly. Through constant comparison, these codes were grouped into 84 initial concepts, which were further clustered into 34 preliminary categories (Table 2).

Table 2. Initial concepts and categories generated through open coding.

Initial Category	Initial Concept	
Weather factors	a1	Wind
	a2	Rain
Thermal factors	a3	Temperature influence
	a4	Humidity influence
	a5	Sun exposure influence
Air quality	a6	Air cleanliness
	a7	Odor
Size and scale	a8	Site size
	a9	Open space
Site management	a10	Sanitation management
	a11	Standing water treatment
	a12	Charging model
Acoustic conditions	a13	Noise
	a14	Insect and bird chirping
	a15	Background music
Thermal comfort measures	a16	Shade facilities
	a17	Ventilation conditions
	a18	Cooling device
Site function	a19	Dedicated site
	a20	Multifunctional site
Lighting conditions	a21	Venue lighting
	a22	Street lights
Distance	a23	Vertical distance from upper floors to the ground
	a24	Horizontal distance between the site and residences

Table 2. Cont.

Initial Category		Initial Concept
Path and traffic barriers	a25	Convenience of vehicle parking
	a26	Accessibility for disabilities
	a27	Pathway accessibility
Site visibility	a28	Entrance and signage
	a29	Site information availability
Activity facilities	a30	Number of facilities
	a31	Facility function matching
	a32	Facility status
Auxiliary facilities	a33	Medical and first aid
	a34	Sanitation and changing facilities
	a35	Rest and supply
Sight and supervision	a36	Visual blind spots
	a37	Remote and unattended areas
Vector and animal control	a38	Unsupervised pets
	a39	Mosquitoes and other insects
	a40	Wildlife
Hardware safety	a41	Site pavement
	a42	Traffic organization
	a43	Personnel management
Natural landscape	a44	Sky view
	a45	Waterscape
	a46	Plant landscape
Artificial landscape	a47	Urban form and architecture
	a48	Landscape ornaments
Commercial facilities	a49	Go shopping
	a50	Catering
Daily support facilities	a51	Express delivery station
	a52	Charging station
Social interaction	a53	Parent–child interaction
	a54	Companion care for the elderly
	a55	Pet interaction
	a56	Neighborhood social interaction
Group atmosphere	a57	Crowd matching
	a58	Atmosphere
Social visibility	a59	Observing others' activities
	a60	Being noticed
Organized activities	a61	Course organization
	a62	Community activities
Moderate-to-vigorous physical activity	a63	Ball games
	a64	Equipment-based exercises
	a65	Track-based activities
Light-intensity physical activity	a66	Walking
	a67	Gymnastic exercises
Activity time	a68	Seasonal time
	a69	Time interval
Activity frequency	a70	Fixed frequency
	a71	Occasional activities
Activity duration	a72	Duration
	a73	Activity disruption
Positive willingness	a74	Willing to engage in physical activity
	a75	Promoting willingness

Table 2. *Cont.*

Initial Category		Initial Concept
Negative willingness	a76	Not willing to participate in physical activity
	a77	Inhibiting willingness
Single motivation	a78	Keep health
	a79	Rehabilitation exercise
	a80	Reduce weight
	a81	Emotional need
Composite motivation	a82	Activities of daily living
	a83	Appreciate the scenery
	a84	Join social/community activities

Examples and extracts of detailed original statements are listed in the Supplementary Materials due to space constraints.

3.2. Axial Coding

In axial coding, clustering analysis was primarily employed to integrate initial categories. Centered around the context of PA among tropical urban residents, conceptual threads across different dimensions were gradually condensed and formed. Specifically, this study focuses on exploring the characteristics and underlying motivations of urban residents' PA in tropical coastal settings, and analyzes how these factors interact with the external site conditions and the socio-cultural atmospheres. Following this approach, this study synthesized the 34 initial categories obtained through open coding, ultimately resulting in the formation of 5 core categories and 13 subcategories (see Table 3).

Table 3. Core categories and subcategories derived from axial coding.

Core Category		Subcategory	Initial Category
C1	Climate conditions	B1	Weather factors
		B2	A1 Weather factors
			A2 Thermal factors
C2	Activity pattern	B3	A3 Air quality
			A4 Moderate-to-vigorous physical activity
		B4	A5 Light-intensity physical activity
			A6 Activity time
			A7 Activity frequency
			A8 Duration
C3	Built environment	B5	A9 Size and scale
			A10 Site function
			A11 Lighting conditions
			A12 Thermal comfort conditions
			A13 Acoustic conditions
			A14 Site management
		B6	A15 Activity facilities
			A16 Auxiliary facilities

Table 3. *Cont.*

Core Category		Subcategory	Initial Category	
C3	Built environment	B7	Accessibility	A17 Distance
				A18 Path and traffic barriers
				A19 Site visibility
		B8	Safety	A20 Hardware safety
				A21 Vector and animal control
				A22 Sight and supervision
		B9	Landscape and surroundings	A23 Natural landscape
				A24 Artificial landscape
		B10	Public facilities	A25 Commercial facilities
				A26 Daily support facilities
C4	Public and social environment	B11	Social factors	A27 Social interaction
				A28 Group atmosphere
				A29 Social visibility
				A30 Organized activities
C5	Activity intention	B12	Activity motivation	A31 Single motivation
				A32 Composite motivation
		B13	Activity willingness	A33 Positive willingness
				A34 Negative willingness

3.3. Selective Coding

During the selective coding phase, this study conducted a systematic analysis of the core categories and refined the internal relationships among them by constructing narrative threads. Focusing on the impact of the built environment in tropical regions on residents' willingness and patterns of physical activity, and taking the built environment as the narrative starting point, influencing factor or outcome, the study delineated 6 lines of the relation among the core categories (see Table 4).

1. The direct effect of the built environment on residents' intentions

The Fogg Behavior Model suggests that for behavioral intention to translate into actual behavior, three conditions must be met: motivation, ability, and prompts. Residents' perception and psychological evaluation of the built environment serve as critical variables affecting the fluctuation of willingness precisely by supporting these three conditions.

