

Mapping Built Environment Characteristics for Active Living in Urban Asia: A Scoping Review

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Abstract

Physical inactivity and sedentary behavior are major public health concerns in Asia's rapidly urbanizing cities. Built environments influence these behaviors, yet regional evidence remains fragmented. This scoping review mapped built environment characteristics examined in relation to physical activity and sedentary behavior among adults in urban Asia. The review followed PRISMA guidelines and was registered in PROSPERO (CRD42023396292). Five databases (Medline, Embase, Web of Science, Scopus, and Cochrane Library) were searched for English-language articles published between 2012 and 2024. Eligible articles assessed at least one built environment characteristic in relation to physical activity or sedentary behavior. Ninety-eight articles were included, yielding 356 reported built environment characteristics. The most commonly examined characteristics were land use mix and accessibility ($n = 63$), recreational facilities ($n = 58$), aesthetic qualities ($n = 50$), street connectivity ($n = 48$), residential density ($n = 44$), and safety ($n = 38$). These characteristics were typically assessed through measures such as destination diversity and proximity, park and sports facility availability, greenery and cleanliness, intersection density, population density, and traffic- or crime-related safety. Public transport accessibility, pedestrian infrastructure, and cycling infrastructure were examined less frequently. Only three articles assessed sedentary behavior. This review highlights important imbalances in the evidence base on built environments and active living in urban Asia, with some domains receiving substantial attention while others remaining underexplored. The findings can help policymakers identify environmental attributes relevant to their local contexts and guide future research and urban planning strategies to promote active living.

Keywords: physical activity, sedentary behavior, urban health, city planning, transportation

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สิ่งแวดล้อมสรรค์สร้างที่เอื้อให้ผู้อยู่อาศัยในเขตเมืองของเอเชียใช้ชีวิตอย่างกระฉับกระเฉง: การทบทวนแบบกำหนดขอบเขต

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บทคัดย่อ

การมีกิจกรรมทางกายไม่เพียงพอและพฤติกรรมเนือยนิ่งเป็นประเด็นสาธารณสุขสำคัญของคนในเมืองเอเชียที่กำลังขยายตัวอย่างรวดเร็ว สิ่งแวดล้อมสรรค์สร้างมีอิทธิพลต่อพฤติกรรมการเคลื่อนไหวร่างกายของประชาชน อย่างไรก็ตาม หลักฐานทางวิชาการในระดับภูมิภาคยังคงมีจำกัด การศึกษานี้มีวัตถุประสงค์เพื่อทำแผนที่ลักษณะของสิ่งแวดล้อมสรรค์สร้างที่มีความสัมพันธ์กับกิจกรรมทางกายและพฤติกรรมเนือยนิ่งในผู้ใหญ่ที่อาศัยอยู่ในบริบทเมืองของภูมิภาคเอเชีย การศึกษาดำเนินการตามแนวทาง PRISMA และลงทะเบียนในฐานข้อมูล PROSPERO (CRD42023396292) โดยสืบค้นบทความภาษาอังกฤษที่ตีพิมพ์ระหว่างปี ค.ศ. 2012–2024 จากฐานข้อมูล 5 แห่ง ได้แก่ Medline, Embase, Web of Science, Scopus และ Cochrane Library เกณฑ์การคัดเลือกกำหนดให้บทความต้องประเมินลักษณะของสิ่งแวดล้อมสรรค์สร้างชนิดใดชนิดหนึ่งที่สัมพันธ์กับกิจกรรมทางกายหรือพฤติกรรมเนือยนิ่ง คัดเลือกการศึกษาจำนวน 98 เรื่อง โดยมีสิ่งแวดล้อมสรรค์สร้างจำนวน 356 รายการ โดยลักษณะที่มีการรายงานมาก ได้แก่ สถานที่ใช้ประโยชน์ที่ดินผสมผสาน ($n = 63$) สถานที่ด้านนันทนาการ ($n = 58$) สถานที่สวยงาม ($n = 50$) จุดเชื่อมต่อโครงข่ายถนน ($n = 48$) สถานที่อยู่ประชากรหนาแน่น ($n = 44$) และสิ่งก่อสร้างด้านความปลอดภัย ($n = 38$) โดยคุณลักษณะที่ศึกษากันมาก ได้แก่ ความหลากหลายและการเข้าถึงได้ในชีวิตประจำวัน สวนสาธารณะและสถานที่ออกกำลังกาย พื้นที่สีเขียวและความสะอาด จำนวนทางแยกและทางข้ามถนน ความปลอดภัยด้านการจราจรหรืออาชญากรรม ส่วนในด้านการเข้าถึงระบบขนส่งสาธารณะ โครงสร้างพื้นฐานสำหรับคนเดินเท้า และการใช้จักรยานนั้น มีจำนวนการศึกษาน้อยกว่า ผลลัพธ์ด้านพฤติกรรมเนือยนิ่งพบเพียง 3 การศึกษา สะท้อนให้เห็นว่ามีการศึกษาสิ่งแวดล้อมสรรค์สร้างที่ไม่สมดุลในบริบทเมืองของภูมิภาคเอเชีย และชี้ให้เห็นช่องว่างสำคัญขององค์ความรู้ โดยเฉพาะด้านพฤติกรรมเนือยนิ่งและลักษณะสภาพแวดล้อมที่ยังได้รับการศึกษาน้อย ข้อค้นพบสามารถใช้กำหนดทิศทางการวิจัยในอนาคต และสนับสนุนการพัฒนากลยุทธ์การวางผังเมืองที่เอื้อต่อการใช้ชีวิตอย่างกระฉับกระเฉงในเมืองที่กำลังเติบโตอย่างรวดเร็ว

คำสำคัญ: กิจกรรมทางกาย, พฤติกรรมเนือยนิ่ง, สุขภาพเขตเมือง, การวางผังเมือง, การคมนาคมขนส่ง

Background & Rationale

Physical inactivity and sedentary behavior are recognized as major contributors to premature mortality and the global burden of non-communicable disease (NCD).⁽¹⁾ Their impact is especially pronounced in Asia, home to over 4.6 billion people and more than 60% of global NCD-related deaths.^(2, 3) Despite global commitments to reduce

inactivity by 2030,⁽⁴⁾ prevalence continues to rise, increasing from 23.4% in 2000 to 31.3% in 2022,⁽⁴⁾ with similar increases in East and Southeast Asia (20.8% in 2010 to 24.6% in 2022).⁽⁵⁾

Urbanization is reshaping daily movement patterns across the region. Built environment attributes including infrastructure, land use, mobility networks, and public spaces increasingly

determine whether cities support or constrain active living.^(4,6) Evidence from high-income settings has identified key characteristics associated with physical activity,⁽⁷⁾ including land use mix, residential density, street connectivity, public transport accessibility, and the availability of parks and recreational facilities.⁽⁸⁾ Modelling of compact cities further highlights how density, mixed land use, and transit access interact with walking and cycling infrastructure to influence activity patterns.⁽⁹⁻¹¹⁾

Research in low- and middle-income countries has expanded these insights, though often with narrower focus. Reviews in these settings commonly report a focus on walkability, safety, and access to recreational facilities, with less attention to attributes such as aesthetics, residential density, or public transport.⁽¹²⁾ Studies from tropical and subtropical regions similarly highlight connectivity, destination access, and infrastructure for walking and cycling, but note that climate-specific characteristics such as shade, tree canopy, or indoor spaces remain underexamined.⁽¹³⁾

Key evidence gaps persist in Asia. Many cities in the region are uniquely dense, rapidly motorizing, and constrained by limited safe public spaces and transport systems.^(12,14,15) These contextual differences raise questions about whether research has adequately captured the built environment characteristics most relevant to the region. A recent systematic review synthesizing 98 articles from 13 Asian countries found that supportive environments, particularly land use mix and

recreational facilities, were frequently associated with increased physical activity.⁽¹⁶⁾ However, that review focused on the frequency and direction of reported associations between built environment characteristics and physical activity or sedentary behavior.