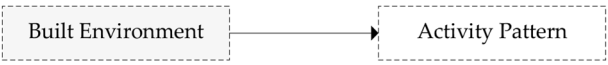
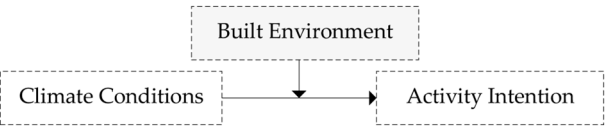
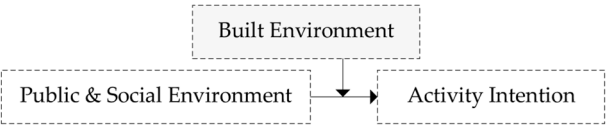
First, the built environment inspires residents' PA motivation by fulfilling their psychological and functional needs. For instance, some respondents mentioned that fitness areas with good equipment, attractive pocket parks, and lively community spots match their goals for health, enjoyment, and social belonging, which boosts their motivation for PA.

Second, the built environment supports residents' PA ability by reducing the barriers for activity. For instance, walk-friendly streets with big sidewalks and no barriers reduce the physical costs of walking, which makes it easier for the older adults to move around. Similarly, user-friendly fitness equipment with clear instructions reduces the complexity for users to engage the activity with it. On the other hand, poor planning sites with obstacles or detours, may inhibit residents' willingness to travel, especially for those with moving difficulties.

Thirdly, the built environment provides prompts for PA through physical visibility of spaces or facilities. For instance, guidance signs in parks, marks on fitness paths, and community boards can remind residents to participate in PA, helping with “forgetting” or “missing prompts to start acting”.

The built environment does more than just serve as a background, rather, it plays an active role by encouraging resident to be active, making it easier to join in activities, and giving signals to start. This direct influence is important for how people plan their activities.

Table 4. Typical relational structure of the core categories.

Typical Relational Structure		Connotation
1		The direct effect of built environment on residents' intentions
2		The shaping effect of the built environment on residents' activity patterns
3		The adaptive regulation of built environment to tropical climatic conditions
4		The coordinated regulation of built environment on public and social environment
5		The demand response of built environment to activity patterns driven by the tropical climate
6		The demand response of built environment to activity patterns driven by public and social environments

2. Shaping effect of the built environment on residents' activity patterns

The built environment serves as the physical foundation for residents' PA. Its spatial layout, facility configuration and environmental conditions lead to what activities residents can do, thus objectively shaping their daily activity patterns. This effect shows across multiple dimensions, including the PA type, timing, and volume.

At first, the facilities and spaces within the built environment directly determines the range of residents' PA options. Some respondents reported that they would stop working out if there were no places close by that fit their exercise needs. This leads to a homogenization of residents' activities and may even push them toward sedentary behaviors. On the other hand, there is a respondent who indicated that the new basketball court built nearby allowed him to pick up the habit of playing basketball. This can be seen that the built environment has a guiding effect on people's choice of activities.

Furthermore, the built environment also affects the frequency and duration of residents' activities. A respondents said her outdoor physical activity increased after her family moved to places with better site conditions and safer areas. In addition, the landscape quality and the access to auxiliary facilities are often considered to be helpful with extending activity duration.

In conclusion, poor-designed built environment restricts the options, duration, and volume of PA, while well-organized planning may help people develop better PA habits.

3. The adaptive regulation of built environment to tropical climatic conditions

In the responses, the climatic impacts were the most widely mentioned. On one hand, the extreme climatic conditions, such as high temperatures, intense sunlight, heavy rains, and strong winds, were mentioned with inhibitory effect on physical activity. On the other hand, the mild and pleasant winter climate in tropical coastal regions was considered as the advantage that increased residents' willingness to engage in outdoor PA.

When dealing with extreme climates, the respondents reported that they usually gave up physical activities or stayed inside with air conditioning. Sometimes, they chose specific outdoor or semi-outdoor spaces for their activities. These spaces were often described as being capable of effectively mitigating the effects of adverse weather conditions. For example, during a hot summer day, one might choose to play badminton on the stilt floor of a building, or practice Tai Chi in a pavilion. In addition, in respondents' descriptions, the natural shaded environments formed by large-leaved arbor trees was also a frequently visited activity area. Furthermore, some facilities with specific climate adaptation functions, such as shading facilities and spray cooling systems, have also received high praise.

From the statements of the respondents, it can be concluded that although the tropical climate itself may limit residents' willingness to engage in physical activities, a well-designed built environment can effectively mitigate these effects.

4. The coordinated regulation of built environment on public and social environment

The public and social environment forms the psychological basis for residents' PA intention. Some respondents reported that the regular organization of collective sports activities and the assignment of professional social sports instructors provide them with incentives to engage in PA. At the social relations level, mutual support among neighbors and the sense of belonging derived from an acquaintance-based society are key to strengthening activity motivation. At the social atmosphere level, active promotion of group norms such as "sports are glorious" can encourage participation through conformity. In contrast, if a prevailing trend of "sedentary lifestyle" and "neglect of exercise" exists, or if there are negative group behaviors such as occupation of activity spaces or disruption of sports activities, this will directly dampen residents' willingness to participate.

From the respondents' remarks, the facilitating role of the built environment can be identified. For instance, some respondents mentioned that seeing people playing badminton on their way home from work made them think they could also take their children to play for a while. Similarly, some others mentioned that the lively atmosphere of the square dancing in nearby venues can bring a sense of vitality, thereby encouraging them to participate. From the perspective of the participants, a respondent stated that when he was exercising in the skateboarding area of a small park, attracting onlookers and generating the interest gave them a sense of achievement. In these descriptions, the visibility of these sites has become a favorable factor for fostering an active community atmosphere.