As a result, it provided limited insight into which environmental attributes have received the greatest research attention, which remain understudied, and how built environment characteristics have been operationalized across Asian settings. Such information is important for researchers seeking to address evidence gaps and for policymakers seeking to identify environmental strategies that may be relevant to their local contexts.

This scoping review aimed to map the built environment characteristics examined in relation to physical activity and sedentary behavior in urban Asia, to identify the most and least studied characteristics, highlight gaps in the evidence base, and clarify opportunities for advancing both research and urban policy.

Methodology

Study design and search strategy

This scoping review followed PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) guidance⁽¹⁷⁾ and was registered with PROSPERO (CRD42023396292). It is part of the same research study of the previous systematic review on built environments and physical

activity in urban Asia, and therefore draws upon the same core concepts and search framework.⁽¹⁶⁾ A comprehensive search was conducted in Ovid Medline, Embase, Web of Science, Scopus, and the Cochrane Library. Developed in consultation with an academic librarian at the National University of Singapore, the search strategy covered three domains: (1) built environment, (2) physical activity or sedentary behavior, and (3) urban settings in Asia, using Boolean operators, truncation, and

controlled vocabulary such as MeSH and Emtree.

Articles were eligible if they met predefined criteria (Table 1). The primary population of interest was adults, given their varied interactions with the built environment.^(13,18-22) Articles including other age groups were eligible only when adults were also assessed, while studies focused exclusively on specific subpopulations such as pregnant women, patients, or athletes were excluded due to limited generalizability.

Table 1 Inclusion and exclusion criteria

Criteria	Inclusion	Exclusion
Population	General adult population (aged 18–65 years). Articles that also included younger or older groups were eligible if adults were assessed separately or in combination.	Articles exclusively focused on children, adolescents, elderly populations, patient groups, pregnant women, people with disabilities, or athletes.
Exposure	Built environment characteristics broadly defined to include land use and spatial organization (e.g., residential density, land use mix, proximity to destinations), transport-related infrastructure (e.g., public transport access, pedestrian and cycling facilities), street design and connectivity, public or recreational spaces (e.g., parks, sports facilities, playgrounds), and perceived safety or aesthetics.	Articles focusing only on individual, social, policy-level, or workplace/school settings without assessment of the built environment.
Outcome	Physical activity and/or sedentary behavior.	Articles without outcomes on physical activity or sedentary behavior.
Setting	Urban areas in Asian countries, as defined by the United Nations M49 classification. Cross-country articles were eligible if Asian data were reported separately.	Articles conducted exclusively in non-Asian countries or in rural-only settings.
Study	Peer-reviewed journal articles with observational (cross-sectional, longitudinal) or experimental (natural experiment) designs, published in English between 2012 and 2024.	Non-peer-reviewed sources, conference abstracts, books, reports, commentaries, editorials, letters, theses, and protocols.

Eligible articles had to examine at least one built environment characteristic in relation to physical activity or sedentary behavior. The built environment was defined broadly as the physical attributes of urban areas that shape opportunities for movement, spanning land use and spatial patterns, transport and mobility infrastructure, public and recreational spaces, and perceived characteristics such as safety or aesthetics. This conceptualization reflects international frameworks describing how urban environments influence active living,^(4, 6-8,12,15, 23) while remaining flexible to capture any additional characteristics measured across articles.

Both objective measures (e.g., GIS indicators, urban audits, facility counts) and perceived measures (e.g., neighborhood surveys, validated instruments such as the Neighborhood Environment Walkability Scale) were eligible. Articles without any built environment measure or focusing solely on individual, social, or policy-level determinants were excluded.

Articles had to be conducted in urban settings in Asian countries based on the United Nations M49 classification.^(24,25) Articles from non-Asian or rural or mixed settings were included only when urban-specific results for Asian populations were clearly reported. Observational (e.g., cross-sectional, longitudinal) and experimental or quasi-experimental designs (e.g., natural experiments) were

eligible. Only peer-reviewed articles published in English between 2012 and 2024 were included.

Identification of articles

Records were imported into EndNote 20 for de-duplication and screened in Rayyan. Each article was reviewed by at least two researchers. The author screened all titles and abstracts, while four additional reviewers screened subsets. Discrepancies were resolved through discussion; no automated screening tools were used. Full texts were retrieved via institutional access, Google Scholar, or direct author contact when needed. Two reviewers independently assessed all full texts against inclusion criteria, with disagreements resolved by consensus. Inter-rater reliability was assessed using Cohen's kappa. The selection process is detailed in the PRISMA flow diagram.

Data analysis

Data extraction used standardized templates, piloted on five articles to ensure clarity and consistency. Two reviewers independently extracted study characteristics (author, year, country), methodological details (design, sample size, analysis), participant characteristics, built environment measures, and physical activity or sedentary behavior outcomes. Data were managed in Microsoft Excel.

A descriptive synthesis was undertaken to map the range of built environment characteristics examined. Characteristics were grouped into domains informed by established frameworks^(4,6-8,12,15,23) and refined based on how variables were operationalized. Conceptually related but distinct constructs were clearly separated. For example, recreational facilities (parks, playgrounds, sports complexes) were distinguished from daily destinations (shops, schools, workplaces), given their differing relevance for leisure versus utilitarian activity.

Composite indices were disaggregated to avoid conflating distinct components. For example, walkability indices derived from NEWS (neighborhood environment walkability scale) or GIS (geographic information system) data were broken down into attributes such as land use mix, residential density, and street connectivity to ensure consistent classification and enable clearer cross-study comparison.

Physical activity outcomes were categorized into overall, transport-related, and recreational domains, while sedentary behavior was treated as a distinct outcome.⁽⁴⁾ When outcome definitions were ambiguous, classification was guided by the descriptions provided in each article, with unclear cases assigned to overall physical activity. Walking and cycling were categorized as transport or recreational activity depending on contextual information.

Results

Study identification and selection

A total of 14,078 records were identified (Figure 1). After removing 5,340 duplicates, 8,738 records were screened by title and abstract. Of these, 458 full-text articles were assessed for eligibility, and 98 met the inclusion criteria.⁽²⁶⁻¹²³⁾ Pooled inter-rater reliability for full-text screening was substantial (Cohen's kappa = 0.65).

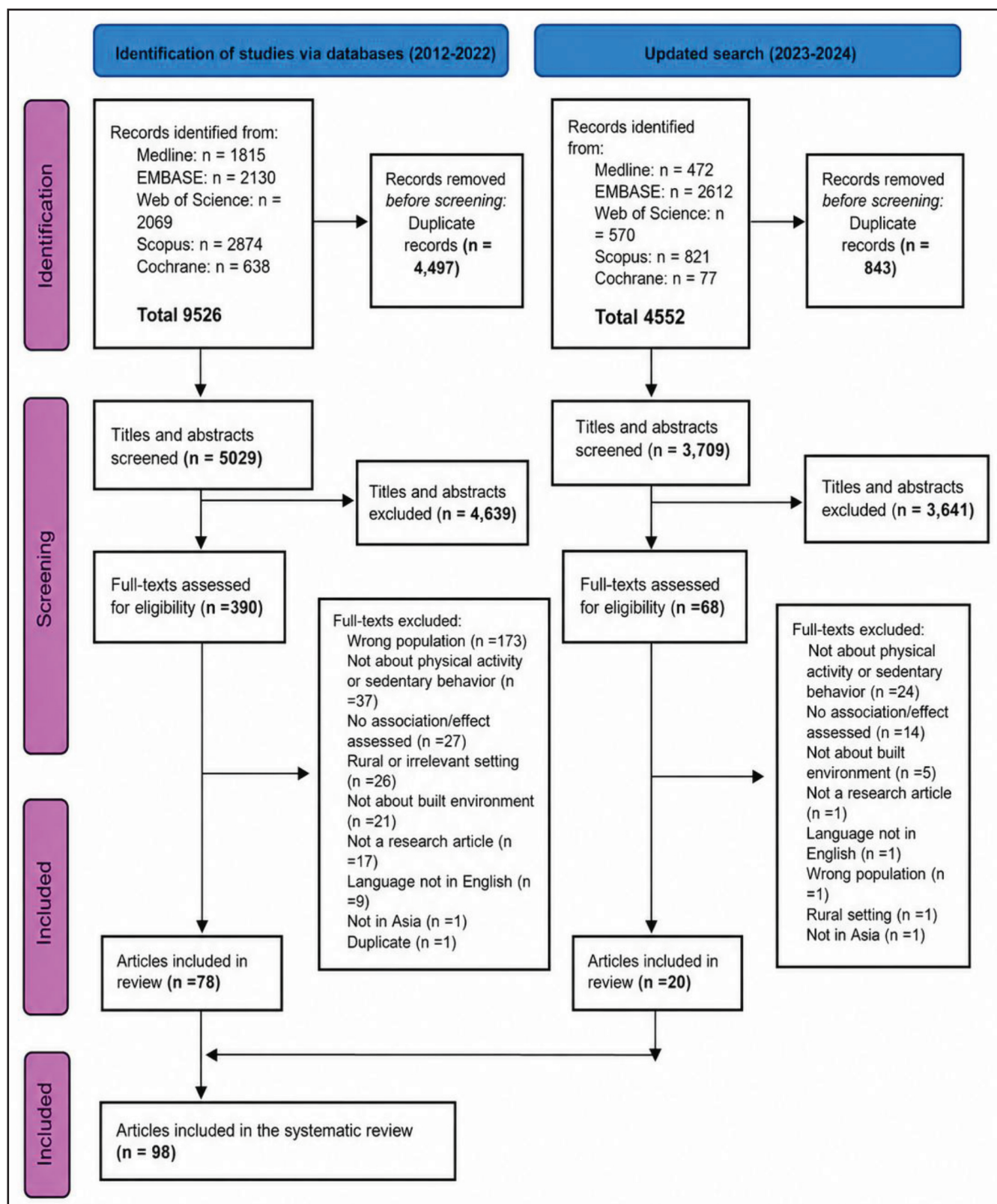


Figure 1 PRISMA flow of the systematic review

Study characteristics

The 98 included articles were conducted across 13 Asian countries (Table 2). China accounted for nearly half of the articles (48.0%), including two from Taiwan, followed by Iran (13.3%), Hong Kong SAR (10.2%), and South Korea (8.2%). Japan contributed 7.1%, India and Thailand each contributed 3.1%, and Malaysia contributed 2.0%.

Pakistan, Saudi Arabia, Singapore, Sri Lanka, and Turkey each contributed 1.0%.

Most articles used cross-sectional designs (96.9%), and the median sample size was 1, 070 participants. Almost all articles (90.8%) focused exclusively on adults, while 9.2% included mixed age groups such as children, adolescents, or older adults.

Table 2 Main characteristics of the included articles (n=98)⁽²⁶⁻¹²³⁾

Characteristics		Frequency	%
Country	China	47	48.0
	Iran	13	13.3
	Hong Kong SAR, China	10	10.2
	South Korea	8	8.2
	Japan	7	7.1
	India	3	3.1
	Thailand	3	3.1
	Malaysia	2	2.0
	Pakistan	1	1.0
	Saudi Arabia	1	1.0
	Singapore	1	1.0
	Sri Lanka	1	1.0
	Turkey	1	1.0
Study design	Cross-sectional	95	96.9
	Natural experiment	3	3.1
Sample size (median = 1, 070)	<1, 001	46	46.9
	1, 001-10, 000	35	35.7
	>10, 000	17	17.4
Population age group	Adults only (specified age range, e.g., 18-65)	68	69.4
	Adults (unspecified age)	21	21.4
	Adults with other age groups	9	9.2
	• With children/adolescents	8	—
	• With elderly	3	—

Built environment characteristics

Across the 98 included articles, a total of 356 built environment characteristics were identified and categorized into nine domains (Tables 3 and 4). The most frequently examined domains were land use mix and accessibility (n = 63), recreational

facilities (n = 58), aesthetics (n = 50), street pattern design and connectivity (n = 48), residential density (n = 44), and safety (n = 38). Public transport availability and accessibility (n = 29), pedestrian infrastructure (n = 15), and bike infrastructure (n = 11) were examined less frequently.

Table 3 Characteristics of built environment, physical activity, and sedentary behavior

Characteristics		Frequency	%
Built environment (n=356)	Land use mix diversity and accessibility to daily destinations	63	17.7
	Recreational facilities availability and accessibility	58	16.3
	Aesthetics	50	14.0
	Street pattern design and connectivity	48	13.5
	Residential density	44	12.4
	Safety	38	10.7
	Public transport availability and accessibility	29	8.1
	Pedestrian infrastructure	15	4.2
	Bike infrastructure	11	3.1
Built environment measurement (n = 98)	GIS-based	48	49.0
	Self-reported	32	32.7
	Mixed methods	13	13.3
	Direct observation	5	5.0
Physical activity and sedentary behavior (n=121)	Overall physical activity	46	38.0
	Recreational physical activity	37	30.6
	Transport-related physical activity	35	28.9
	Sedentary behavior	3	2.5
Physical activity and sedentary behavior measurement (n = 98)	Self-reported	74	75.5
	Device-based	10	10.2
	GIS-based	7	7.1
	Mixed methods	4	4.1
	Direct observation	3	3.1

Land use mix and accessibility

Land use mix and accessibility was the most frequently examined built environment category (n = 63).^(27,28,31,32,34,37-39,41,43,44,46,47,50,52,53,55,56,59,63-65,72,76,77,79,82,83,85,87,88,90,94,96,97,100-102,104,106,108,109,111,113-115,117,120,121) These attributes were generally defined as the diversity of residential and commercial destinations within neighborhoods and the ease of reaching them, and were frequently considered core elements of walkability.

Several articles in Japan^(28,31) and China^(32,34,37,44,82,88,97) assessed residents' perceptions of access to shops, services, and schools, often alongside density and connectivity. In India, articles captured perceived proximity to facilities within neighborhoods.^(47,72) Articles from Beijing and Shanghai developed GIS-based indices of land use diversity and destination accessibility, sometimes

incorporating facility counts or entropy measures.