On the other side, the built environment also plays a role in isolating the population and preventing conflicts. For example, some respondents mentioned that there might be interference from other activities during their exercise sessions, such as the noise from square dancing and the potential risks of accidental injuries caused by running children. These could be mitigated or eliminated by setting up diverse activity areas separated by green buffer zones or sound barriers. In addition, setting up clear usage rules indicated by signs near the activity area, or supplementing with basic monitoring measures, can also help regulate behavior, prevent vandalism or disruptions to the activities.

5. Built environment responding to the activity patterns driven by the tropical climate

The respondents who have lived in the tropical coastal regions for a long time developed adaptive PA patterns to cope with the high temperatures, intense solar radiation, high humidity, and frequent short-duration heavy rainfall. According to the statements of some respondents with different regional living experiences, these patterns show distinct regional adaptability characteristics in terms of activity types, time arrangements, and duration. These characteristics, in turn, have generated specific functional and experiential requirements for the built environment.

The results show that in terms of activity types, most residents tend to take moderate-to-low-intensity activities such as walking, gentle square dancing, and Tai Chi. Their preferences enable them to avoid the discomfort and risk of heatstroke associated with vigorous exercise in hot environments. Meanwhile, water-based activities such as swimming are also very popular among local residents, as they offer the dual benefits of cooling and exercising. Additionally, to avoid prolonged exposure to the outdoors, people also choose to combine physical activities with daily routines. For instance, walking to pick up packages or go shopping, which integrate physical activities into daily life without special planning, thus allows for an increase in physical activity during fragmented time periods.

From the perspective of the timing of the activities, to avoid the midday heat and intense sunlight, the tropical residents' activities peak from dawn to early morning and dusk to late evening. These periods offer a more comfortable outdoor environment with lower solar altitude and 3–5 °C lower temperature. At midday, extreme heat and strong sunlight forced most activities into air-conditioned indoor settings. Several respondents mentioned that they prefer to conduct their activities at evening, and therefore have higher requirements for the lighting of the venue. Dim or uneven lighting could hinder the progress of their activities. In addition, the rainy season further narrows the time window for outdoor activities. Frequent rainfall makes residents' outdoor physical activities fragmented, and also increases their reliance on indoor activity spaces.

To this end, the respondents put forward some new requirements for the built environment based on the patterns of their activities, like installing devices to regulate the microclimate, such as canopies, columns, and facilities close to water sources; ensuring uniform low-glare lighting for nighttime activities; and creating small, compact and finely arranged spaces that can be integrated into fragmented time periods. The fulfillment of these requirements is considered to effectively enhance the overall experience of the activity and provide sustained motivation.

6. Built environment responding to the activity patterns driven by public and social environments

The public social environment shapes activity patterns characterized by cultural orientation, generational differences, economic adaptation, and community organization. First of all, the activity patterns are closely aligned with the local cultural traits. The respondents stated that activities with cultural adaptability can enhance social cohesion and increase people's participation in community activities. In the cultural environment of this survey, activities that are highly favored by the elderly respondents include square dancing, Tai Chi and Baduanjin. Based on the characteristics of these activities, they also require specific environmental support. For instance, the group activity nature of square dancing necessitates ample open space, flat terrain, and sound management that can control the volume and avoid causing disturbances. While activities like Tai Chi and Baduanjin require a serene and natural landscape environment to promote physical and mental harmony.

Secondly, there are differences in activity needs among people of different age groups, which requires targeted planning of the architectural environment. As an example, most middle-aged and elderly people prefer low-intensity and rhythmic activities, while young people tend to prefer high-intensity and intermittent activities. Therefore, elderly respondents usually mentioned that they need walking paths and square dance areas. While young respondents frequently mentioned professional facilities such as badminton courts and table tennis tables.

In addition, from a socio-economic perspective, the types, intensity levels, and arrangements of residents' activities may closely relate to the economic conditions and occupation. Residents engaged in physical labor tend to choose low-intensity and restorative activities during their leisure time. This group prefers to select free public spaces that are equipped with basic functions such as sunshade facilities, ventilation equipment, and drinking water facilities. In contrast, high-income groups exhibit different preferences and behavioral patterns. They emphasize privacy, professional-grade equipment, and additional services, and have a higher acceptance and usage rate for reservation-based and membership-based venues. When planning the architectural environment, it is necessary to respond to these differentiated needs.

The organization and management of physical activities in the community also impose certain requirements on the built environment. For instance, some communities regularly organize various collective physical activities, which can to some extent stimulate the activity motivation of the residents. However, this organized use of public spaces may also lead to specific groups monopolizing certain areas for an extended period, thereby causing the space to become exclusive. As reported by the respondents, dance teams might regularly occupy a significant portion of the space during fixed time slots, preventing other residents from using it. This may lead to some conflicts sometimes. Therefore, it is necessary to design reasonable spatial divisions and usage regulations to support organized activities, while ensuring the fair and accessible use of public resources.

In summary, socio-cultural context, economic development level, and community organizational structure collectively shape the PA patterns among residents in tropical cities. Through complex interactions, these factors generate diverse demands for spatial and facility conditions. Therefore, built environment design should respond with cultural adaptability, functional diversity, and managerial flexibility to meet these multi-dimensional needs.

4. Specialized Survey for the Built Environment Category and the Results

4.1. Five Dimensions of the Built Environment

Following the coding procedure described in Section 3, this study identified five subcategories under the core category of built environment, encompassing a total of 16 initial categories, and each one demonstrates unique tropical characteristics. The points number, core connotations, and the tropical-specific attributes of each subcategory are detailed in Table 5.

Table 5. The connotations and descriptive statistics of the five built-environment dimensions.