^(39,64,79,83,87) In Osaka, neighborhoods were categorized as highly commercial, mixed residential, or unurbanized to reflect variations in accessibility.⁽⁴⁰⁾

In Seoul, composite indices combined land use mix with density and connectivity to capture neighborhood walkability.^(76,77)

Other articles quantified accessibility through buffer-based measures, counting facilities or services within 500 m. to 1, 500 m. from residences.^(45,50,90)

Broader constructs such as “urban vibrancy,” which integrated land use diversity with facility and population density, were applied in Beijing and Changsha.^(100,101) Finally, several articles incorporated land use mix and accessibility into analyses of transport, cycling, and leisure-time activity in cities including Wuhan, Hong Kong, Seoul, and Kumamoto.^(104,108,109,113-115,117,121)

Table 4 Overview of included articles (N = 98)⁽²⁶⁻¹²³⁾

No.	Author, Year	Country	Sample	Study design	BE domains	BE measurement	PA/SB outcome	PA/SB measurement
1	Lee, 2012	South Korea	424 adults, Seoul	Cross-sectional	Safety, aesthetics, convenience, traffic safety	Questionnaire	Leisure-time walking	Questionnaire
2	Moeini, 2012	Iran	252 adults, Tehran	Cross-sectional	Safety, aesthetics, mobility, connectivity, land use	Questionnaire	Walking duration	Questionnaire
3	Chen, 2013	Japan	3,806 adults	Cross-sectional	Residential density, land use mix, street connectivity, aesthetics, safety	NEWS-A	Walking, habitual exercise	Questionnaire
4	Hu, 2013	Taiwan	804 residents + 231 community directors	Cross-sectional	Physical facilities	Interviews	Physical activity	Interviews
5	Park, 2013	South Korea	4,148 adults, 7 cities	Cross-sectional	Public park area per person	GIS (govt. data)	PA levels	IPAQ
6	Saito, 2013	Japan	2,449 adults	Cross-sectional	Residential density, land use mix, connectivity, aesthetics, safety	IPAQ-E	MVPA, recreational & transport walking	IPAQ
7	Zhou, 2013	China	478 parents, Shanghai	Cross-sectional	Residential density, land use mix, connectivity, aesthetics, safety	NEWS-A	Transport PA, leisure PA, MVPA	PAQ + accelerometer
8	Alfonzo, 2014	China	1,070 residents, Shanghai & Hangzhou	Cross-sectional	Composite index (density, land use, connectivity, safety, aesthetics, recreation)	Audit (SoP tool)	Walking (transport & leisure)	Questionnaire

Table 4 Overview of included articles (N = 98)⁽²⁶⁻¹²³⁾ (cont.)

No.	Author, Year	Country	Sample	Study design	BE domains	BE measurement	PA/SB outcome	PA/SB measurement
9	Jia, 2014	China	1,528 adults, Shanghai	Cross-sectional	Residential density, land use mix, connectivity, aesthetics, safety	NEWS	Walking (transport & leisure)	IPAQ
10	Lee, 2014	Hong Kong	480 adults	Cross-sectional	Recreational facilities	GIS + observation + questionnaire	MVPA	Accelerometer
11	Soltani, 2014	Iran	328 adults, Shiraz	Cross-sectional	Density, land use, parks, aesthetics, safety, proximity to exercise facilities	GIS + questionnaire	Transport & leisure PA	IPAQ
12	Su, 2014	China	1,440 adults, Hangzhou	Cross-sectional	Residential density, land use mix, connectivity, aesthetics, safety	NEWS-A	Leisure-time PA, walking	IPAQ
13	Sung, 2014	South Korea	2,050 residents, Seoul	Cross-sectional	Development density, land use mix, public transport	GIS	Walking (min/day)	Questionnaire
14	Zhao, 2014	China	613 households, Beijing	Cross-sectional	Population density, land use mix, road density, cycling lanes, transit proximity	GIS	Work trip transport (walk, bike)	Questionnaire
15	Waygood, 2015	Japan	>1M participants, Osaka	Cross-sectional	Neighborhood type (commercial, residential, mixed)	Cluster analysis	Transport PA	Questionnaire
16	Ying, 2015	China	1,100 adults, Shanghai	Cross-sectional	Street connectivity, parks, residential density, land use mix	GIS	Steps	Pedometer



Table 4 Overview of included articles (N = 98)⁽²⁶⁻¹²³⁾ (cont.)

No.	Author, Year	Country	Sample	Study design	BE domains	BE measurement	PA/SB outcome	PA/SB measurement
17	Akpinar, 2016	Turkey	420 adults, Aydin	Cross-sectional	Distance & quality of green space, aesthetics, visibility	Questionnaire	Frequency & duration of PA	Questionnaire
18	Sun, 2016	China	495 metro riders, Beijing	Cross-sectional	Traffic speed, sidewalks, connectivity, aesthetics, land use	GIS + survey	Walking time (last mile)	GPS
19	Adlakha, 2017	India	370 adults, Chennai	Cross-sectional	Residential density, land use mix, connectivity, aesthetics, safety	NEWS	Travel & leisure PA	IPAQ
20	Liu, 2017	China	308 adults, Beijing	Cross-sectional	Park accessibility, features (aesthetics, comfort)	GIS + survey	PA levels	IPAQ
21	Lu, 2017	Hong Kong	1,078 adults	Cross-sectional	Population density, land use, intersection density	GIS	Walking (transport, leisure, total)	IPAQ
22	Adlakha, 2018	India	370 adults, Chennai	Cross-sectional	Residential density, land use, connectivity, aesthetics, safety	NEWS	Commuting modes	Questionnaire
23	Etminani-Ghasrodashti, 2018	Iran	426 adults, Kish Island	Cross-sectional	Facility design, safety, cycling infrastructure	GIS + survey	Recreational cycling	Questionnaire
24	Gul, 2018	Pakistan	1,042 adults, Karachi	Cross-sectional	Crime safety	NEWS	Walking	Neighborhood PA Q
25	Habibian, 2018	Iran	17,000+ adults, Rasht	Cross-sectional	Street density, land use mix, population density, destination access	GIS	Walking trips	Questionnaire
26	Kim, 2018	South Korea	82,695 adults	Cross-sectional	Safety, natural environment, transport, cycle paths, facilities	Questionnaire	MVPA	IPAQ-short



Table 4 Overview of included articles (N = 98)⁽²⁶⁻¹²³⁾ (cont.)

No.	Author, Year	Country	Sample	Study design	BE domains	BE measurement	PA/SB outcome	PA/SB measurement
27	Li, 2018	Japan	2,843 workers, Nagoya	Cross-sectional	Walkability, parks, sports facilities	GIS	Walking, PA time	Questionnaire
28	Lu, 2018	Hong Kong	1,994 residents	Cross-sectional	Greenness, density, land use, connectivity, shops, transit	GIS + Google Street View	Walking	Questionnaire
29	Lu, 2018	Hong Kong	616 adults	Cross-sectional	TOD type, transit proximity	GIS	Walking (transport & leisure)	IPAQ
30	Lu, 2018	Hong Kong	203,900 households	Cross-sectional	Street green, density, land use, connectivity, transit	GIS	Mode choice	GPS
31	Mirzaei, 2018	Iran	863 adults, Isfahan	Cross-sectional	Land use, residential density, facility accessibility, safety	GIS + survey	Utilitarian & leisure walking	Questionnaire
32	Wang, 2018	China	803 adults, Xi'an	Cross-sectional	Cycling lanes, network density	GIS	Cycling distance	GPS + survey
33	Wang, 2018	China	803 adults, Xi'an	Cross-sectional	Cycling lane types, network density	GIS	Cycling distance	GPS + questionnaire
34	Aliyas, 2019	Iran	398 adults, Bandar Abbas	Cross-sectional	Safety, aesthetics, parks (size, proximity, facilities)	GIS + survey	Exercise, recreational walking	Questionnaire
35	Aliyas, 2019	Iran	442 adults, Bandar Abbas	Cross-sectional	Park facilities, amenities, aesthetics, safety	EAPRS audit	Recreational walking	Questionnaire
36	Jia, 2019	China	641 adults, Shanghai	Cross-sectional	Bicycle lanes, access to destinations, safety	Questionnaire	Cycling vs. non-cycling	Questionnaire
37	Kubota, 2019	Japan	1,669 adults, Nagaizumi/Oiso	Panel (non-randomized)	Availability of new exercise facilities	Questionnaire	PA levels	IPAQ

Table 4 Overview of included articles (N = 98)⁽²⁶⁻¹²³⁾ (cont.)

No.	Author, Year	Country	Sample	Study design	BE domains	BE measurement	PA/SB outcome	PA/SB measurement
38	Lu, 2019	Hong Kong	1,390 adults	Cross-sectional	Street greenery, parks, density, land use mix	GIS + Google Street View	Recreational PA	IPAQ-short
39	Sun, 2019	China	649 adults, Dalian	Cross-sectional	Land use, road network density, connectivity, aesthetics, safety	GIS + NEWS-A	MVPA, walking	IPAQ-short
40	Sun, 2019	China	173 adults, Yuncheng	Cross-sectional	Land use mix (recreation, education)	NEWS-A	Walking duration	Questionnaire
41	Wang, 2019	China	513 adults, Nanning	Cross-sectional	Accessibility, safety, green space quality	Questionnaire	PA	Questionnaire
42	Wang, 2019	China	808 adults, Guangzhou	Cross-sectional	Perceptions: safety, aesthetics, liveliness	Street View + deep learning	Recreational PA	IPAQ-short
43	Wang, 2019	China	1,551 adults, Nanjing	Cross-sectional	Residential density (low–high)	Govt. statistics	PA levels	IPAQ
44	Wang, 2019	China	1,551 adults, Nanjing	Cross-sectional	Access to public transport stops	PANES	PA levels	IPAQ-short
45	Wu, 2019	China	20M bike-metro transfer trips, Shenzhen	Cross-sectional	Destination accessibility, cycling infra, aesthetics	GIS	Bike-metro transfer trips	Smartcard/QR trip data
46	Yuen, 2019	Hong Kong	554 residents, 9 districts	Cross-sectional	Residential green space %	GIS	PA (MET-min/week)	IPAQ-short
47	Adlakha, 2020	India	370 adults, Chennai	Cross-sectional	Residential density, land use mix, connectivity, safety, aesthetics	NEWS	Total, transport & leisure PA	IPAQ
48	Aliyas, 2020	Iran	1,132 adults, Bandar Abbas	Cross-sectional	Safety (crime, traffic, social, physical)	NEWS-A	Leisure & transport walking	IPAQ

Table 4 Overview of included articles (N = 98)⁽²⁶⁻¹²³⁾ (cont.)

No.	Author, Year	Country	Sample	Study design	BE domains	BE measurement	PA/SB outcome	PA/SB measurement
49	Aliyas, 2020	Iran	13,342 users, Darab	Cross-sectional	Park size, amenities, aesthetics, incivilities	CPAT audit	Sedentary, walking, MVPA	SOPARC
50	Arifwidodo & Chandrasiri, 2020	Thailand	62,031 park users	Cross-sectional	Park size, facilities, transport access, density	SOPARC	MVPA	SOPARC
51	Kim, 2020	South Korea	5,742 (leisure) + 3,722 (shopping) trips	Cross-sectional	Walkability score, land use mix, sidewalk length	GIS	Non-motorized commuting	Questionnaire
52	Kim, 2020	South Korea	129,044 commuting trips, Seoul	Cross-sectional	Walkability score, land use mix, density, transit access	GIS	Non-motorized commuting	Questionnaire
53	Liu, 2020	China	1,002 adults, Guangzhou	Cross-sectional	Access to PA facilities (counts, proximity)	GIS	MVPA	IPAQ-short
54	Liu, 2020	China	17,353 leisure trips, Beijing	Cross-sectional	Parks, shops, walkable streets, land use diversity	GIS	Leisure walking trips	Questionnaire
55	Qin, 2020	China	1,551 adults, Nanjing	Cross-sectional	Residential density	Govt. statistics	Walking time	IPAQ
56	Rosli, 2020	Malaysia	100 park visitors, Batu Gajah	Cross-sectional	Park quality (facilities, signage, safety, attraction)	Questionnaire	PA time (min/week)	Questionnaire
57	Sun, 2020	China	728 adults, Xi'an	Cross-sectional	Residential density, land use, connectivity, aesthetics, safety	NEWS-A	MVPA (total, transport, leisure)	IPAQ
58	Xiao, 2020	China	96,010 respondents, Xiamen	Cross-sectional	Density, land use, road, transit	GIS	Walking & cycling trips	Questionnaire
59	Zhao, 2020	China	1,308 adults, Fuzhou	Cross-sectional	Humanized space (POI density, diversity, infra, safety)	GIS + survey	Leisure MVPA	Questionnaire



Table 4 Overview of included articles (N = 98)⁽²⁶⁻¹²³⁾ (cont.)

No.	Author, Year	Country	Sample	Study design	BE domains	BE measurement	PA/SB outcome	PA/SB measurement
60	Ahmadipour, 2021	Iran	2,500 residents, Tehran	Cross-sectional	Residential density, connectivity, land use, transit access, aesthetics	GIS + survey	Walking choice & distance	GPS + questionnaire
61	Arifwidodo, 2021	Thailand	23,700 park users (before/after)	Pre-post	Renovated park features	SOPARC	Sedentary, light, MVPA	SOPARC
62	Chen, 2021	China	3.79M Codoon app users	Cross-sectional	Density, POI, connectivity, parks	GIS	Leisure-time PA	Codoon app
63	Dun, 2021	China	842 adults, Shenzhen	Cross-sectional	Residential density, land use mix, connectivity, aesthetics, safety	NEWS-A	PA levels (METs/week)	IPAQ
64	Jiang, 2021	China	1,168 adults, Nanjing	Cross-sectional	Proximity & density of parks, leisure squares, walking paths	GIS	Leisure walking participation	IPAQ
65	Ma, 2021	China	1,520 greenway users, Chongqing	Cross-sectional	Land use mix, residential density, slope, node ratio	GIS	PA duration, distance	KEEP app
66	Petrunoff, 2021	Singapore	3,435 adults	Cross-sectional	Park access (perceived & GIS)	GIS + questionnaire	Park-based PA	Questionnaire
67	Shaer, 2021	Iran	386 adults, Tehran	Cross-sectional	Walkability, bikeability, safety, aesthetics, destination access	Questionnaire	Active travel (min/week)	Questionnaire
68	Sun, 2021	China	354 adults, Yuncheng & Suihua	Cross-sectional	Food environment (7 amenities), diversity	NEWS-A	Daily walking (>60 vs ≤60 min)	Questionnaire
69	Weliance, 2021	Sri Lanka	284 adults, Colombo	Cross-sectional	Residential density, land use, intersections, transit access, parks	GIS	Walking (transport & leisure)	IPAQ

Table 4 Overview of included articles (N = 98)⁽²⁶⁻¹²³⁾ (cont.)