Category	Points	Connotation	Subcategory	Points	Connotation	Tropical Attribute
Safety	79	The level of security assurance for residents in activity sites and their surrounding areas	Hardware Safety	55	The structural stability, physical integrity, and environmental suitability of activity-site surfaces, furniture, and protective installations.	durability and surface temperature of outdoor facilities
			Vector and Animal Control	18	Prevention and control measures for vector organisms such as mosquitoes and cockroaches, as well as wild animals, stray animals, and unattended animals in activity sites	Enriched ecosystems entail heightened risks from pathogens, pests, and wildlife.
			Visual supervision and monitoring	6	The visual openness of activity sites and their immediate surroundings, along with the spatial coverage and operational status of video surveillance systems	Sightline obstruction caused by dense vegetation; safety support for nighttime activities
Site Conditions	228	The physical state of activity sites and spaces	Thermal Comfort Conditions	46	The capacity of activity spaces to moderate local micro-climate through shade structures, tree cover, and ventilation design.	Sun-shading and cooling devices
			Site Function	79	The functional zoning of activity spaces and the equipment layout	The optimization of PA spaces informed by tropical socio-cultural characteristics
			Site Management	31	The routine upkeep, order maintenance, and emergency response capability of activity spaces	Prompt cleanup of heavy rainwater accumulation and typhoon debris
			Size and Scale	36	The gross footprint of activity spaces and the proportional relationships within the spatial layout	Multisensory integration of spatial scale and thermal comfort
			Lighting Conditions	21	The provision and layout of artificial lighting systems within activity spaces	Support for nighttime activities
			Acoustic conditions	15	The degree of ambient noise control	The interference of high-frequency, high-decibel biological noise in tropical regions
Landscape and Surroundings	108	The combination of natural landscape elements and human-designed landscape facilities in and around the sites.	Natural Landscape	82	Naturally occurring landscape elements within and around activity sites, such as open sky views, natural water bodies, and topographical features.	Regulatory role of landscape in microclimate
			Artificial Landscape	26	Human-designed landscape amenities within activity sites, including stylized sculptures, ornamental features, artificial water features, decorative paving, and functional greenery arrangements.	Landscape amenities with a tropical atmosphere
			Path and Traffic	25	The travel conditions of the way to physical activity sites, encompassing route continuity, multi-modal convenience, and obstacle-related impediments.	Thermal comfort of paths
Accessibility	82	The level of ease for residents to reach the sites from their residential locations	Site Visibility	10	Residents' ease of site identification, determined by factors such as prominent placement and clear signage.	Obstruction of sites by dense vegetation
			Distance	47	The spatial straight-line distance or actual travel distance from residents' location to activity sites	vertical distance and activity space like sky gardens
Facility Conditions	68	The provision status of diverse hardware facilities that support residents' physical activities	Activity Facilities	31	The on-site hardware provision for fitness, sports, and other activities, covering sufficient, good maintenance, and compatibility with diverse activity types	Requirements for weather resistance; the integration of heat dissipation and cooling functions
			Auxiliary Facilities	37	Auxiliary facilities ensure the convenience and comfort during activities, such as water stations, rest benches, and public toilets.	Facilities for drinking water supply; requirements for changing, cleansing, and cooling

4.2. Analytic Hierarchy Process

To quantitatively determine the relative importance of built-environment attributes influencing PA in tropical coastal settings, this study adopts the Analytic Hierarchy Process to weight the indicator system. The five dimensions serve as primary indicators to form the evaluation framework.

To ensure the credibility of expert opinions, this study invited experts engaged in practice or research related to architecture, environmental design, or urban planning in tropical regions to participate in the consultation. In order to ensure that the consultation results are both academically rigorous and practically feasible, the study selected experts from two aspects. The first is to select scholars from well-known domestic universities or research institutions who have long-term research experience in the field of tropical architectural environment. On the other hand, senior architects or registered planners from well-known design institutions with extensive project experience in tropical regions were invited.

Based on these criteria, through peer recommendations and institutional investigation, a preliminary list of qualified experts was selected. Subsequently, invitations were sent to approximately 15 experts. Eventually, 12 experts confirmed their participation and completed the entire consultation. Among them, there are 6 research-oriented experts and 6 design-practice-oriented ones. This composition effectively balances dual perspectives of theory and practice, ensuring the professional representativeness of the consultation results in the field of tropical coastal built environment and PA.

During the consultation, each expert independently completed a questionnaire in which indicators at the same hierarchical level were compared pairwise on the 1–9 scale, thereby constructing individual judgment matrices. To control for order effects, the sequence of indicators was randomized across questionnaires. After collecting the questionnaires, the consistency ratio (CR) of the judgment matrix from each expert was computed individually. All valid matrices satisfied the consistency requirement ($CR < 0.10$), indicating reliable judgments. For each consistent matrix, local priority weights were derived. Then, research team fed back the preliminary weight results to the corresponding experts, discussed and confirmed the weight allocation scheme. The geometric mean method was then used for group decision-making calculations to ultimately determine the comprehensive weights of each indicator.

4.3. The Comprehensive Weights of the Built Environment Indicators

Following the above procedure, the final weights of the built environment indicators influencing PA in tropical coastal regions are reported in Table 6.

Table 6. Comprehensive weights of the built environment indicators.

Primary Indicator		Sub-Indicator		
Subcategory	Weight	Initial Category	Weight	Comprehensive Weight
Safety	38.25%	Hardware safety	48.11%	18.40%
		Vector and animal control	28.88%	11.05%
		Visual supervision and monitoring	23.01%	8.80%
Site Conditions	20.68%	Thermal comfort conditions	28.51%	5.90%
		Site function	28.15%	5.82%
		Site management	15.74%	3.26%
		Size and scale	13.14%	2.72%
		Lighting conditions	8.99%	1.86%
		Acoustic conditions	5.46%	1.13%

Table 6. *Cont.*

Primary Indicator		Sub-Indicator		
Subcategory	Weight	Initial Category	Weight	Comprehensive Weight
Landscape & Surroundings	14.49%	Natural landscape	64.10%	9.29%
		Artificial landscape	35.90%	5.20%
Accessibility	14.48%	Distance	47.85%	6.93%
		Path and traffic	26.24%	3.80%
		Site visibility	25.91%	3.75%
Facility Conditions	12.09%	Activity facilities	81.76%	9.88%
		Auxiliary facilities	18.24%	2.21%

5. Discussion

5.1. The Connotation of the Built Environment and Its Narrative Relationships with PA

The core categories of PA scenarios for residents in tropical coastal regions can be divided into two dimensions: one is the external environment composed of tropical climate, public and social conditions, and the built environment; the other is the PA patterns and inventions related to residents themselves. In most previous studies, scholars have generally focused on the direct impact pathways between the environment and PA, forming a relatively linear binary correlation of “environmental factors—physical activity”. For example, a study has demonstrated that high-visibility modifications can effectively encourage residents to go for walks [29]. Conversely, monotonous and enclosed environments undermine the willingness to participate [30]. However, the occurrence of behavior is complex, and the built environment—being subject to human intervention—needs to be distinguished from objective climate and social conditions.