No.	Author, Year	Country	Sample	Study design	BE domains	BE measurement	PA/SB outcome	PA/SB measurement
70	Wu, 2021	China	1,755 bike stations, 40M+ trips, Suzhou	Cross-sectional	Bike station attributes, density, diversity	GIS	Bike trips	Smartcard/QR trip records
71	Wu, 2021	China	132 adults, Beijing	Cross-sectional	POI density, land use mix, connectivity, transit access	GIS	Active travel (duration, distance, frequency, mode)	GPS + travel diaries
72	Yu, 2021	China	986 adults, Shenzhen	Cross-sectional	Residential density, land use mix, connectivity, aesthetics, safety	NEWS-A	Recreational MVPA	IPAQ
73	Zhao, 2021	China	1.43M public bike trips, Nanjing	Cross-sectional	POIs, station attributes	GIS	Public bike trip duration	Bike app
74	Kamelifar, 2022	Iran	603 adults, Tabriz	Cross-sectional	Distance to services, sidewalks, connectivity, safety	GIS + survey	Commute walking	Questionnaire
75	Lai, 2022	China	9,251 running grid cells, Beijing	Cross-sectional	Urban vibrancy (population, POI density, green space)	GIS	Outdoor running	KEEP app
76	Li, 2022	China	735 activities, Changsha	Cross-sectional	Land use mix, density, roads, transit	GIS	Walking/running frequency	Duorui app
77	Zhang, 2022	China	1,875 adults, Shanghai, Hangzhou, etc.	Cross-sectional	Facility proximity, connectivity, aesthetics, safety	NEWS-A	Active PA (medium/high)	IPAQ-short
78	Zhang, 2022	Hong Kong	1,977 adults	Cross-sectional	Leisure facilities (gyms, parks, rec centers), street centrality	GIS	PA (MPA/VPA), sedentary time	IPAQ-short
79	Guo, 2023	China	20,008 short trips, Wuhan	Cross-sectional	Location, transit access, density, land use	GIS	Active travel (walk/cycle)	Questionnaire

Table 4 Overview of included articles (N = 98)⁽²⁶⁻¹²³⁾ (cont.)

No.	Author, Year	Country	Sample	Study design	BE domains	BE measurement	PA/SB outcome	PA/SB measurement
80	Musthafa, 2023	Malaysia	385 adults, Subang Jaya	Cross-sectional	Neighborhood facilities, safety, environment	Questionnaire	MVPA & VPA	Questionnaire
81	Noormohammadpour, 2023	Iran	486 adults, Tehran	Cross-sectional	Walkability index	GIS	PA levels (150 min/week)	GPAQ
82	Shi, 2023	China	372 residents, Gulangyu	Cross-sectional	Landscape (function, safety, aesthetics, comfort)	Questionnaire	Walking (purposeful & leisure)	Questionnaire
83	Tao, 2023	Hong Kong	5,041 adults	Cross-sectional	Market/restaurant access, density, transit availability	GIS	Home-based walking trips	Questionnaire
84	Zhang, 2023	China	530 trips, Shanghai	Cross-sectional	FAR, land use mix, green space, facilities, transit	GIS	Walking & cycling trips	GPS
85	Zheng, 2023	China	398 adults, Chongqing	Cross-sectional	Community green space aesthetics, safety, connectivity	GIS	Recreational PA	Questionnaire:
86	Arifwidodo, 2024	Thailand	579 adults, Bangkok	Cross-sectional	Facility proximity, connectivity, aesthetics, safety	NEWS-A	PA levels	GPAQ
87	Banger, 2024	Saudi Arabia	556 adults, Jeddah	Cross-sectional	Walkability (safety, accessibility, comfort)	Questionnaire	Walking (yes/no)	Questionnaire
88	Cheng, 2024	Taiwan	311 metro passengers, Taipei	Cross-sectional	Population density, commercial ratio, transit distance	GIS	Public bike use	Questionnaire
89	Chung, 2024	South Korea	41,882 bike trips, Seoul	Cross-sectional	Land use, density, bike infra, transit	GIS	Bike usage	GPS
90	Fang, 2024	Japan	46,628 running trips, Kumamoto	Cross-sectional	Density, diversity, design, destination access, transit	GIS	Leisure running	Strava app

Table 4 Overview of included articles (N = 98)⁽²⁶⁻¹²³⁾ (cont.)

No.	Author, Year	Country	Sample	Study design	BE domains	BE measurement	PA/SB outcome	PA/SB measurement
91	Gong, 2024	South Korea	184 adults, Daegu	Cross-sectional	Riverside park proximity, connectivity	GIS	Leisure walking time	Questionnaire
92	He, 2024	China	2,385 adults, Wuhan	Cross-sectional	Density, diversity, design, access, transit, green spaces	GIS + survey	Walking (transport & leisure)	Questionnaire
93	Kato, 2024	Japan	4,817 adults, Ibaraki	Natural experiment	New multifunctional facility (ONIKURU)	GIS	Walking time (min/day)	GPS
94	Peng, 2024	China	210 adults, 9 provinces	Cross-sectional	Parks, gyms, restaurants, transit, road type	Questionnaire	Leisure walking duration	Questionnaire
95	Rao, 2024	China	71 adults, Beijing	Cross-sectional	Intersection density, green accessibility	GIS	MVPA	Accelerometer
96	Yan, 2024	China	11M bike-sharing trips, Shenzhen	Cross-sectional	Diversity, connectivity, greenery, urban integration	GIS	Bike-to-subway connections	GPS
97	Zhang, 2024	China	760 residents, Fuzhou	Cross-sectional	Green spaces, recreational & catering facilities	GIS	Leisure PA	Questionnaire
98	Zhang, 2024	China	1,459 adults, Zhejiang & Shaanxi	Cross-sectional	Vegetation, availability of free facilities	Questionnaire	Exercise time (≥150 min/week)	Questionnaire

Abbreviations

App, application; BE, built environment; CPAT, Community Park Audit Tool; EAPRS, Environmental Assessment of Public Recreation Spaces; FAR, floor area ratio; GIS, geographic information system; GPAQ, Global Physical Activity Questionnaire; IPAQ, International Physical Activity Questionnaire; IPAQ-E, International Physical Activity Questionnaire–Environmental module; IPAQ-short, International Physical Activity Questionnaire–Short Form; MET, metabolic equivalent of task; min = minute; MVPA, moderate-to-vigorous physical activity; NEWS, Neighborhood Environment Walkability Scale; NEWS-A, Neighborhood Environment Walkability Scale–Abbreviated; PA, physical activity; PANES, Physical Activity Neighborhood Environment Scale; POI, point of interest; SB, sedentary behavior; SoP, State of Place; SOPARC, System for Observing Play and Recreation in Communities; TOD, transit-oriented development; VPA, vigorous physical activity.



Recreational facilities

Recreational facilities were the second most frequently examined built environment category ($n = 58$),^(29,30,35,36,41,42,45,48,52,56,59,60,62,63,67,75,78,81,86,87,89,91,94,102,103,105,107,110,111,116-118,122,123) typically defined in terms of availability, accessibility, and quality, including both public parks and playgrounds and commercial venues such as gyms and sports clubs. Articles assessed park provision through measures such as park area per person across major cities in South Korea,⁽³⁰⁾ or by applying buffer distances such as 500 m. and 1, 500 m. to parks and open spaces in Beijing and Nanjing, China.^(45,89) Other articles emphasized the density and distribution of facilities, including assessments of fitness centers, sports clubs, and commercial gyms in Hong Kong and Shanghai.^(35,103,122)

Another group of articles assessed the quality and attributes of facilities, with surveys in Bandar Abbas, Iran, and Batu Gajah, Malaysia capturing dimensions such as safety, maintenance, signage, and comfort.^(60,61) In Bangkok, Thailand, the renovation of Benjakitti Park was highlighted for introducing new playgrounds, jogging tracks, and bike lanes.⁽⁸⁶⁾ In Japan, an article from Ibaraki evaluated the impact of a newly opened multifunctional recreational complex on activity opportunities.⁽¹¹⁸⁾

Aesthetics

Aesthetics was the third most frequently examined built environment category ($n = 50$).^(41-45,47,51,53,56,59,60,63,66,67,72-74,81,82,84,85,88,92,97,102,103,105,107,110-112,116) Across articles, aesthetics were most often defined

in terms of greenery, cleanliness, and overall visual quality. They were frequently assessed as part of broader neighborhood perception constructs and sometimes considered alongside safety, convenience, or land use mix. Several articles focused on greenery and vegetation, including street-level greenery in Hong Kong,^(53,63) community green spaces in Chongqing,⁽¹¹⁰⁾ and neighborhood greenery in Bangkok.⁽¹¹¹⁾ Park-based aesthetics were also emphasized, with articles from Iran and Malaysia highlighting greenery, comfort, and maintenance.^(59,60,81)