The study finds that the impact of environment on PA is highly dependent on their shaping and regulation of activity intentions. By improving factors such as site conditions, landscape attractiveness, accessibility, etc., the built environment can influence people’s intentions to engage in activities, and subsequently affect their behavioral expression.

The objective conditions of climatic and social environment also have a promoting or inhibiting effect on activity willingness to engage in activities. Under such effects, the built environment plays an indirect mediating role. The well-designed built environments can alleviate or even eliminate the obstacles brought by unfavorable external environments. For instance, in communities with weak social ties, residents are more likely to give up PA due to lack of company or lack of encouragement [31]. Improving the visibility of activity spaces and strengthening social support of the environment and facilities often can solve this problem. In addition, a supportive built environment can also enhance the positive benefits of favorable external conditions. For example, providing the facilities located within a 15 min walking distance, complemented by sidewalks, guardrails and night lighting, will encourage residents to utilize fragmented time for PA [32].

The study further reveals a feedback loop, that is the stable activity patterns formed by individuals over time under specific external contexts, will in turn put forward specific functional and quality requirements for the built environment. Whether the built environment satisfies these pattern-derived demands will strongly affect future activity willingness and choice. Built environments that fail to meet the demands will become structural barriers. As shown in the case of hindered night running intention, under the comprehensive nighttime environment, trail systems lacking adequate lighting, security measures, or emergency call facilities fail to meet the core safety and convenience requirements for the night running pattern, directly suppressing the PA emergence and sustainability. Conversely, built environments that accurately respond to the needs can

effectively lower participation thresholds, intensify willingness, and foster the maintenance and development of activity patterns.

Therefore, to fully understand the built environment influences PA in tropical coastal areas, it must be placed within a dynamic interactive framework of “climate conditions—public and social environment—built environment—activity intention—activity pattern” (see Figure 3). Within this framework, the built environment fulfils two key roles:

- As a mediator and amplifier of external influences, it buffers adverse impacts and enhances favorable effects through design interventions, indirectly shaping activity intention.
- As a responder and adapter to pattern-derived demands, it should meet the functional and quality requirements derived from specific spatiotemporal behavioral patterns to support the maintenance of PA.

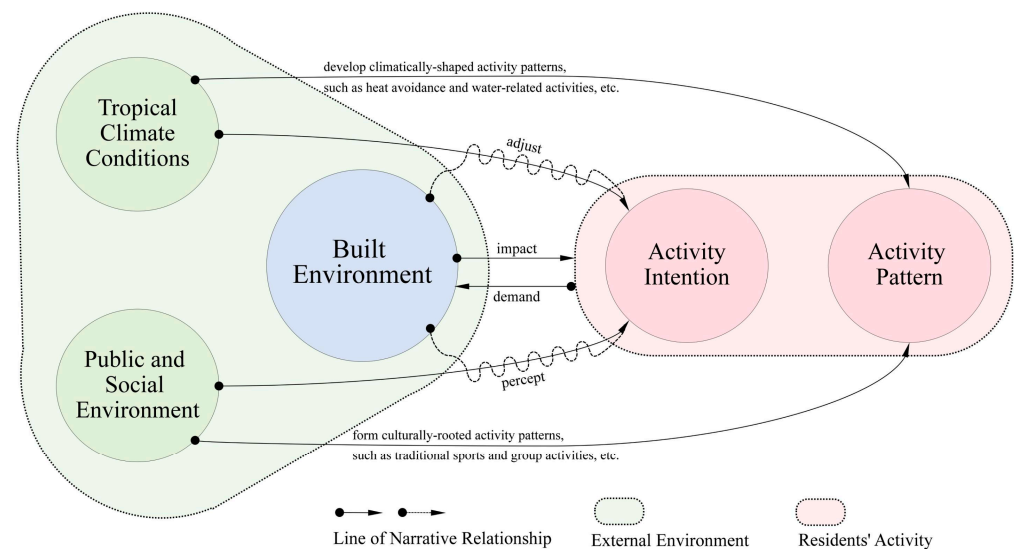


Figure 3. A model of the core-category relationship in tropical coastal resident PA scenarios.

This system framework transcends simple linear causality, accounts for the regional disparities reported in previous studies, and provides a theoretical cornerstone for context-specific design in tropical coastal regions. It requires designers to attend not only to the built environment factors but also to how they interact with the unique microclimate and social context, and to how they can dynamically adapt to the specific activity patterns developed by local residents.

5.2. Key Built Environment Factors Influencing PA and the Weights

This study yielded two sets of core findings. The first set of results is derived from the number of reference points for environmental factors identified through grounded theory coding. The second set is the weight distribution of the influence of environmental factors obtained from the analytic hierarchy process. Based on the residents' accounts and the experts' feedback, these results collectively reveal the key built environment factors that affect residents' PA in tropical coastal regions and their relative importance (see Figure 4).

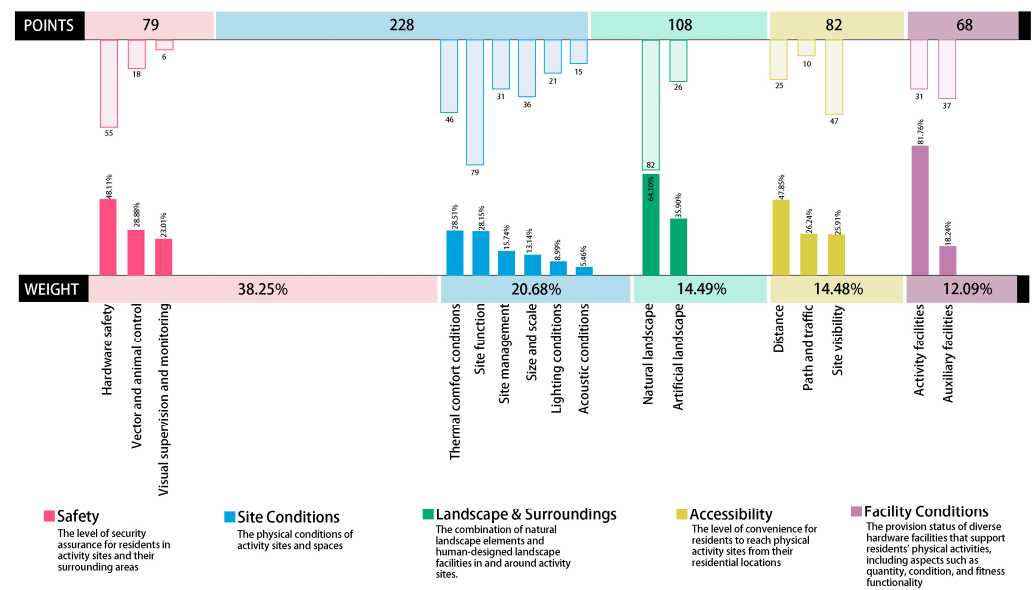


Figure 4. The comparison chart of the code points and AHP weights for built environment factors.

The number of reference points reflects the subjective opinions of the residents. When describing their activity experiences and intentions, the respondents most frequently mentioned the site conditions (228 points) and landscape and surroundings (108 points). This reflects that the intuitive and perceptible experience attributes are considered to play a dominant role in the stimulation or inhibition of activity intentions. Among these two categories, site functions (79 points) and natural landscapes (82 points) were cited most often. Previous studies have already explained this effect of the environment on physical activity. A study suggests that sequential landscape nodes can act as visual anchors, reducing perceived exertion and subconsciously encouraging longer walks [33]. On the contrary, monotonous and homogeneous spaces tend to trigger boredom, leading to a decrease in activity levels [34]. This is consistent with the explanations provided by the respondents in this study.

The weight distribution results reflect the viewpoints of the designers and research experts. The research results show that safety has been given the highest weight, followed by site conditions, landscape and surroundings, accessibility, and facility conditions. It can be seen that experts believe that safety is the most fundamental and indispensable prerequisite for the conduct of physical activities. However, it can be observed from the above conclusion that there is a certain degree of inconsistency between the environmental factors most frequently mentioned by the residents and the factors that experts consider to be the most important. Although experts believe safety be the top priority, the residents rarely spontaneously mention this point.

This inconsistency might stem from fundamental differences in the perspective of the explanation. The residents' statements are mainly based on their everyday, embodied experiences. In their experience, the content related to basic guarantees that have already been well-satisfied, such as safety baseline, may be regarded as a taken-for-granted background rather than a point requiring special discussion. When the security is not seriously threatened, it is less likely to be mentioned in the respondents' subjective statements. The ones mentioned are usually the conditions that they believe should be better met, which have a certain motivating effect. While the experts' assessments are grounded in the systematic design logic and risk management thinking, they regard the satisfaction of basic safety requirements as the primary principle of environmental design, and consider

it an unnegotiable precondition for any physical activity. This viewpoint is particularly important in tropical coastal regions due to their distinctive climatic risks.

Based on the above results and discussion, this study presents the following design and optimization strategies for the tropical coastal built environments:

- Safety and site conditions should be regarded as the primary considerations and constraints in design. The core objective is to eliminate or minimize potential risks and inhibitory factors, and construct a physically safe and functionally usable built environment for PA. Where resources are limited, addressing safety hazards first is the prerequisite for unlocking the environment's activity-promoting potential.
- On the premise of safety, high-quality site conditions and attractive landscape resources become the key factors for stimulating and maintaining residents' PA intention. These immediately perceptible experiential attributes directly affect residents' emotional connection with the environment, sense of pleasure, and willingness to linger, and play a more direct and powerful influence on environmental attractiveness and, consequently, on PA promotion.

5.3. Limitations

The study's primary limitation lies in its geographical specificity. Data was collected only in Hainan Province, China, a region distinguished by a marine-influenced tropical climate, distinct sociocultural contexts, and locally specific activity patterns. Consequently, its main findings may not be directly generalized to other areas with markedly different natural and socio-cultural conditions.

In addition, the interviewees in this study included young adults, middle-aged adults, and young-old groups, excluding minors and the older-old. Therefore, the conclusions may not apply to these unincluded age groups. Although age stratification was considered during sampling to control potential differences in group perspectives, the analysis remains a whole-sample descriptive account. The study mainly presents the trends and focuses reflected by code frequencies, featuring relatively qualitative characteristics. This means the study can effectively reveal the common tendencies in terms of built environment perception or behavioral patterns, but it is difficult to capture the subtle differences among individuals within the groups. Based on the current research design and sample size, the statistical data of coding frequencies are insufficient to support in-depth stratified research on demographic variables. Therefore, future studies should be conducted with a larger sample size and using structured questionnaires to carry out more detailed quantitative research in order to explore these issues.

Although this study has certain limitations, it still makes some contributions. Firstly, the study focused on the tropical coastal areas of China, expanding the geographical scope of related studies. It emphasized the crucial role of the built environment in the interaction between the objective external environment and physical activities, clarified the regulatory effect of built environment factors on climate and social conditions, and deepened the relevant theories. Secondly, the findings can provide direct theoretical basis and practical guidance for the future design of built environment, urban renewal, and the policy formulation in this specific region. Finally, the methodological framework adopted and the specific action mechanisms revealed also serve as a transferable model for research in other climatic and cultural settings.

6. Conclusions

This study introduced tropical climate as a moderating variable, systematically expounded on the interaction relationships among tropical climate conditions, public and social environment, built environment, activity intention, and activity pattern, and further

verified the association between environment and physical activity. Within the residents' activity scenarios, the built environment is mainly manifested as a direct influence on residents' activity, a regulator of external factors, and a respondent to specific physical activity demands.