Other articles assessed cleanliness, comfort, and maintenance as core attributes of visual appeal, often embedded within composite neighborhood perception indicators, such as in Tehran and Chennai.^(27,44,47,72) Broader descriptors like “beautiful,” “lively,” or “comfortable” were also applied in Guangzhou⁽⁶⁷⁾ and Gulangyu,⁽¹⁰⁷⁾ while in Beijing, metro rider surveys incorporated visual appeal into pedestrian environment evaluations, reflecting aesthetics in transport-related contexts.⁽⁴³⁾ Aesthetics were also included in composite constructs, where they were combined with other domains such as safety, convenience, and density. This approach was evident in Seoul,⁽²⁶⁾ Tsuruoka and Fujisawa,^(28,31) and in Chinese cities where perceived attractiveness was commonly evaluated.^(32,37)

Street pattern and connectivity

Street pattern design and connectivity was the fourth most frequently examined built

environment category ($n = 48$).^(27,28,31,32,34,37,38,41,43,44,46,47, 50,53,55,57,58,64,82,85,88,90,94,96,97,99,102,109-111,114,115,117,120,121)

Articles generally defined connectivity in terms of how easily pedestrians could move through neighborhoods, shaped by features of the street network such as intersection density, block size, and pedestrian permeability. Characteristics assessed included intersection density and street density in many cities in Hong Kong and mainland China,^(46,53,55,56,63,64,109) block size and block length in China and Japan,^(28,31,44,47) and pedestrian infrastructure and crosswalks in Tehran, Isfahan, and Rasht.^(27,50,57,85) Perceived neighborhood connectivity was captured in surveys in Japan and India,^(28,31,44,47) while more advanced network-based metrics such as straightness, intersection reach, and node ratios were applied in Beijing.^(43,90,96,120)

Residential density

Residential density was another commonly examined built environment category ($n = 44$).^(28,30-32,34,37-39,41,44,46,47,50,52,53,55,56,63,68,72,77,80,82,83,85,87,88,90,94,97,104,108, 109,111,113-115,117) typically defined by the concentration of people or dwellings within a neighborhood. Population and dwelling unit counts were reported in Hong Kong, China, Iran, South Korea, and Japan, while floor-area ratio was applied in Seoul and Shanghai^(38,109) and categorical thresholds were used in Nanjing⁽⁶⁸⁾ and Seoul.⁽¹¹⁴⁾ Perceived density was examined in neighborhood surveys in Japan, India, and China,^(28,31,32,34,37,44,47,82,88,90,97) often capturing how crowded, built-up, or compact residents considered their neighborhoods, and

frequently assessed together with land use mix and connectivity.

Safety

Safety was also commonly examined ($n = 38$).^(26-28,31-34,36,37,44,45,47-49,51,56,59-61,64,66,67,72-74,82,84,85,88,92,97, 102,105,107,110-112) broadly defined in terms of traffic risk, crime, and personal security, and often assessed as part of walkability or neighborhood perception constructs. Perceived traffic safety was captured in surveys in Seoul, Tsuruoka, Fujisawa, and Shanghai,^(26,28,31,32) while objective indicators included traffic volume and violations in Shanghai.⁽⁶¹⁾ Crime and security were reported in Karachi, Tehran, Kish Island, and Chinese cities such as Fuzhou.^(27,48,49,84,92)

Composite audits also integrated safety measures, for example the State of Place index in Shanghai and Hangzhou,⁽³³⁾ and walkability audits that combined both personal and traffic safety.^(72,73) Park-based assessments incorporated safety as a quality attribute, with articles from Iran, Taiwan, and Beijing reporting indicators such as lighting, visibility, and supervision.^(45,59,60,74) Neighborhood surveys in several contexts further linked safety with aesthetics and convenience, reflecting its role as a multidimensional aspect of the built environment.

Public transport

Public transport availability and accessibility was a less frequently examined built environment category ($n = 29$).^(38,39,46,53-55,69,72,77,83,85,87,91,94,96,98,104,108,109,113-115,117,119) Across

articles, public transport was generally defined by the proximity, density, and ease of access to transit services such as bus stops, metro stations, and bike–metro connections. In Hong Kong, Mass Transit Railway (MTR) proximity and bus stop density were frequently assessed.⁽⁵³⁻⁵⁶⁾ In Nanjing, perceived access to bus stops within a 10 to 15-minute walk was reported,⁽⁶⁹⁾ while in Chennai, public transport was captured within broader neighborhood perception surveys.⁽⁷²⁾ Composite indices also incorporated transport availability, including walkability indices in Seoul,⁽⁷⁷⁾ accessibility indices in Xiamen,⁽⁸³⁾ and active travel assessments in Wuhan and Beijing.^(39,96,117) Articles from Nanjing and Suzhou examined intermodal connectivity, such as bike–metro transfers and public bike-sharing systems.⁽⁹⁸⁾

Pedestrian infrastructure

Pedestrian infrastructure was examined less frequently ($n = 15$)^(26,43,48,51,59,67,76,77,81,85,92,99,102,109,112), and was generally defined by the presence, continuity, and quality of sidewalks and crossings, as well as design features supporting safe and convenient pedestrian movement. Characteristics assessed included sidewalk continuity, width, and pavement quality, along with curb ramps, crossings, and traffic-calming features. In Beijing, articles captured sidewalk width, continuity, and ease of crossing.⁽⁴³⁾ In Seoul, sidewalk length was incorporated into composite walkability indices.^(76,77) In Tabriz and Tehran, audits assessed sidewalk quality and the availability of shortcuts.^(85,99) Con-

text-specific applications were also observed. In Bangkok and Batu Gajah, Malaysia, pedestrian infrastructure was evaluated within park-based assessments, where the condition of sidewalks and crossings formed part of broader recreational quality measures.^(81,86)

Bicycle infrastructure

Bicycle infrastructure was the least frequently examined built environment category ($n = 11$),^(39,48,57,58,61,70,76,77,95,98,114,121) defined by the availability, type, and quality of facilities that support cycling, including dedicated lanes, cycling networks, and bike-sharing systems. In Beijing, exclusive bicycle lanes were analyzed alongside the broader road network.⁽³⁹⁾ In Xi'an, lane typologies were classified into barrier-separated, greenbelt-separated, and mixed-traffic forms.⁽⁵⁸⁾ In Shanghai, perceived conditions of bicycle lanes were assessed through resident surveys.⁽⁶¹⁾ Several articles examined integration with public transport. In Shenzhen, the bike–metro transfer environment was evaluated,⁽⁷⁰⁾ while in Suzhou and Nanjing, the availability and use of public bike-sharing systems were studied.^(95,98) In Seoul, datasets captured bikeway forms such as bike boulevards and shared sidewalk bikeways.⁽¹¹⁴⁾

Measurement approaches of the built environment

Measurement approaches varied across the included articles (Tables 3 and 4). GIS-based methods were the most common (48 articles, 49.0%), using government spatial datasets, sat-

ellite imagery, road network analyses, or Google Street View.^(30,38-41,43,45,46,48,50,52-59,63,64,67,68,70,71,76-80,83,85,87,89-91,94-96,98-101,103,104,106,108-110,113-118,120-122)

Self-reported measures were used in 32 articles (32.7%), most often through standardized questionnaires such as NEWS or the Physical Activity Neighborhood Environment Scale (PANES).^{(26-28,31,32,34,37,42,44,47,49,61,62,65,66,69,72,73,81,82,88,92,93,97,102,105,107,111,112,}