Furthermore, the findings deepen the tropical-specific connotations of the five dimensions of safety, accessibility, site conditions, facility conditions, and landscape and surroundings. The reference-point statistics show that residents are highly attuned to site conditions and landscape, whereas the expert-weighting survey ranks safety as the top priority within the tropical context. Therefore, to stimulate activity, upgrading site conditions and landscape can significantly raise residents' perceived positivity, whereas to secure foundational support, safety and basic site conditions should be addressed first to avoid creating inhibitory effects.

The conceptual model developed in this study offers a systematic framework for evaluating the impact of built environment on residents' physical activities. It takes climate, social context, and behavioral dimensions into account, providing the possibility for interdisciplinary discussions on environmental design. This model is specifically developed to adapt to the residential regions under specific climate conditions. Future research can attempt to apply it in parallel to other climate regions, such as cold regions or different types of sites, like university campuses, and elderly-care institutions, to test its cross-situational applicability and explanatory power. Moreover, the weight indicators derived in this study may assist residential planners, architects, landscape designers, and facility managers in identifying and prioritizing the key environmental factors during the decision-making process. This will enable the design and management of the built environment to effectively enhance residents' PA intentions, ultimately promoting their overall health and well-being.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/buildings15234289/s1>, Table S1: Initial concepts and categories generated through open coding (supplementary extract).

Author Contributions: Conceptualization, L.Z., L.J. and Y.J.; methodology, L.Z.; validation, Y.J.; formal analysis, L.Z. and L.J.; investigation, L.Z., L.J. and Y.J.; data curation, L.Z.; writing—original draft preparation, L.Z.; writing—review and editing, L.J. and Y.J.; visualization, L.Z.; project administration, L.Z. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Hainan Provincial Natural Science Foundation of China, grant number 423QN207.

Institutional Review Board Statement: This research poses no risk to the privacy and rights of the participants, thus an exemption from ethical review is requested.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The original contributions presented in this study are included in the article/Supplementary Materials. Further inquiries can be directed to the corresponding author.

Acknowledgments: The authors would like to express their sincere gratitude to all the interviewees and experts who participated in this study. We appreciate their patient responses and insightful sharing, which not only formed the fundamental data for this study but also provided crucial inspiration for the expansion of our research ideas.

Conflicts of Interest: The authors declare no conflicts of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Abbreviation

The following abbreviation is used in this manuscript:

PA Physical Activity

References

1. World Health Organization. *WHO Guidelines on Physical Activity and Sedentary Behaviour*; World Health Organization: Geneva, Switzerland, 2020; pp. 32–38.
2. World Health Organization. Physical Activity. Available online: <https://www.who.int/news-room/fact-sheets/detail/physical-activity> (accessed on 1 January 2025).
3. World Health Organization. *Global Status Report on Physical Activity 2022*; World Health Organization: Geneva, Switzerland, 2022.
4. Wang, Y.; Steenbergen, B.; van der Krabben, E.; Kooij, H.; Raaphorst, K.; Hoekman, R. The Impact of the Built Environment and Social Environment on Physical Activity: A Scoping Review. *Int. J. Environ. Res. Public Health* **2023**, *20*, 6189. [CrossRef] [PubMed]
5. Hegde, M.V.; Park, S.; Zhu, X.; Lee, C. Multi-Family Housing Environment and Physical Activity: A Systematic Review of the Literature. *Am. J. Health Promot.* **2025**, *39*, 127–140. [CrossRef] [PubMed]
6. Azeez, S.A.; Mustafa, F.A.; Ahmed, R.M. A Meta-Analysis of Evidence Synthesis for a Healthy Campus Built Environment by Adopting Active Design Approaches to Promote Physical Activity. *Buildings* **2023**, *13*, 1224. [CrossRef]
7. Mansor, R.; Sheau-Ting, L. Criteria for occupant well-being: A qualitative study of Malaysian office buildings. *Build. Environ.* **2020**, *186*, 107364. [CrossRef]
8. Pedersen, M.R.L.; Bredahl, T.V.G.; Elmoose-Østerlund, K.; Hansen, A.F. Motives and Barriers Related to Physical Activity within Different Types of Built Environments: Implications for Health Promotion. *Int. J. Environ. Res. Public Health* **2022**, *19*, 9000. [CrossRef]
9. Ge, C.; Yang, F.; Wang, H.; Xu, L. Shaping Built Environments for Health-Oriented Physical Activity: Evidence from Outdoor Exercise in Dongguan, China. *Buildings* **2025**, *15*, 2812. [CrossRef]
10. Sawyer, A.D.M.; Jones, R.; Ucci, M.; Smith, L.; Kearns, A.; Fisher, A. Cross-sectional interactions between quality of the physical and social environment and self-reported physical activity in adults living in income-deprived communities. *PLoS ONE* **2017**, *12*, e188962. [CrossRef] [PubMed]
11. Auchincloss, A.H.; Michael, Y.L.; Kuder, J.F.; Shi, J.; Khan, S.; Ballester, L.S. Changes in physical activity after building a greenway in a disadvantaged urban community: A natural experiment. *Prev. Med. Rep.* **2019**, *15*, 100941. [CrossRef]
12. Kärmeniemi, M.; Lankila, T.; Ikäheimo, T.; Koivumaa-Honkanen, H.; Korpelainen, R. The Built Environment as a Determinant of Physical Activity: A Systematic Review of Longitudinal Studies and Natural Experiments. *Ann. Behav. Med.* **2018**, *52*, 239–251. [CrossRef]
13. Zhu, L.; Zhang, S.; Lu, Z. Respect for Autonomy: Seeking the Roles of Healthcare Design From the Principle of Biomedical Ethics. *Herd-Health Env. Res.* **2020**, *13*, 230–244. [CrossRef] [PubMed]
14. Fan, J.X.; Wen, M.; Kowaleski-Jones, L. Sociodemographic and Environmental Correlates of Active Commuting in Rural America. *J. Rural Health* **2015**, *31*, 176–185. [CrossRef] [PubMed]
15. Zhu, X.; Yu, C.; Lee, C.; Lu, Z.; Mann, G. A retrospective study on changes in residents' physical activities, social interactions, and neighborhood cohesion after moving to a walkable community. *Prev. Med.* **2014**, *69* (Suppl. 1), S93–S97. [CrossRef] [PubMed]
16. Cavazzotto, T.G.; Ronque, E.R.V.; Vieira, E.R.; Queiroga, M.R.; Serassuelo Junior, H. Social-Ecological Correlates of Regular Leisure-Time Physical Activity Practice among Adults. *Int. J. Environ. Res. Public Health* **2020**, *17*, 3619. [CrossRef]
17. Hoekman, R.; Breedveld, K.; Kraaykamp, G. Sport participation and the social and physical environment: Explaining differences between urban and rural areas in the Netherlands. *Leis. Stud.* **2017**, *36*, 357–370. [CrossRef]
18. Bernard, P.; Chevance, G.; Kingsbury, C.; Baillot, A.; Dancause, K.N. Climate Change, Physical Activity and Sport: A Systematic Review. *Sports Med.* **2021**, *51*, 1041–1059. [CrossRef]
19. Mabry, R.M.; Al Siyabi, H.; Kannan, M.; Al Siyabi, A. Physical activity and the built environment: Perceptions of policy-makers in Oman. *Health Promot. Int.* **2020**, *35*, 762–770. [CrossRef] [PubMed]
20. Wan Omar, W.R.; Patterson, I.; Pegg, S. Using a Health Belief Model to investigate the walking behaviour of residents living in Kuala Lumpur, Malaysia. *Ann. Leis. Res.* **2013**, *16*, 16–38. [CrossRef]
21. Nigg, C.; Alothman, S.A.; Alghannam, A.F.; Schipperijn, J.; AlAhmed, R.; Alsukait, R.F.; Rakic, S.; Cetinkaya, V.; Al-Hazzaa, H.M.; Alqahtani, S.A. A systematic review on the associations between the built environment and adult's physical activity in global tropical and subtropical climate regions. *Int. J. Behav. Nutr. Phys. Act.* **2024**, *21*, 59. [CrossRef]
22. Dahlan, N.D.; Kurmanbekova, M.; Yusoff, W.F.M.; Elias, S.M. Physical Activity as a Health Determinant in Tropical Built Environments: A Multifaceted Intervention. *Environ. Urban. ASIA* **2023**, *14*, 39–54. [CrossRef]