^{119,123)} Thirteen articles (13.3%) combined objective and self-reported methods, typically pairing GIS-based indicators with survey instruments.^{(35,36,43,}

^{45,48,51,57,59,64,84,91,99,117)} Five articles (5.0%) relied on direct observation, applying structured audit and observation tools such as the Environmental Assessment of Public Recreation Spaces (EAPRS), the Community Park Audit Tool (CPAT), or the System for Observing Play and Recreation in Communities (SOPARC).^(33,60,74,75,86)

Outcome characteristics

The most frequently assessed outcomes were overall physical activity (46 articles, 38.0%), which included total physical activity, moderate-to-vigorous physical activity, steps, and combined walking or cycling measures.^{(29-32,35-37,44-46,51,54,62-64,67-69,71-73,78,}

^{80,82,86-89,94,97,102,103,105,106,111,120,122,123)} (Tables 3 and 4). Recreational physical activity was reported in 37 articles (30.6%), including leisure-time exercise, running, and sports participation.^(26,28,31,33,34,37,42,44,48,49,52,59,60,63,64,67,72,82,84,87,89,91,97,100-102,110,115,116,119,122)

Transport-related physical activity was assessed in 35 articles (28.9%), usually through walking or cycling for com-

muting or utilitarian trips.^(27,31-34,38-40,43,46,47,50,53,54,56-58,61,70,76,77,79,83,85,92,93,95,96,98,99,104,108,109,113,114,117,118,121)

Sedentary behavior was assessed in only three articles (2.5%), measured through sitting time, screen time, or sedentary bouts.^(74,75,103)

Discussion

This review provides the first systematic mapping of built environment characteristics examined in relation to physical activity and sedentary behavior in urban Asia. Drawing on 356 built environment characteristics reported across 98 articles from 13 countries, it highlights substantial variation in the characteristics assessed and clear imbalances in research coverage across domains and settings.

Articles most frequently focused on land use mix, street connectivity, and residential density. These domains reflect foundational aspects of compact, mixed-use urban form and align with evidence from high-income countries showing that land use diversity, density, and connectivity support higher physical activity.^(7,8) In Asia, where rapid urbanization has produced dense, transit-oriented, and high-rise environments, these characteristics are particularly relevant. Articles from China, South Korea, and Japan commonly used density, intersection measures, and block configuration to examine relationships with walking, cycling, and transit use.^(28,30-32,38,39,51,53,77,80,83,115,117)

The Asian literature also places comparatively greater emphasis on recreational facilities, aesthetics, and perceived safety. These domains

reflect contexts where greenery, cleanliness, and security heavily influence outdoor activity. Park audits highlighted shading, amenities, and maintenance,^(59,60,74) while case examples such as the redevelopment of Benjakitti Park in Bangkok⁽⁸⁶⁾ or new recreational complexes in Japan⁽¹¹⁸⁾ were used to assess impacts on leisure activity. Articles from China frequently examined greenery and shading,^(45,64,66,67,84,110) while articles from Japan and India emphasized perceptions of safety, aesthetics, and walkability in relation to leisure and transport walking.^(28,31,44,47,72) Articles from Iran and Malaysia also highlighted comfort, maintenance, and security in parks and recreational spaces.^(59,60,81) Compared with European or North American literature, where structural indicators dominate,^(7,15,21,124) Asian articles more consistently consider experiential qualities alongside urban form, reflecting lived realities of crowding, uneven infrastructure, and safety concerns.

Despite major investments in urban mobility, relatively few articles examined public transport or cycling infrastructure. International reviews highlight strong associations between high-quality cycling networks, transit access, and active commuting,^(8,9) yet only a small number of articles assessed cycling lane typologies, bike-metro transfers, or bike-sharing systems.^(57,58,61,70,95,98,114,121) Proximity to mass transit was assessed more frequently, especially in Hong Kong and Beijing,^(39,53-55,96) but overall coverage remains limited given rapid mobility transitions in many Asian cities. This represents a key area for future

research.

Sedentary behavior was rarely assessed, appearing in only three articles.^(74,75,103) This mirrors international patterns in which sedentary behavior has received less attention than physical activity,^(10,21) despite its independent health risks. In rapidly digitalizing Asian contexts, more systematic investigation of sedentary outcomes is needed.

Future research should examine underrepresented domains such as pedestrian and cycling infrastructure, multimodal mobility, and sedentary behavior, using longitudinal or natural experiment designs where possible. More consistent and context-specific measurement of experiential qualities, including shade, comfort, and perceived safety, would strengthen comparability across cities. Future studies should also investigate factors influencing the use of public spaces for physical activity, such as urban parks, examine the role of health and marketing communication in promoting physical activity, and develop and evaluate integrated models for physical activity promotion that incorporate policy, leadership, partnerships, and community participation.

For policy, the findings demonstrate the importance of adopting a Health in All Policies approach, in which health considerations are integrated into urban planning, transportation, housing, and environmental policies. The built environment characteristics identified in this review provide a useful evidence base for collaboration among public health agencies, urban planning authorities, and local governments. In rapidly

urbanizing Asian settings, investments in mixed-use development, accessible public transport, safe cycling routes, walkable neighborhoods, and high-quality public and recreational spaces can support active living while delivering broader co-benefits for health, sustainability, and quality of life.

This review has several strengths, including a comprehensive multi-database search, adherence to PRISMA procedures, dual independent screening, and standardized data extraction. Disaggregating composite metrics allowed clearer mapping of built environment domains across diverse contexts. Key limitations include the concentration of articles in East Asia, reliance on cross-sectional and self-reported measures, heterogeneity in definitions and metrics, some variability in reviewer judgement during full-text screening despite substantial agreement, and the exclusion of non-English and grey literature.

Conclusion

This scoping review mapped 356 built environment characteristics reported across 98 articles from 13 Asian countries in relation to physical activity and sedentary behavior. Research has primarily focused on land use mix and accessibility, recreational facilities, aesthetics, street connectivity, residential density, safety, and public transport, while pedestrian infrastructure, bicycle infrastructure, and sedentary behavior remain understudied. By identifying both well-studied and underexplored characteristics, this review

provides direction for future research and offers policymakers a clearer understanding of the built environment attributes most commonly examined in urban Asia. These insights can help inform priority-setting and urban planning strategies that support healthier, more active cities across the region.

Abbreviations

CPAT, Community Park Audit Tool; EAPRS, Environmental Assessment of Public Recreation Spaces; FAR, floor-area ratio; GPAQ, Global Physical Activity Questionnaire; GIS, geographic information system; GPS, global positioning system; HIC, high-income country; IPAQ, International Physical Activity Questionnaire; IPAQ-E, International Physical Activity Questionnaire Environmental module; IPAQ-SF, International Physical Activity Questionnaire Short Form; LMIC, low- and middle-income country; MeSH, medical subject headings; MPA, moderate-intensity physical activity; MTR, mass transit railway; MVPA, moderate-to-vigorous physical activity; NCD, non-communicable disease; NEWS, Neighborhood Environment Walkability Scale; NEWS-A, Neighborhood Environment Walkability Scale Abbreviated; PANES, Physical Activity Neighborhood Environment Scale; POI, point of interest; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; PROSPERO, International Prospective Register of Systematic Reviews; SAR, Special Administrative Region; SoP, State of Place; SOPARC, System for Observing Play and Recreation in Communities;

TOD, transit-oriented development; UN, United Nations; VPA, vigorous-intensity physical activity.

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Availability of data and materials

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Competing interests

The authors declare no competing interests.

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