23. Jin, L.; Zhang, Y.; Zhang, Z. Human responses to high humidity in elevated temperatures for people in hot-humid climates. *Build. Environ.* **2017**, *114*, 257–266. [CrossRef]
24. Song, S.; Yap, W.; Hou, Y.; Yuen, B. Neighbourhood built Environment, physical activity, and physical health among older adults in Singapore: A simultaneous equations approach. *J. Transp. Health* **2020**, *18*, 100881. [CrossRef]
25. Nordin, N.; Nakamura, H. The Influence of the Objective and Subjective Physical Neighbourhood Environment on the Physical Activity of Older Adults: A Case Study in the Malaysian Neighbourhoods of Johor Bahru. *Sustainability* **2020**, *12*, 1760. [CrossRef]
26. Wee, L.E.; Tsang, Y.Y.T.; Tay, S.M.; Cheah, A.; Puhaindran, M.; Yee, J.; Lee, S.; Oen, K.; Koh, C.H.G. Perceived Neighborhood Environment and Its Association with Health Screening and Exercise Participation amongst Low-Income Public Rental Flat Residents in Singapore. *Int. J. Environ. Res. Public Health* **2019**, *16*, 1384. [CrossRef] [PubMed]
27. The People's Government of Province. Climatic Conditions. Available online: https://www.hainan.gov.cn/hainan/qhqk/list1_tt.shtml?ivk_sa=1024320u (accessed on 1 September 2025).
28. National Bureau of Statistics. The 7th National Population Census. Available online: <https://www.stats.gov.cn/sj/pcsj/> (accessed on 1 September 2025).
29. Kuzuoglu, S.; Glover, T.D.; Moyer, L.; Todd, J. How Built Environment Characteristics Influence Social Interactions During Neighbourhood Walks Among Urban Inhabitants. *Int. J. Environ. Res. Public Health* **2024**, *21*, 1519. [CrossRef]
30. US Centers for Prevention. Designing Activity-Friendly Communities. Available online: <https://www.cdc.gov/physical-activity/features/designing-activity-friendly-communities.html> (accessed on 1 September 2025).
31. Quinn, T.D.; Wu, F.; Mody, D.; Bushover, B.; Mendez, D.D.; Schiff, M.; Fabio, A. Associations Between Neighborhood Social Cohesion and Physical Activity in the United States, National Health Interview Survey, 2017. *Prev. Chronic Dis.* **2019**, *16*, E163. [CrossRef]
32. Liu, Y.; Wang, X.; Zhou, S.; Wu, W. The association between spatial access to physical activity facilities within home and workplace neighborhoods and time spent on physical activities: Evidence from Guangzhou, China. *Int. J. Health Geogr.* **2020**, *19*, 22. [CrossRef]
33. Hunter, R.F.; Adlakha, D.; Cardwell, C.; Cupples, M.E.; Donnelly, M.; Ellis, G.; Gough, A.; Hutchinson, G.; Kearney, T.; Longo, A.; et al. Investigating the physical activity, health, wellbeing, social and environmental effects of a new urban greenway: A natural experiment (the PARC study). *Int. J. Behav. Nutr. Phys. Act.* **2021**, *18*, 142. [CrossRef]
34. Yanji, Z.; Xiaohui, C.; Lizhen, Z.; Yan, M. The Impact of Urban Built Environment on Residents' Physical Activity: Based on the Empirical Research in Fuzhou City. *Sci. Geogr. Sin.* **2019**, *39*, 779–787.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.